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Montana Environmental Trust Group

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By US Mail

December 3, 2011

Betsy Burns
RCRA Project Officer
US Environmental Protection Agency – 8
Montana Office
Helena, Montana 59626

RE: Final Baseline Ecological Risk Assessment: Former ASARCO East Helena Facility, East Helena, Montana

Dear Betsy:

The Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust (the Custodial Trust), respectfully submits to the US Environmental Protection Agency (EPA), as Lead Agency for the East Helena Facility (the Site), the attached documents, which represent the final report for the Baseline Ecological Risk Assessment (BERA) for the Site. Additionally, the Custodial Trust has enclosed the following attachments, which set forth the comments from EPA and the US Fish & Wildlife Service (USFWS) (collectively the Agencies) and the responses to such comments prepared by Gradient Corporation (Gradient) on behalf of the Custodial Trust:

- Comment Letter from US EPA (Cheryl Overstreet) dated February 2, 2011 (Attachment I);
- Comment Letter from USFWS (R. Mark Wilson) dated January 27, 2011 (Attachment II); and
- Summary of Responses to Agencies' Comments prepared by Gradient dated November 14, 2011 (Attachment III).

As indicated in Attachment III, the Custodial Trust is proposing to perform additional sampling of perimeter soils to further assess risk to passerine and other birds protected by the Migratory Bird Treaty Act, as well as risk to cattle. Funds have been included in the preliminary 2012 East Helena Cleanup Budget for a sampling and analysis plan (SAP) to better characterize perimeter soils for those parcels that are included in the Corrective Measure Studies pursuant to the 1998 RCRA Consent Decree (which has been modified and will be entered in US Federal District Court in the near future) (the Modified CD). In developing the proposed SAP, the Custodial Trust will incorporate the results of all existing sampling and analysis data, including the results of a sampling and bioavailability studies currently being performed through a cooperative agreement with the US Department of Agriculture and the EPA. Depending on the EPA's preference, the results of the above-described SAP can be provided to EPA as a standalone technical memorandum or as part of the final Corrective Measures Studies Report for the Site.

The BERA is hereby submitted to EPA to satisfy, in part, the Custodial Trust's obligations set forth in ¶26 of the Modified CD, which requires that the Custodial Trust, *"prepare an analysis and summary of the RFI and its results ("Final RFI Report"). The objective is to ensure that the investigative data collected pursuant to the Phase 2 RFI Work Plan are sufficient in quality and quantity to describe the nature, extent and rate of releases of hazardous waste or hazardous constituents, threat(s) to human health and/or the environment (including risk assessment analysis), and to support a Corrective Measures Study."*

Please do not hesitate to contact me with any questions pertaining to this transmittal.

Sincerely,

Cynthia Brooks

Montana Environmental Trust Group, LLC
Trustee of the Montana Environmental Custodial Trust
By: Greenfield Environmental Trust Group, Inc., Member
By: Cynthia Brooks, President

Attachments

cc: Jim Ford—Custodial Trust
Denise Kirkpatrick—MDEQ
Karen Nelson—USFWS
Dave Mayfield—Gradient
Cheryl Overstreet—EPA
Tim Verslycke—Gradient
Marc Weinreich—Custodial Trust

Attachment I

MEMORANDUM

DATE: February 2, 2011

SUBJECT: Comments on **Baseline Ecological Risk Assessment: Former ASARCO East Helena Facility**, dated December 31, 2010

FROM: Cheryl Overstreet, 8P-HW
Risk Assessor
Office of Partnerships and Regulatory Assistance
Region 8

TO: Betsy Burns
RCRA Project Manager
Montana Office
EPA Region 8

We have reviewed the Baseline Ecological Risk Assessment (BERA), dated December 31, 2010, and offer the following general and specific technical review comments:

GENERAL COMMENTS

1. In general, we find that the BERA has been well conducted, is consistent with EPA ERA guidance (including EPA's 8-step ecological risk assessment [ERA] process) and with the August 2010 BERA Work Plan, and reaches appropriate conclusions regarding ecological risk at the East Helena site. However, see General Comment 2 below regarding conclusions for Prickly Pear Creek. There are minor deviations from the BERA Work Plan in the numbers of samples collected, but acceptable rationale has generally been provided in the BERA (e.g., fewer earthworm samples were collected due to very low abundances of earthworms in some exposure units).

   Although we may have some concerns with the specific exposure parameters or toxicity values used in the BERA, we believe that further refinement of these values is unlikely to change the conclusions, and generally do not advise devoting limited resources toward making these types of changes in the context of this BERA. For the purposes of developing media cleanup values in the Corrective Measures Study (CMS), some revision or adjustment may be advisable (refer to comments below). Additionally, there are a few uncertainties in the BERA that should be quantified, if practicable. In the process of developing media cleanup values, risk assessors and managers should evaluate whether any further site-specific data collection would be useful to reduce uncertainties. The need to develop media cleanup values that incorporate a high degree of site-specific precision should be considered in light of remedial alternatives that are being considered (i.e., high precision is not needed for many remedial alternatives).

2. The BERA paints a clear picture of pervasive ecological risks in all exposure units at the site that would typically be considered unacceptable under Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and

Recovery Act (CERCLA/RCRA) guidelines. Although risks at Prickly Pear Creek (both aquatic and riparian terrestrial) are low in comparison to the rest of the site, the risks are still high enough to be considered unacceptable, since hazard quotients (based on lowest observed adverse effect levels [LOAELs]) are greater than 1 (10 for methylmercury) and there are exceedances of acute and chronic water quality criteria. We agree with the qualitative summary of Prickly Pear Creek risks that is presented in Table 12.1 (characterizing risk as "low/moderate"), but believe that surface water should be added as a primary exposure medium and mercury should be added as a chemical of concern (COC), due to exceedances of water quality criteria. Also, the accompanying text on page 187, which characterizes Prickly Pear Creek risks as "low," should be revised to be more consistent with Table 12.1.

In addition, for risk managers' reference, we note that Prickly Pear Creek downstream sediment concentrations of metals such as arsenic, lead, manganese, mercury, and zinc were not significantly different from upstream concentrations. However, there were significant differences between upstream and downstream concentrations of metals in surface water, benthic invertebrate tissue, and fish tissue. This situation is somewhat unusual, and may suggest that there is an ongoing source of contamination from Lower or Upper Lake to Prickly Pear Creek. Control of the source of this contamination will need to be addressed in the CMS. Based on this comparison with upstream media, it appears that sediment remedial action (which is the typical prescription for reducing aquatic risks) may not meet risk-based cleanup goals over the long-term in Prickly Pear Creek.

3. High risks in perimeter soils raise concerns about off-site risks. It is unclear whether any further off-site remedial investigation is still being considered at this time. The BERA (page 46) notes that adjacent ranchland likely provides habitat for a variety of biota. Clarification on the status of off-site investigation and/or remedial action is needed.

4. While there are uncertainties due to estimation of modeled plant and earthworm concentrations, these uncertainties appear to have little impact on the risk estimates and no impact on the risk conclusions, because wildlife risks are driven by incidental soil and sediment ingestion rather than consumption of contaminated plants or earthworms. Nonetheless, for the purposes of developing media cleanup concentrations in the CMS, we advise avoiding the use of receptors with a high dietary proportion of plants (e.g., mallard, vole). It appears that adequately protective cleanup values can be developed based on other wildlife species with high soil or sediment ingestion rates (e.g., sandpiper for aquatic exposure units). Further, for the development of cleanup concentrations in soil, the use of exposure parameters that assume a high dietary proportion of earthworms is not advised in areas where earthworms are not abundant (e.g., Tito Park). Cleanup values based on food web modeling that assumes a lower proportion of earthworms as a dietary source, and a correspondingly higher proportion of other terrestrial invertebrates in the diet, may be more realistic in areas where earthworm abundances are low.

5. A major risk driver in this BERA is incidental ingestion of soil and sediment by wildlife receptors. The BERA notes that there is considerable uncertainty associated with these risk estimates because they assume that metals in soil and sediments are 100%

bioavailable. The BERA should make quantitative estimates of this uncertainty. It appears that hazard quotients are high enough that this uncertainty would not impact the conclusions of this assessment. However, the uncertainty analysis should, if possible, provide sufficiently quantitative information to allow risk managers to determine whether additional site-specific data collection may be needed to reduce uncertainties. This comment is also applicable to the assumption that measured mercury in soil and sediments is 100% methylmercury. Additional information regarding this uncertainty should be provided in the uncertainty analysis.

6. In EPA's May 4, 2010 letter that conditionally approved the BERA Work Plan, EPA requested resampling of locations ULM_10, ULM_11, and ULM_12 in Upper Lake/Upper Lake Marsh. Based on a review of Map 5b, it appears that these locations were not resampled. Please clarify whether these locations were resampled, and if not, provide the rationale for excluding these locations from the recent sampling effort.

7. While we have not attempted to complete an editorial review of the BERA, and generally refrain from making editorial comments, we note that the incorrect use of "Ca" as an abbreviation for cadmium and "Si" as an abbreviation for silver (rather than Cd and Ag, respectively) may cause confusion for readers. For clarity, these abbreviations should be consistent with current scientific terminology throughout the document.

   Additionally, we noted a number of inconsistencies among tables and between tables and text in the BERA. A few examples for illustration include:
   - Table 12.1, under Prickly Pear Creek, lead is included as a COC, but is not included in the adjacent lists of risk drivers (low/moderate or high).
   - Table 6.4 does not include an "x" for mercury in Prickly Pear Creek, but Table E-5a indicates exceedances of surface water benchmarks for mercury in Prickly Pear Creek.
   - Table E-5a lists the 95UCL for dissolved selenium in Upper Lake/Marsh as 17.5 µg/L, but Table E-6 lists the mean for dissolved selenium in Upper Lake/Marsh as 0.5 µg/L, with standard deviation of 0 and frequency of detection of 0.

   The BERA should be comprehensively reviewed to identify and correct errors and internal inconsistencies.

SPECIFIC COMMENTS

Section 2.2.1, Remedial Investigation of Soils, Vegetation, and Livestock (1987)

1. The isoline map of soil lead concentrations (showing the greatest concentrations of lead at 32 mg/kg in the immediate vicinity of the site) in Figure 2.2 (page 8) appears to be inconsistent with lead data provided in Tables 2.4 and 2.5 and with discussion on page 24 that indicates a fairly large area (approximately 0.75-mile radius) of lead concentrations exceeding 650 mg/kg. If Figure 2.2 is an accurate depiction of soil concentrations in 1987, then it provides some assurance that off-site lead concentrations are not unacceptably high. However, the accuracy of the data in this isoline map seems questionable. Clarification should be provided.

Section 3.6, Assessment Endpoints

2. On pages 75-76, the BERA lists the ecological risk questions addressed in this assessment. There are a number of similarly-worded risk questions that may be misinterpreted by readers. For example, this question is included at the top of page 76: "Is the survival, growth, or reproduction of fish exposed to porewater, surface waters, and biota from the site significantly lower than reference sites?"

   This question seems to imply that laboratory toxicity tests using fish or field studies of fish were conducted. Similar risk questions are included for amphibians, plants, and terrestrial invertebrates. These questions should be revised to clarify. For example, the above question could be revised as follows: "Are fish at the site exposed to metals concentrations in porewater, surface waters, and biota that are significantly higher than concentrations at reference sites?"

Section 5.1.5, Sediment Toxicity Tests

3. The discussion regarding sediment toxicity test results in Section 5.1.5 should be expanded to discuss whether sample locations with the highest metals concentrations were tested, in order to allow readers to better understand how much confidence can be placed on this line of evidence. A table that presents toxicity test results, mean probable effect concentration (PEC) quotients, and simultaneously-extracted metals-acid volatile sulfide (SEM-AVS) results side-by-side for every sediment sampling location would be useful. (Note, however, we do recognize that not all of these pieces of data are available for every sample.) This table would also facilitate an evaluation of the assertion that the observed reduced *Hyallela* survival in PPC-102 is most likely not due to metals toxicity. In addition, this section should reference Table B-17, which summarizes the toxicity test results.

Section 6.1.3, Tissue Chemistry

4. This section concludes that, "…tissue concentrations are not at levels that would present a risk to fish." Considering that one of three (i.e., 33 percent) fish tissue samples in Lower Lake had concentrations that exceeded critical body residue (CBR) values for six metals, this line of evidence does suggest potential risk for fish in Lower Lake. While we concur that confidence in this line of evidence may be low for metals other than mercury and selenium, Sections 6.1.3 and 6.3 should be revised to more accurately reflect results for Lower Lake.

   Also, the next to last sentence on page 125 should be revised to insert the word "some" before "exceedances", as follows: "However, ***some*** exceedances of As, Cd, and Se were due to elevated detection limits."

Section 6.3, Weight-of-Evidence Summary and Conclusions

5. We recommend adding "Fish Tissue Reference Comparison" to the weight-of-evidence analysis for fish in Table 6.5.

Appendix C

6. Section 3.3 of Appendix C discusses fish tissue residue benchmarks. EPA's fish tissue residue benchmark of 7.91 mg /kg dw (1.58 mg/kg ww) for selenium (EPA 2004, as cited in the BERA) was used in the ERA. We note that there is controversy regarding this benchmark (e.g., refer to http://www.ucsusa.org/scientific_integrity/abuses_of_science/selenium-standards.html). It may be useful to include in the uncertainty analysis a somewhat more detailed discussion of the uncertainties associated with the selenium fish tissue residue benchmark. In general, the use of a lower benchmark (e.g., 5.85 mg/kg dw, as recommended by United States Forest Service selenium expert Dennis Lemly) would not affect the results of this ERA. However, if this more conservative benchmark were used, then two of the three fish tissue samples at Lower Lake would exceed the benchmark, thereby providing stronger evidence of risk to fish in Lower Lake.

7. Table C-11 is missing from the December 31, 2010, version of the BERA Appendices. The final BERA should include this table.

8. Section 7- References- could be improved by being consistent with other EPA documents by listing the Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses as an U.S. EPA 1985 document which it is, followed by the names of its authors, if so desired. The other EPA citations in this document do not list the authors.

9. Page C-19 cites US EPA 2003 as the source for Region 5 EPA RCRA soil screening levels. In the reference section beginning on page C37, the US EPA 2003 listing provides no link to Region 5, but to ORNL for EPA's Eco SSL's. Please include a reference to Region 5's screening values.

Please let me know if you have any questions concerning our comments. I look forward to working with you on the next steps to this document.

Attachment II

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
MONTANA FIELD OFFICE
585 SHEPARD WAY
HELENA, MONTANA 59601
PHONE (406) 449-5225, FAX (406) 449-5339

January 27, 2011

10,145C

U.S. Environmental Protection Agency
Attn: Betsy Burns
10 West 15th Street, Suite 3200
Helena, MT 59626

Dear Ms. Burns:

The U.S. Fish and Wildlife Service (Service) has reviewed the documents entitled "Draft Baseline Ecological Risk Assessment: Former ASARCO East Helena Facility, East Helena, MT (December 2010)." We offer the following comments on the document.

Page ES-1. Exposure Assessment

The symbol for cadmium should be changed here and numerous places in the document from Ca to Cd, and silver should be changed from Si to Ag. Lead should be spelled out prior to its symbol.

Page 6-7. 2.2.1 Remedial Investigation of Soils, Vegetation, and Livestock (1987)

The statement in the second paragraph in this section should probably say the site instead of the Helena Valley. Listed species would have been present in the Helena Valley in 1987.
In the list of elements exceeding background in the third paragraph, tin should be abbreviated as well.

Page 20. Table 2.9 Sediment Concentrations measured in Prickly Pear Creek and Reference Sites

Symbols for Boron and Magnesium should be used in the table instead of spelling these two elements.

Page 26. 2.2.9 Baseline Ecological Risk Assessment Work Plan and Ecological Site Investigation (2010)

Close parenthesis in first sentence.

Page 33. 2.4 Environmental Setting

The Helena Valley is located in west central Montana.

Page 34. Climate

Wind rose data for the Helena Valley should be obtained and used for wind directions and speeds. Additionally it may be more useful to break these data out seasonally. These data are important since emission sources are a large part of historic contamination related to the smelter.

Page 62. Table 2.21 Montana Species of Concern for Lewis and Clark County

Ursus arctos, Grizzly Bear is listed as a threatened species in Lewis and Clark County, source codes DM and XN should be removed, these are incorrect modifiers.

Page 73. 3.6 Assessment Endpoints

The second paragraph in this section states that the ecological risk management goals for the Facility include maintaining healthy, viable populations of invertebrates, fish, amphibians, birds, mammals and plants in Lower Lake. The remediation of Lower Lake may not be possible, and should not be included as a goal.

Page 83. 4.2.1 Benthic Invertebrates

Selenium should be listed in the metals further analyzed in the BERA. In table 4.2, in the Fish Dietary Items column, it states that no benchmark was available for screening. Impacts to fish and birds from dietary food items have been documented by numerous studies (Lemly 1996, Ohlendorf et al. 2008, UDEQ 2008, and USDOI 1998). A benchmark of 3 mg/kg DW would be a good threshold benchmark according to the listed studies.

Page 107. 5.1.1 Sediment Quality Guidelines

Sediment PECs identified in the MacDonald et al. (2000) paper should be distinguished from those that were developed using other methods (Al, Sb, Fe, Mn and Ag). In addition, because Al, Fe and Mn are unlikely to cause or substantially contribute to toxicity, they should not be included in the risk characterization for benthic invertebrates, especially in calculating the mean PEC quotients. Antimony and Ag were also not part of the original model developed by MacDonald et al. (2000), and comparing Mean PECQs calculated with additional metals is not recommended. The sediment toxicity predicted in the model is only for As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn, adding additional metals to the mean PECQs would not reflect the modeled toxicity, and the comparison would not be valid.

The additional metals not used in the mean PECQ can be assessed for their toxicity using the normal HQ technique to predict toxicity to sediment-dwelling organisms. A maximum $PECQ_{@1\%TOC}$ of <0.1 Ingersoll (2007) noted that toxicity was unlikely, but the toxicity was 50% or higher when the maximum $PECQ_{@1\%TOC}$ exceeded 2.3. These exceedances could be included in Table 5.1. Silver was left off the list in Table 5.1.

In the second paragraph in this section, the third sentence states that PECs were not available for six metals, this should be changed to 11, and sentence inserted about the development of five "PECs" from other sources. The Service requests that the mean PEC Quotients be recalculated eliminating the developed "PECs" from the equation. These recalculations would necessitate a change in Table 5.2, and perhaps Figure 8. Interpretation of the mean PECQs should also be described in more detail. Ingersoll (2007) describes the predictability of mean PECQs in percentages, for example 20% of samples with a mean $PECQ_{@1\%TOC}$ of <0.1 were toxic to sediment dwelling organisms, 28% of sediment samples with a mean $PECQ_{@1\%TOC}$ of 0.1 – 1.0 were toxic, sediments with a mean $PECQ_{@1\%TOC}$ 1.0 – 5.0 were toxic to sediment dwelling invertebrates 72% of the time, sediments with a mean $PECQ_{@1\%TOC}$ >5.0 were toxic 90% of the time.

Page 111. Surface Water

This section would be much easier to follow if exceedances of both chronic and acute water quality standards, and the corresponding HQ were placed in a table.

Page 114. Sediment Toxicity Tests

The first sentence in this paragraph should be changed to reflect which sediments were collected for toxicity testing in 2003 versus 2010. This sentence makes it sound like sediments from all locations were collected and tested both years. The appendices should also include methods used for conducting the tests. Table B-1 in Appendix B appears to be missing sample locations for sediment toxicity, these should be added. If future sediment toxicity tests are conducted, they should use longer duration tests. From the Ingersoll (2007) paper it appears that the longer duration tests are more sensitive indicators of sediment toxicity.

Page 115. Community /Habitat Data

In the first sentence in this section, it would be helpful for the reader to know what kind of RBPs were completed in what year. Reading this section it appears invertebrate communities in were completed in 2003, and habitat characteristics only in 2010.

In addition to the RBP used in 2003 and 2010, an index specific to Montana and ecoregion (i.e. low valley multimetric index) may reflect impairment better than assessing the individual metrics currently used. MT DEQ (Jessup et al. 2005) outline additional methods that may prove useful in comparing reference sites to on-site areas. The following five metrics are suggested for use when applying a multimetric index approach to assessing stream condition in "Low Valley" areas:

- % EPT excluding Hydropsychids and Baetids
- % Midge
- % Crustacea & Mollusca
- Shredder taxa (rarefacted to 300)

- % predator

In addition, incorporating the Montana-specific metals tolerance values into a single biological index value for each site may add to the weight-of-evidence approach. This index is simply the sum of (proportional abundance of a taxon in the sample x tolerance values specified by DEQ for that taxon) for all taxa in the sample. Tolerance values range from 0 to 10 and were derived from McGuire (1994, 1993, and 1992). This would provide another approach for comparing reference and on-site areas.

Page 122. Table 5.9 Weight-of-Evidence Analysis for Benthic Invertebrates

Under the CSM unit Prickly Pear Creek, the lines of evidence, community/habitat data analysis should be changed from a 0 to a + due to decreased richness and abundance in the invertebrate community. Under the CSM unit Lower Lake, the lines of evidence sediment toxicity tests should be changed from a 0 to a + because the mean survival was significantly lower than the laboratory control. In addition, the community/habitat data analysis lines of evidence should be changed from a 0 to not assessed.

Page 125. Tissue Chemistry

Table E-10. Fish Tissue Chemistry Compared to Critical Body Residues should include a percent moisture or solids column as well as include the year the sample was collected to help distinguish samples collected recently to those collected in 2003. In the forth sentence in this paragraph you have a “?” after 51, this should be removed. In the next sentence you state that exceedances are related to elevated detection limits, it appears from table E-10 that this is true for only some of the samples.

Page 127. Dietary Assessment

Selenium should be included in the risk characterization for fish. Impacts to fish and birds from dietary food items have been documented by numerous studies (Lemly 1996, Ohlendorf et al. 2008, UDEQ 2008, and USDOI 1998). A benchmark of 3 mg/kg DW would be a good threshold benchmark according to the listed studies. Since all of the benchmarks are in dry weight, prey items should be converted into dry weight and compared to the benchmarks. This may prove more accurate than converting the benchmark to ww based on 80% moisture.

Page 128. 6.1.5 Fish Health/Habitat

This paragraph states that the Wilson Ditch may not provide optimal habitat, this should be changed to provides only seasonal habitat. This is an important distinction because Wilson Ditch is likely used by several wildlife receptors during the irrigation season.

Page 138. 7.2 Uncertainty Analysis

In the Toxicity Benchmarks section, when algae is used as an adjective, it should be algal, as in algal toxicity.

Page 138. 7.3 Weight-of-Evidence Summary and Conclusions

This section states that Zn is one of the metals that pose negligible risks to aquatic plants, Zn can cause significant adverse effects of growth and survival in sensitive species of aquatic plants at water concentrations between 10-25 µg/L (Eisler 1993). In addition, Zn and Cd can act synergistically (Eisler 1993). Zinc toxicity to aquatic plants should be reviewed further before eliminating Zn as a COC.

Page 163. 11.1 Dietary Assessment

In the last sentence in this paragraph, the terrestrial CSM units should include Tito Park and add East and West to the Site Perimeter locations.

The dietary assessment for swallows states that the swallow diet is broken down into four principle components, Terrestrial Plants = 25%, Benthic Invertebrates = 25%, Soil Invertebrates = 25%, Aerial/Foliar Invertebrates = 25% and Sediment Ingestion (% of total diet) = 0.0%. Tree Swallows feed entirely on insects, and primarily on flying emergent aquatic, and terrestrial flying insects. Based on this feeding strategy, only benthic invertebrates (that emerged) and aerial/foliar invertebrates should be used in the dietary assessment. Soil invertebrates (which according to the appendices targeted earthworms) would not be consumed by tree swallows, nor would terrestrial plants. These two dietary components should be removed from the assessment, and the model run using only the two remaining components.

Page 189. 12 Baseline Ecological Risk Assessment Summary and Conclusions

In the section discussing Wilson Ditch, the BERA states that the ditch provides limited habitat, this should be changed to seasonal habitat. When the ditch flows during the irrigation system habitat is provided to organisms entrained in the irrigation ditch from Upper Lake, as well as terrestrial and aquatic receptors that use the ditch for food.

Page 195. Conclusions

The BERA states that risks are minimal in the Prickly Pear CSM to the aquatic and terrestrial community. Max PECQs for several metals exceeded 2.3, and mean metal PECQs exceeded 1.3 indicating a 50% or higher incidence of toxicity to sediment dwelling organisms (Ingersoll 2007), and several risk characterizations for terrestrial wildlife receptors had hazard quotients exceeding 10. While the list of COCs driving toxicity is reduced, a few COCs are still resulting in high risks to some receptors. The mean Pb soil concentration in the CSM for example is 1054 mg/kg dw resulting in a wildlife HQ of 96. The Supplemental Ecological Risk Assessment for the East Helena Smelter Site states that soil lead concentrations exceeding 650 mg/kg dw may adversely impact passerine insectivores (USEPA 2005, Hooper et al. 2002). These exposures create an unacceptable risk to the Service's migratory bird trust resource

The risks at the Upper Lake and Upper Lake Marsh CSM to the aquatic and terrestrial community are described in the BERA as low to moderate. Max PECQs for several metals exceeded 2.3, and mean metal PECQs exceeded 1.3 indicating a 50% or higher incidence of toxicity to sediment dwelling organisms (Ingersoll 2007), and several risk characterizations for terrestrial wildlife as well as aquatic-dependent wildlife receptors had hazard quotients exceeding 10. The mean Pb soil concentration in the CSM for example is 2596 mg/kg dw resulting in a mean wildlife HQ of 236. The Supplemental Ecological Risk Assessment for the East Helena Smelter Site states that soil lead concentrations exceeding 650 mg/kg may adversely impact passerine insectivores (USEPA 2005, Hooper et al. 2002).

Thank you for the opportunity to comment of these documents. Should you have any questions concerning these comments or desire additional information please contact me at 406-449-5225 extension 205, or Ms. Karen Nelson of my staff at extension 210.

Sincerely,

R. Mark Wilson

R. Mark Wilson
Field Supervisor

References

Eisler, R. 1993. "Zinc Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review." US Fish and Wildlife Service, Biological Report 10.

Ingersoll, C.G. 2007. Expert Report on the Development and Application of Sediment Quality Guidelines to Assess the Toxicity of Metals in Sediment. Prepared for U.S. Department of Justice, U.S. Department of the Interior, Office of the Solicitor. 59 pp

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Hooper, M.J., G.P. Cobb, S.T. McMurry. 2002. Wildlife Biomonitoring at the Anaconda Smelter Site, Deer Lodge County, Montana. Texas Cooperative Fish and Wildlife Research Center, Texas, Tech University. 380 pp.

Attachment III
Summary of Responses to Comments from US EPA and USFWS
East Helena Baseline Ecological Risk Assessment (BERA) 11/14/11

Comment	Agency	Section	*Response/Action*
1. In general, we find that the BERA has been well conducted, is consistent with EPA ERA guidance (including EPA's 8-step ecological risk assessment [ERA] process) and with the August 2010 BERA Work Plan, and reaches appropriate conclusions regarding ecological risk at the East Helena site. However, see General Comment 2 below regarding conclusions for Prickly Pear Creek. There are minor deviations from the BERA Work Plan in the numbers of samples collected, but acceptable rationale has generally been provided in the BERA (e.g., fewer earthworm samples were collected due to very low abundances of earthworms in some exposure units). Although we may have some concerns with the specific exposure parameters or toxicity values used in the BERA, we believe that further refinement of these values is unlikely to change the conclusions, and generally do not advise devoting limited resources toward making these types of changes in the context of this BERA. For the purposes of developing media cleanup values in the Corrective Measures Study (CMS), some revision or adjustment may be advisable (refer to comments below). Additionally, there are a few uncertainties in the BERA that should be quantified, if practicable. In the process of developing media cleanup values, risk assessors and managers should evaluate whether any further site-specific data collection would be useful to reduce uncertainties. The need to develop media cleanup values that incorporate a high degree of site-specific precision should be considered in light of remedial alternatives that are being considered (i.e., high precision is not needed for many remedial alternatives).	EPA	General Comment	*Comment acknowledged. Edits have been made to the BERA consistent with the general and specific Agency recommendations.* *For example, additional selenium toxicity values have been evaluated and the text has been updated (Appendix C and Section 6.2)* *Also, additional uncertainty analysis was prepared and added to Section 11.2 to aid in the CMS evaluation.* *Revisions to the conclusions for Prickly Pear Creek have been made in Sections 5, 6, 7, 11, and 12.*
2. The BERA paints a clear picture of pervasive ecological risks in all exposure units at the site that would typically be considered unacceptable under Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and Recovery Act (CERCLA/RCRA) guidelines. Although risks at Prickly Pear Creek (both aquatic and riparian terrestrial) are low in comparison to the rest of the site, the risks are still high enough to be considered unacceptable, since hazard quotients (based on lowest observed adverse effect levels [LOAELs]) are greater than 1 (10 for methylmercury) and there are exceedances of acute and chronic water quality criteria. We agree with the qualitative summary of Prickly Pear Creek risks that is presented in Table 12.1 (characterizing risk as "low/moderate"), but believe that surface water should be added as a primary exposure medium and mercury should be added as a chemical of concern (COC), due to exceedances of water quality criteria. Also, the accompanying text on page 187, which characterizes Prickly Pear Creek risks as "low," should be revised to be more consistent with Table 12.1. In addition, for risk managers' reference, we note that Prickly Pear Creek downstream sediment concentrations of metals such as arsenic, lead, manganese, mercury, and zinc were not significantly different from upstream concentrations. However, there were significant differences between upstream and downstream concentrations of metals in surface water, benthic invertebrate tissue, and fish tissue. This situation is somewhat unusual, and may suggest that there is an ongoing source of contamination from Lower or Upper Lake to Prickly Pear Creek. Control of the source of this contamination will need to be addressed in the CMS. Based on this comparison with upstream media, it appears that sediment remedial action (which is the typical prescription for reducing aquatic risks) may not meet risk-based cleanup goals over the long-term in Prickly Pear Creek.	EPA	General Comment	*Comment acknowledged. The suggested changes to Table 12.1 were adopted in the revised version of the BERA. In addition, text was modified to reflect the low/moderate risks posed by metals in Prickly Pear Creek.*

3. High risks in perimeter soils raise concerns about off-site risks. It is unclear whether any further off-site remedial investigation is still being considered at this time. The BERA (page 46) notes that adjacent ranchland likely provides habitat for a variety of biota. Clarification on the status of off-site investigation and/or remedial action is needed.	EPA	General Comment	*Comment acknowledged. To address this issue, the Custodial Trust is proposing to perform additional sampling of perimeter soils to further assess risk to passerine and other birds protected by the Migratory Bird Treaty Act, as well as risk to cattle. Specifically, the Custodial Trust will develop a sampling and analysis plan for perimeter soils (the Perimeter Soils SAP) on those parcels where EPA will make final remedy decisions pursuant to the 1998 RCRA Consent Decree (first modification). The CMS Parcels include Parcels 10, 11, 12, 15, 16, 17, 18, 19, 23 and portions of 2 (as depicted on the map attached hereto as Attachment IV.) The Custodial Trust will incorporate the results of all existing sampling and analysis programs, including the results of sampling and bioavailability studies currently being performed through a cooperative agreement with the US Department of Agriculture and the EPA. Soils on all other Trust-owned properties will be addressed pursuant to the OU-2 ROD.*
4. While there are uncertainties due to estimation of modeled plant and earthworm concentrations, these uncertainties appear to have little impact on the risk estimates and no impact on the risk conclusions, because wildlife risks are driven by incidental soil and sediment ingestion rather than consumption of contaminated plants or earthworms. Nonetheless, for the purposes of developing media cleanup concentrations in the CMS, we advise avoiding the use of receptors with a high dietary proportion of plants (e.g., mallard, vole). It appears that adequately protective cleanup values can be developed based on other wildlife species with high soil or sediment ingestion rates (e.g., sandpiper for aquatic exposure units). Further, for the development of cleanup concentrations in soil, the use of exposure parameters that assume a high dietary proportion of earthworms is not advised in areas where earthworms are not abundant (e.g., Tito Park). Cleanup values based on food web modeling that assumes a lower proportion of earthworms as a dietary source, and a correspondingly higher proportion of other terrestrial invertebrates in the diet, may be more realistic in areas where earthworm abundances are low.	EPA	General Comment	*Comment acknowledged. No changes to the BERA have been made for this comment, however, additional analysis can be conducted as part of the CMS evaluation. EPA agreed with our response (see March 29, 2011 letter from EPA).*
5. A major risk driver in this BERA is incidental ingestion of soil and sediment by wildlife receptors. The BERA notes that there is considerable uncertainty associated with these risk estimates because they assume that metals in soil and sediments are 100% bioavailable. The BERA should make quantitative estimates of this uncertainty. It appears that hazard quotients are high enough that this uncertainty would not impact the conclusions of this assessment. However, the uncertainty analysis should, if possible, provide sufficiently quantitative information to allow risk managers to determine whether additional site-specific data collection may be needed to reduce uncertainties. This comment is also applicable to the assumption that measured mercury in soil and sediments is 100% methylmercury. Additional information regarding this uncertainty should be provided in the uncertainty analysis.	EPA	General Comment	*Comment acknowledged. Additional discussion and a quantitative analysis have been added to section 11.2 Uncertainty Analysis which illustrates the results of varying bioavailability assumptions. As the analysis shows, additional site-specific data regarding metal bioavailability would reduce uncertainty but are not expected to change the BERA conclusions.*
6. In EPA's May 4, 2010 letter that conditionally approved the BERA Work Plan, EPA requested resampling of locations ULM_10, ULM_11, and ULM_12 in Upper Lake/Upper Lake Marsh. Based on a review of Map 5b, it appears that these locations were not resampled. Please clarify whether these locations were resampled, and if not, provide the rationale for excluding these locations from the recent sampling effort.	EPA	General Comment	*There was an error in the draft of Map 5b. The error has been corrected in the revised version which now shows that 2 sediment samples were collected (re-sampled) in the vicinity of ULM_10 and ULM_11.*

7. While we have not attempted to complete an editorial review of the BERA, and generally refrain from making editorial comments, we note that the incorrect use of “Ca” as an abbreviation for cadmium and “Si” as an abbreviation for silver (rather than Cd and Ag, respectively) may cause confusion for readers. For clarity, these abbreviations should be consistent with current scientific terminology throughout the document. Additionally, we noted a number of inconsistencies among tables and between tables and text in the BERA. A few examples for illustration include: • Table 12.1, under Prickly Pear Creek, lead is included as a COC, but is not included in the adjacent lists of risk drivers (low/moderate or high). • Table 6.4 does not include an “x” for mercury in Prickly Pear Creek, but Table E-5a indicates exceedances of surface water benchmarks for mercury in Prickly Pear Creek. • Table E-5a lists the 95UCL for dissolved selenium in Upper Lake/Marsh as 17.5 µg/L, but Table E-6 lists the mean for dissolved selenium in Upper Lake/Marsh as 0.5 µg/L, with standard deviation of 0 and frequency of detection of 0. The BERA should be comprehensively reviewed to identify and correct errors and internal inconsistencies.	EPA	General Comment	*Comment Acknowledged. The indicated errors have been revised in the BERA and a review of the document has been conducted.* *On the last comment regarding selenium concentrations - the values are correct. The discrepancy is due to the various data sets. In Table E-5a all data is included (2003 and 2010) which included an elevated detection limit from 2003 resulting in a UCL of 17.5 ug/L. The summary statistics in Table E-6 only include data from 2010 for statistical comparisons, thus the elevated detection limit from 2003 is not represented. No change was made for this comment*
1. The isoline map of soil lead concentrations (showing the greatest concentrations of lead at 32 mg/kg in the immediate vicinity of the site) in Figure 2.2 (page 8) appears to be inconsistent with lead data provided in Tables 2.4 and 2.5 and with discussion on page 24 that indicates a fairly large area (approximately 0.75-mile radius) of lead concentrations exceeding 650 mg/kg. If Figure 2.2 is an accurate depiction of soil concentrations in 1987, then it provides some assurance that off-site lead concentrations are not unacceptably high. However, the accuracy of the data in this isoline map seems questionable. Clarification should be provided.	EPA	Section 2.2.1, Remedial Investigation of Soils, Vegetation, and Livestock (1987)	*The isoline map is presented in units of Log10 therefore the concentrations differ than those presented in Tables 2.4 and 2.5. No change has been made. EPA agreed that no change is needed in their March 29, 2011 letter .*
2. On pages 75-76, the BERA lists the ecological risk questions addressed in this assessment. There are a number of similarly-worded risk questions that may be misinterpreted by readers. For example, this question is included at the top of page 76: “Is the survival, growth, or reproduction of fish exposed to porewater, surface waters, and biota from the site significantly lower than reference sites?” This question seems to imply that laboratory toxicity tests using fish or field studies of fish were conducted. Similar risk questions are included for amphibians, plants, and terrestrial invertebrates. These questions should be revised to clarify. For example, the above question could be revised as follows: “Are fish at the site exposed to metals concentrations in porewater, surface waters, and biota that are significantly higher than concentrations at reference sites?”	EPA	Section 3.6, Assessment Endpoints	*The suggested change has been made to the BERA revision.*
3. The discussion regarding sediment toxicity test results in Section 5.1.5 should be expanded to discuss whether sample locations with the highest metals concentrations were tested, in order to allow readers to better understand how much confidence can be placed on this line of evidence. A table that presents toxicity test results, mean probable effect concentration (PEC) quotients, and simultaneously-extracted metals-acid volatile sulfide (SEM-AVS) results side-by-side for every sediment sampling location would be useful. (Note, however, we do recognize that not all of these pieces of data are available for every sample.) This table would also facilitate an evaluation of the assertion that the observed reduced Hyallela survival in PPC-102 is most likely not due to metals toxicity. In addition, this section should reference Table B-17, which summarizes the toxicity test results.	EPA	Section 5.1.5, Sediment Toxicity Tests	*The suggested changes have been made to the BERA revision. In addition a table (5.7) was added with sediment toxicity and chemistry results for each of the CSM units.*
4. This section concludes that, “…tissue concentrations are not at levels that would present a risk to fish.” Considering that one of three (i.e., 33 percent) fish tissue samples in Lower Lake had concentrations that exceeded critical body residue (CBR) values for six metals, this line of evidence does suggest potential risk for fish in Lower Lake. While we concur that confidence in this line of evidence may be low for metals other than mercury and selenium, Sections 6.1.3 and 6.3 should be revised to more accurately reflect results for Lower Lake. Also, the next to last sentence on page 125 should be revised to insert the word “some” before “exceedances”, as follows: “However, some exceedances of As, Cd, and Se were due to elevated detection limits.”	EPA	Section 6.1.3, Tissue Chemistry	*The suggested change has been made to the BERA revision.*

5. We recommend adding "Fish Tissue Reference Comparison" to the weight-of-evidence analysis for fish in Table 6.5.	EPA	Section 6.3, Weight-of-Evidence Summary and Conclusions	*The suggested change has been made to the BERA revision.*
6. Section 3.3 of Appendix C discusses fish tissue residue benchmarks. EPA's fish tissue residue benchmark of 7.91 mg /kg dw (1.58 mg/kg ww) for selenium (EPA 2004, as cited in the BERA) was used in the ERA. We note that there is controversy regarding this benchmark (e.g., refer to http://www.ucsusa.org/scientific_integrity/abuses_of_science/selenium-standards.html). It may be useful to include in the uncertainty analysis a somewhat more detailed discussion of the uncertainties associated with the selenium fish tissue residue benchmark. In general, the use of a lower benchmark (e.g., 5.85 mg/kg dw, as recommended by United States Forest Service selenium expert Dennis Lemly) would not affect the results of this ERA. However, if this more conservative benchmark were used, then two of the three fish tissue samples at Lower Lake would exceed the benchmark, thereby providing stronger evidence of risk to fish in Lower Lake.	EPA	Appendix C	*The suggested change has been made and additional information was provided to the uncertainty section of Section 6.1.5 and Appendix C.*
7. Table C-11 is missing from the December 31, 2010, version of the BERA Appendices. The final BERA should include this table.	EPA	Appendix C	*This error has been corrected in the revised version of the BERA.*
8. Section 7- References- could be improved by being consistent with other EPA documents by listing the Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses as an U.S. EPA 1985 document which it is, followed by the names of its authors, if so desired. The other EPA citations in this document do not list the authors.	EPA	References	*Comment acknowledged, the suggested changes have been adopted in the revised version of the BERA.*
9. Page C-19 cites US EPA 2003 as the source for Region 5 EPA RCRA soil screening levels. In the reference section beginning on page C37, the US EPA 2003 listing provides no link to Region 5, but to ORNL for EPA's Eco SSL's. Please include a reference to Region 5's screening values.	EPA	Appendix C	*This error has been corrected in the revised version of the BERA.*
The symbol for cadmium should be changed here and numerous places in the document from Ca to Cd, and silver should be changed from Si to Ag. Lead should be spelled out prior to its symbol.	USFWS	Page ES-1. Exposure Assessment	*These errors have been corrected in the revised version of the BERA.*
The statement in the second paragraph in this section should probably say the site instead of the Helena Valley. Listed species would have been present in the Helena Valley in 1987. In the list of elements exceeding background in the third paragraph, tin should be abbreviated as well.	USFWS	Page 6-7. 2.2.1 Remedial Investigation of Soils, Vegetation, and Livestock (1987)	*These errors have been corrected in the revised version of the BERA.*
Symbols for Boron and Magnesium should be used in the table instead of spelling these two elements.	USFWS	Page 20. Table 2.9 Sediment Concentrations measured in Prickly Pear Creek and Reference Sites	*These errors have been corrected in the revised version of the BERA.*
Close parenthesis in first sentence.	USFWS	Page 26. 2.2.9 Baseline Ecological Risk Assessment Work Plan and Ecological Site Investigation (2010)	*These errors have been corrected in the revised version of the BERA.*
The Helena Valley is located in west central Montana	USFWS	Page 33. 2.4 Environmental Setting	*These errors have been corrected in the revised version of the BERA.*

Wind rose data for the Helena Valley should be obtained and used for wind directions and speeds. Additionally it may be more useful to break these data out seasonally. These data are important since emission sources are a large part of historic contamination related to the smelter.	USFWS	Page 34. Climate	*Comment acknowledged. Wind rose data would be informative, however, this additional data would not substantially change the results of the BERA. Thus, no change was made in the revised version of the BERA. The effect of wind patterns can be observed in Figure 2.2 which shows elevated lead concentrations extending to the south and east which is in general agreement with the prevailing wind direction as described in Section 2.4.1.*
Ursus arctos, Grizzly Bear is listed as a threatened species in Lewis and Clark County, source codes DM and XN should be removed, these are incorrect modifiers.	USFWS	Page 62. Table 2.21 Montana Species of Concern for Lewis and Clark County	*These errors have been corrected in the revised version of the BERA consistent with the May 2011 T&E species list..*
The second paragraph in this section states that the ecological risk management goals for the Facility include maintaining healthy, viable populations of invertebrates, fish, amphibians, birds, mammals and plants in Lower Lake. The remediation of Lower Lake may not be possible, and should not be included as a goal.	USFWS	Page 73. 3.6 Assessment Endpoints	*Comment acknowledged. "Lower Lake" was removed from the management goals.*
Selenium should be listed in the metals further analyzed in the BERA. In table 4.2, in the Fish Dietary Items column, it states that no benchmark was available for screening. Impacts to fish and birds from dietary food items have been documented by numerous studies (Lemly 1996, Ohlendorf et al. 2008, UDEQ 2008, and USDOI 1998). A benchmark of 3 mg/kg DW would be a good threshold benchmark according to the listed studies.	USFWS	Page 83. 4.2.1 Benthic Invertebrates	*Comment acknowledged. A dietary benchmark of 3 mg/kg-dw was added to this section for screening prey items for fish. Selenium was identified as a COPC through this screening. The main text, Appendix C and D were updated to reflect this change.*
Sediment PECs identified in the MacDonald et al. (2000) paper should be distinguished from those that were developed using other methods (Al, Sb, Fe, Mn and Ag). In addition, because Al, Fe and Mn are unlikely to cause or substantially contribute to toxicity, they should not be included in the risk characterization for benthic invertebrates, especially in calculating the mean PEC quotients. Antimony and Ag were also not part of the original model developed by MacDonald et al. (2000), and comparing Mean PECQs calculated with additional metals is not recommended. The sediment toxicity predicted in the model is only for As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn, adding additional metals to the mean PECQs would not reflect the modeled toxicity, and the comparison would not be valid. The additional metals not used in the mean PECQ can be assessed for their toxicity using the normal HQ technique to predict toxicity to sediment-dwelling organisms. A maximum PECQ@1%TOC of <0.1 Ingersoll (2007) noted that toxicity was unlikely, but the toxicity was 50% or higher when the maximum PECQ@1%TOC exceeded 2.3. These exceedances could be included in Table 5.1. Silver was left off the list in Table 5.1. In the second paragraph in this section, the third sentence states that PECs were not available for six metals, this should be changed to 11, and sentence inserted about the development of five "PECs" from other sources. The Service requests that the mean PEC Quotients be recalculated eliminating the developed "PECs" from the equation. These recalculations would necessitate a change in Table 5.2, and perhaps Figure 8. Interpretation of the mean PECQs should also be described in more detail. Ingersoll (2007) describes the predictability of mean PECQs in percentages, for example 20% of samples with a mean PECQ@1%TOC of <0.1 were toxic to sediment dwelling organisms, 28% of sediment samples with a mean PECQ@1%TOC of 0.1 – 1.0 were toxic, sediments with a mean PECQ@1%TOC 1.0 – 5.0 were toxic to sediment dwelling invertebrates 72% of the time, sediments with a mean PECQ@1%TOC >5.0 were toxic 90% of the time.	USFWS	Page 107. 5.1.1 Sediment Quality Guidelines	*The suggested changes have been made. Specifically, the PECQ analysis was revised to include only those elements with PECs provided by MacDonald. Associated tables and figures in the report have been updated. Additional discussion of the PECs was provided in Appendix C of the report.*

This section would be much easier to follow if exceedances of both chronic and acute water quality standards, and the corresponding HQ were placed in a table.	USFWS	Page 111. Surface Water	*Comment acknowledged, a summary table has been added to this section.*
The first sentence in this paragraph should be changed to reflect which sediments were collected for toxicity testing in 2003 versus 2010. This sentence makes it sound like sediments from all locations were collected and tested both years. The appendices should also include methods used for conducting the tests. Table B-1 in Appendix B appears to be missing sample locations for sediment toxicity, these should be added. If future sediment toxicity tests are conducted, they should use longer duration tests. From the Ingersoll (2007) paper it appears that the longer duration tests are more sensitive indicators of sediment toxicity.	USFWS	Page 114. Sediment Toxicity Tests	*Comment acknowledged, the suggested changes have been adopted in the revised version of the BERA. No further testing is planned at this time.*
In the first sentence in this section, it would be helpful for the reader to know what kind of RBPs were completed in what year. Reading this section it appears invertebrate communities in were completed in 2003, and habitat characteristics only in 2010. In addition to the RBP used in 2003 and 2010, an index specific to Montana and ecoregion (i.e. low valley multimetric index) may reflect impairment better than assessing the individual metrics currently used. MT DEQ (Jessup et al. 2005) outline additional methods that may prove useful in comparing reference sites to on-site areas. The following five metrics are suggested for use when applying a multimetric index approach to assessing stream condition in "Low Valley" areas: % EPT excluding Hydropsychids and Baetids % Midge % Crustacea & Mollusca Shredder taxa (rarefacted to 300) % predator In addition, incorporating the Montana-specific metals tolerance values into a single biological index value for each site may add to the weight-of-evidence approach. This index is simply the sum of (proportional abundance of a taxon in the sample x tolerance values specified by DEQ for that taxon) for all taxa in the sample. Tolerance values range from 0 to 10 and were derived from McGuire (1994, 1993, and 1992). This would provide another approach for comparing reference and on-site areas.	USFWS	Page 115. Community /Habitat Data	*Comment acknowledged. While additional data analysis may prove informative, no additional EPT taxa metrics were collected in 2010. Further, some reference sites used in 2003 were found to not be suitable for comparisons (US EPA 2005). Therefore, in lieu of the lack of data, no additional analysis was conducted with the community results.*
Under the CSM unit Prickly Pear Creek, the lines of evidence, community/habitat data analysis should be changed from a 0 to a + due to decreased richness and abundance in the invertebrate community. Under the CSM unit Lower Lake, the lines of evidence sediment toxicity tests should be changed from a 0 to a + because the mean survival was significantly lower than the laboratory control. In addition, the community/habitat data analysis lines of evidence should be changed from a 0 to not assessed.	USFWS	Page 122. Table 5.9 Weight-of-Evidence Analysis for Benthic Invertebrates	*Comment acknowledged, the suggested changes have been made in the revised BERA.*
Table E-10. Fish Tissue Chemistry Compared to Critical Body Residues should include a percent moisture or solids column as well as include the year the sample was collected to help distinguish samples collected recently to those collected in 2003. In the forth sentence in this paragraph you have a "?" after 51, this should be removed. In the next sentence you state that exceedances are related to elevated detection limits, it appears from table E-10 that this is true for only some of the samples.	USFWS	Page 125. Tissue Chemistry	*Comment acknowledged, the suggested changes have been made in the revised BERA. Note that moisture data was not available for 2003 samples*
Selenium should be included in the risk characterization for fish. Impacts to fish and birds from dietary food items have been documented by numerous studies (Lemly 1996, Ohlendorf et al. 2008, UDEQ 2008, and USDOI 1998). A benchmark of 3 mg/kg DW would be a good threshold benchmark according to the listed studies. Since all of the benchmarks are in dry weight, prey items should be converted into dry weight and compared to the benchmarks. This may prove more accurate than converting the benchmark to ww based on 80% moisture.	USFWS	Page 127. Dietary Assessment	*Comment acknowledged. A dietary benchmark of 3 mg/kg-dw was added to this section for screening prey items for fish. Selenium was identified as a COC through this screening. The main text and Appendix E were updated to reflect this change.*
This paragraph states that the Wilson Ditch may not provide optimal habitat, this should be changed to provides only seasonal habitat. This is an important distinction because Wilson Ditch is likely used by several wildlife receptors during the irrigation season.	USFWS	Page 128. 6.1.5 Fish Health/Habitat	*The suggested change has been made to the BERA revision.*
In the Toxicity Benchmarks section, when algae is used as an adjective, it should be algal, as in algal toxicity.	USFWS	Page 138. 7.2 Uncertainty Analysis	*The suggested change has been made to the BERA revision.*

This section states that Zn is one of the metals that pose negligible risks to aquatic plants, Zn can cause significant adverse effects of growth and survival in sensitive species of aquatic plants at water concentrations between 10-25 µg/L (Eisler 1993). In addition, Zn and Cd can act synergistically (Eisler 1993). Zinc toxicity to aquatic plants should be reviewed further before eliminating Zn as a COC.	USFWS	Page 138. 7.3 Weight-of-Evidence Summary and Conclusions	*Zinc did not exceed water quality standards in surface water, but did exceed in porewater in Prickly Pear Creek. The US EPA National Water Quality Criterion for Zinc was prepared in consideration of aquatic plants which have a wide range of associated toxicity values. The EPA criterion comparison provides a reasonable approximation of potential risks for aquatic receptors including plants. Therefore, alternative benchmarks were not further examined in the revised BERA.*
In the last sentence in this paragraph, the terrestrial CSM units should include Tito Park and add East and West to the Site Perimeter locations. The dietary assessment for swallows states that the swallow diet is broken down into four principle components, Terrestrial Plants = 25%, Benthic Invertebrates = 25%, Soil Invertebrates = 25%, Aerial/Foliar Invertebrates = 25% and Sediment Ingestion (% of total diet) = 0.0%. Tree Swallows feed entirely on insects, and primarily on flying emergent aquatic, and terrestrial flying insects. Based on this feeding strategy, only benthic invertebrates (that emerged) and aerial/foliar invertebrates should be used in the dietary assessment. Soil invertebrates (which according to the appendices targeted earthworms) would not be consumed by tree swallows, nor would terrestrial plants. These two dietary components should be removed from the assessment, and the model run using only the two remaining components.	USFWS	Page 163. 11.1 Dietary Assessment	*The soil invertebrate samples included only insects and were separated from earthworm samples. Therefore, the swallow diet consisted of 75% insects. Further, the Montana State Field Guide suggest that Tree Swallows do consume some vegetable matter (http://fieldguide.mt.gov/detail_ABPAU03010.aspx). Therefore, we believe that the current analysis provides a reasonable estimate of exposure. Several COCs were identified in this assessment and it is unlikely that a change in diet would substantially change the results of the risk assessment, therefore no change was made to this scenario*
In the section discussing Wilson Ditch, the BERA states that the ditch provides limited habitat, this should be changed to seasonal habitat. When the ditch flows during the irrigation system habitat is provided to organisms entrained in the irrigation ditch from Upper Lake, as well as terrestrial and aquatic receptors that use the ditch for food.	USFWS	Page 189. 12 Baseline Ecological Risk Assessment Summary and Conclusions	*The suggested change has been made to the BERA revision.*
The BERA states that risks are minimal in the Prickly Pear CSM to the aquatic and terrestrial community. Max PECQs for several metals exceeded 2.3, and mean metal PECQs exceeded 1.3 indicating a 50% or higher incidence of toxicity to sediment dwelling organisms (Ingersoll 2007), and several risk characterizations for terrestrial wildlife receptors had hazard quotients exceeding 10. While the list of COCs driving toxicity is reduced, a few COCs are still resulting in high risks to some receptors. The mean Pb soil concentration in the CSM for example is 1054 mg/kg dw resulting in a wildlife HQ of 96. The Supplemental Ecological Risk Assessment for the East Helena Smelter Site states that soil lead concentrations exceeding 650 mg/kg dw may adversely impact passerine insectivores (USEPA 2005, Hooper et al. 2002). These exposures create an unacceptable risk to the Service's migratory bird trust resource The risks at the Upper Lake and Upper Lake Marsh CSM to the aquatic and terrestrial community are described in the BERA as low to moderate. Max PECQs for several metals exceeded 2.3, and mean metal PECQs exceeded 1.3 indicating a 50% or higher incidence of toxicity to sediment dwelling organisms (Ingersoll 2007), and several risk characterizations for terrestrial wildlife as well as aquatic-dependent wildlife receptors had hazard quotients exceeding 10. The mean Pb soil concentration in the CSM for example is 2596 mg/kg dw resulting in a mean wildlife HQ of 236. The Supplemental Ecological Risk Assessment for the East Helena Smelter Site states that soil lead concentrations exceeding 650 mg/kg may adversely impact passerine insectivores (USEPA 2005, Hooper et al. 2002).	USFWS	Page 195. Conclusions	*Comment acknowledged. This comment is similar to EPA's comments regarding Prickly Pear Creek risks and we have made changes to address EPA's comments that should address FWS's concerns (i.e., surface water was added as a medium of concern and Hg was added as a COC). The text was changed to reflect this. No additional changes were made to the discussion of Upper Lake and Upper Lake Marsh in the BERA since we think current risks (i.e., low to moderate) are accurately described for these CSM units.*

Attachment IV

SOURCE: AIR PHOTO-NAIP 2009

	LEWIS & CLARK I.D. NO .	ACRES	SECTION	DESCRIPTION	PREVIOUS OWNER	YEAR PURCHASED
2	1888-25-3-32-20-0000	166	25-10N, 3W	SW¼NW¼; S½NW¼;NW¼SW¼;PARTSW¼SW¼	LAMPING	1988
3	1888-26-1-02-01-0000	157	26-10N, 3W	NE¼SE¼;S½NE¼;SE¼NW¼;PARTSE¼SE¼	LAMPING	1988
4	1888-25-1-01-01-0000	160	25-10N, 3W	NE¼	DARTMAN	1994
6	1888-24-4-01-01-0000	40.00	24-10N,3W	SE¼SE¼;	DARTMAN	1994
7	1889-32-2-01-04-0000	208	32-10N,2W	PART NW¼NW¼; N½SW¼NW¼; SW¼SW¼ NW¼; NW¼NW¼SW¼; SW¼SW¼;PART NW¼SW¼;PART SE¼SW¼;PART SW¼NE¼ SW¼; S½NE¼SW¼;PART SE¼SW¼;	VOLMER	1990
8	1889-31-3-04-02-0000	58.92	31-10N,2W	NW¼SW¼; PART NE¼SW¼;	VOLMER	1971
9	1889-31-1-01-50-AG00	193.22	31-10N,2W	N½;	VOLMER	1990
10	1889-31-3-07-03-AG00	18.46	31-10N,2W	SW¼SW¼;PART WEST OF HIGHWAY R/W	KLEFFNER	1985
11	1788-06-2-01-15-AG00	13.77	6-10N,2W	NW¼NW¼ PART WEST OF HIGHWAY R/W	KLEFFNER	1985
12	1786-01-1-02-15-AG00	3.77	1-10N,3W	NE¼NE¼; PART EAST PRICKLE PEAR CREEK	KLEFFNER	1985
13	1788-06-1-01-01-AG00 1788-06-1-01-25-AG00 1788-06-1-01-30-AG00 1788-06-1-01-50-AG00 1788-06-1-01-25-AG00 1788-06-2-01-50-AG00	141.87	6-T9,2W	N½N½;	STOKES	1991
14	1889-31-3-05-30-AG00 1889-31-3-05-40-AG00 1889-31-4-01-01-AG00 1889-31-4-01-02-AG00 1889-31-4-01-10-AG00 1889-31-4-01-20-AG00 1889-31-4-01-30-AG00 1889-31-4-01-40-AG00 1889-31-4-01-50-AG00 1889-31-4-01-60-AG00	231.12	31-T10,2W	S¼; S½SW¼; & EAST 8.63 CHAINS OF THE NE¼SW¼;	STOKES	1991
15	1888-36-2-01-01-0000	436.4	36-T10N,R3W	NW¼; SE¼; SW¼;	?	?
16	1888-36-1-01-40-0000	141.26	36-T10N,R3W	NE¼;	?	?
17	1888-31-2-13-01-AG00	70	31-T10N,R2W	PT.SW¼NW¼; PT.NE¼NW¼;	?	?
18	1888-36-1-05-10-0000	10.52	36-T10N,R3W	STRIP OF LAND BETWEEN S.MONT.AVE & PRICKLEY PEAR CREEK AND BETWEEN SMELTER HOUSING & OX.PLT.	?	?
19	1888-36-1-05-01-0000	3.00	36-T10N,R3W	TR IN SW¼SW¼SW¼NE¼;	?	?
21	1786-01-1-01-05-0001	5.49	1-T9N,R3W	TR.NW¼NE¼;	HELEN SMITH	1994
22	1888-25-3-16-18-0000	3.00	25-T10N,R3W	TR.N½SE¼SW¼;	HRELLA	1994
23	1786-01-1-02-05-AG00	26.00	1-T9N,R3W	PT.LYING BETWEEN PRICKLEY PEAR CREEK & E.SIDE GN RR R/W	SOMMERS	1969

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MT ENVIRONMENTAL TRUST GROUP, LLC
EAST HELENA PLANT
EAST HELENA, MT

EAST HELENA PLANT
PROPERTY MAP

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UPDATE TIME: 9:28 AM

Baseline Ecological Risk Assessment: Former ASARCO East Helena Facility East Helena, Montana

Prepared for
Montana Environmental Trust Group, LLC
Trustee of the Montana Environmental Custodial Trust
P.O. Box 1230
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December 2011

Gradient

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Science and Strategies for Health and the Environment

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List of Abbreviations

Ag	Silver
Al	Aluminum
ALA-D	Delta-amino Levulinic Acid Dehydratase
APSD	Acid Plant Sediment Drying
As	Arsenic
ASARCO	ASARCO, LLC
AVS	Acid Volatile Sulfide
AWQC	Ambient Water Quality Criteria
Ba	Barium
Be	Beryllium
BERA	Baseline Ecological Risk Assessment
BLL	Blood Lead Level
BLM	Biotic Ligand Model
CAMU	Corrective Action Management Unit
CBR	Critical Body Residue
Cd	Cadmium
Co	Cobalt
COC	Chemical of Concern
COI	Chemical of Interest
COPC	Chemical of Potential Concern
Cr	Chromium
CSM	Conceptual Site Model
Cu	Copper
DBH	Diameter at Breast Height
EcoSSL	Ecological Soil Screening Level
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
Fe	Iron
FS	Feasibility Study
FSAP	Field Sampling and Analysis Plan
HDS	High Density Sludge
Hg	Mercury
HQ	Hazard Quotient
LOAEL	Lowest Observed Adverse Effect Level
MDEQ	Montana Department of Environmental Quality
MFWP	Montana Department of Fish, Wildlife and Parks
MgHg	Methylmercury
Mn	Manganese
MNHP	Montana Natural Heritage Program
MPDES	Montana Pollutant Discharge Elimination System
Ni	Nickel
NOAEL	No Observed Adverse Effect Level
Pb	Lead
PEC	Probable Effect Concentration
PECQ	Probable Effect Concentration Quotient
RBP	Rapid Bioassessment Protocol
RCRA	Resource Conservation and Recovery Act

RFI	Resource Conservation and Recovery Act Facility Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
Sb	Antimony
Se	Selenium
SEM	Simultaneously Extracted Metal
SLERA	Screening-Level Ecological Risk Assessment
SMDP	Scientific Decision Management Point
SQG	Sediment Quality Guideline
TDS	Total Dissolved Solids
TEC	Threshold Effect Concentration
Tl	Thallium
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
US FS	US Forestry Service
US FWS	US Fish and Wildlife Service
V	Vanadium
Zn	Zinc
ZPP	Zinc Protoporphyrin

Executive Summary

This document presents the baseline ecological risk assessment (BERA) for the former ASARCO, LLC (ASARCO) lead (Pb) smelter ("the Facility") located in East Helena, Montana. The Facility operated from 1888-2001 and produced Pb bullion from smelting of a variety of foreign and domestic concentrates, ores, fluxes, and other non-ferrous metal-bearing materials. For more than 20 years, extensive site clean-up activities have been undertaken at the Facility, including the demolition of numerous structures. This BERA was conducted as part of the Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The purpose of the BERA is to estimate the likelihood and magnitude of unacceptable risks to ecological receptors posed by current or likely future exposure to metals in soil, water, sediments, plants and biota at the Facility and its immediately surrounding areas. The BERA was designed to provide information required to support risk management decisions and to determine whether corrective measures are needed to protect ecological resources around the Facility.

Problem Formulation

The problem formulation phase of the BERA established the overall scope of the risk assessment and the ecological attributes to be evaluated. A conceptual site model (CSM) was developed which examined several distinct ecological units (CSM units), including Prickly Pear Creek, Upper Lake and Upper Lake Marsh, Lower Lake, Wilson Ditch, Tito Park, and the Site Perimeter. Representative ecological receptors of concern were identified for each of the CSM units and measurement and assessment endpoints were developed to guide the risk assessment process. Ecological receptors identified at the Facility and examined in the BERA include benthic invertebrates, fish, amphibians, aquatic and terrestrial plants, soil invertebrates, birds, and mammals.

Exposure Assessment

The exposure assessment phase of the BERA provided an examination of reasonable upper-bound exposures to the chemicals of potential concern (COPCs) in each of the CSM units of the Facility. Exposure to 19 metal COPCs (aluminum [Al], antimony [Sb], arsenic [As], barium [Ba], beryllium [Be], cadmium [Cd], chromium [Cr], cobalt [Co], copper [Cu], iron [Fe], lead [Pb], manganese [Mn], mercury [Hg], nickel [Ni], selenium [Se], silver [Ag], thallium [Tl], vanadium [V], and zinc [Zn]) was evaluated using a number of lines of evidence. Available exposure data included sediment, surface water, porewater, and soil chemistry. Metal exposures were also examined in biological tissues, including benthic invertebrates, fish, soil invertebrates, amphibians, and avian eggs. Finally, metal concentrations from the Facility were compared to metal concentrations from reference areas outside of the influence of the Facility. Exposure of benthic invertebrates to metals was evaluated based on sediment chemistry results and toxicity tests collected from a number of stations in each area of the Facility. For the other ecological receptors evaluated in the BERA, mean, 95% upper confidence limit (UCL) on the mean, and maximum concentrations were examined. For wildlife receptors, the exposure assessment quantified the total dietary dose from prey items for each of the COPCs. Dietary doses for wildlife were estimated using available information on biological and life history, including body weight, feeding behavior, site usage, and diet. The surrogate wildlife species evaluated in the BERA were mallard, belted kingfisher, sandpiper, mink, American robin, tree swallow, short-tailed shrew, and meadow vole.

Effects Assessment

Potential adverse effects (*i.e.*, reduced survival, reduced growth, or impaired reproduction) were identified for each ecological receptor group. The benthic invertebrate community was assessed using direct measures of sediment toxicity (*i.e.*, sediment bioassays using *Hyalella azteca* and *Chironomus dilutus*), sediment quality guidelines (SQGs), and bioavailability measures. Aquatic receptors were also evaluated by comparing surface water concentrations to federal and state water quality criteria. The toxicological literature was reviewed to identify tissue concentrations or dietary concentrations (doses) that represent toxicity threshold concentrations. The effect measures were used to identify the primary risk drivers for each of the ecological receptor groups.

Risk Characterization

The exposure and effects data were compared in the risk characterization phase of the BERA to assess the potential risks of COPCs in each of the CSM units defined in the problem formulation. The results of the BERA risk characterization, by CSM unit, are as follows:

- Prickly Pear Creek provides a range of habitats for aquatic and terrestrial receptors and is relatively undisturbed, except near the Facility. Current COPC concentrations in Prickly Pear Creek and associated riparian areas appear to pose low risk to the aquatic and terrestrial community. Further, onsite COPC concentrations are generally within the range of concentrations found in reference areas.

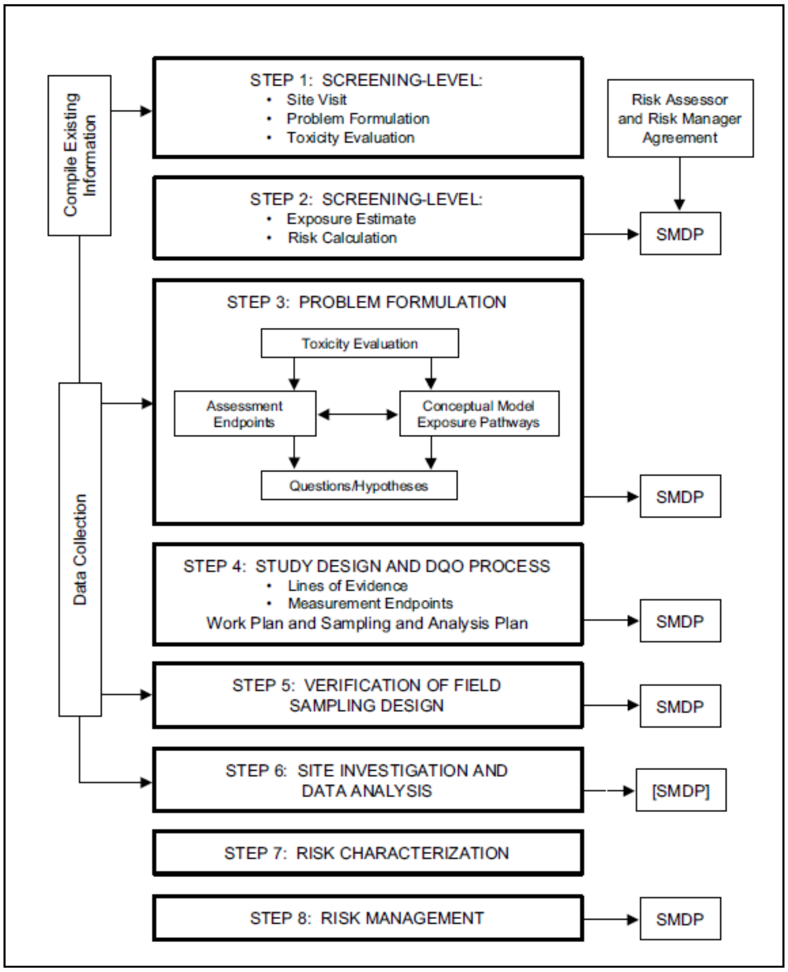
- The Upper Lake and Upper Lake Marsh area supports a diverse mix of habitats and ecological receptors. COPC concentrations are elevated in this area, particularly at the north side adjacent to Tito Park. Overall, risk estimates for this area were low to moderate.
- Risks to ecological receptors from metal exposures in Wilson Ditch are low to moderate. Metal contamination is evident in this channel and concentrations are similar to those of its primary water source, Upper Lake. However, Wilson Ditch provides only seasonal habitat for aquatic receptors since water flows only during the irrigation season (approximately April-September).
- Lower Lake and Tito Park are man-made structures with very minimal vegetation or habitat available for ecological receptors. Lower Lake and Tito Park have significantly elevated COPC concentrations in aquatic and terrestrial environments. COPC concentrations in these two CSM units posed a risk to most of the receptors evaluated in the BERA. In addition, Lower Lake is a likely source of COPCs to adjacent CSM units (*i.e.*, Upper Lake and Prickly Pear Creek); additional corrective measures are likely needed to reduce the transport of COPCs to surrounding ecological habitats.
- The East and West Perimeter of the Facility is characterized by elevated metal concentrations indicative of impacts from historic smelting activities. The East and West Perimeter CSM units of the Facility have COPC concentrations that are elevated above reference areas and are expected to pose a risk to terrestrial ecological receptors. Overall, risks from soil exposures in these areas were characterized as high and remedial activities may need to be undertaken to reduce exposure.
- The primary chemicals of concern (COCs) for ecological receptors throughout most CSM units of the Facility are As, Cd, Cu, Hg (and MeHg), Pb, and Se.
- Metals that may pose a risk in some CSM units of the Facility, particularly those closest to the Facility, are Sb, Mn, Ag, Tl, and Zn
- Metals that generally pose negligible risks to ecological receptors and are not significantly elevated above reference areas are Al, Ba, Be, Cr, Co, Fe, Ni, and V.

1 Introduction

This document presents the BERA for the former ASARCO Pb smelter ("the Facility") located in East Helena, Montana. Ownership of the Facility was transferred to the Montana Environmental Trust Group, LLC, as Trustee for the Montana Environmental Custodial Trust ("the Custodial Trust"), in December 2009 as part of the larger ASARCO bankruptcy settlement agreement. The BERA was prepared by Gradient on behalf of the Custodial Trust. The purpose of the BERA is to estimate the likelihood and magnitude of unacceptable risks to ecological receptors posed by current or likely future exposure to metals in soil, water, sediments, plants, and biota at the Facility and in areas immediately surrounding the Facility. Elevated metals concentrations have been identified in surface water, sediment, surface soil, and groundwater at the Facility, primarily as a result of deposition from historical stack and fugitive emissions, slag, and process water. The BERA is being conducted as part of the Phase II RFI, which also includes a Phase II Site Characterization and Human Health Risk Assessment. The BERA has been designed to provide information required to support risk management decisions in connection with the Custodial Trust's obligations under the 1998 RCRA Consent Decree (US District Court, 1998) and to determine whether corrective measures are needed to protect ecological resources at the Facility. The approach, analyses, and results of the BERA are provided in the following sections.

The BERA was prepared in general accordance with US Environmental Protection Agency (US EPA) guidance documents (US EPA, 1997, 1998, 1999a, 2007) and site investigation work plans (Gradient, 2010; Hydrometrics, 2010). The BERA follows the eight-step risk assessment process (Figure 1.1) set forth by US EPA (1997). Site investigations and screening-level analyses have been performed previously for ecological resources at the Facility (US EPA, 2005a; Gradient, 2010; Hydrometrics, 2005, 2010). Additional Facility investigations, data analyses, and risk characterizations were performed as part of the BERA and are presented herein. The objectives of the BERA are to:

- Evaluate the likelihood for potential risks (if any) posed by metals to aquatic and terrestrial ecological receptors within the study area; and
- Provide risk managers with information that will aid in remediation or cleanup efforts to protect ecological resources present (or likely to be present) at the Facility.



Note: SMDP = Scientific Management Decision Point

Figure 1.1 Eight-Step Ecological Risk Assessment Process for Superfund (US EPA, 1997)

The sections of the BERA are:

- **Section 1. Introduction**
- **Section 2. Site Description**: In this section, we provide an overview and history of the East Helena Facility and a summary of the ecological resources present within the study area.
- **Section 3. Problem Formulation**: This section synthesizes existing information describing the site operations, contaminant sources, exposure pathways, potential ecological effects of COPCs, and ecological receptors of interest. A CSM describing the relationships between sources and receptors is presented and the assessment and measurement endpoints that define the ecological resources to be protected are established.

- **Section 4. Analysis Plan**: The available site-specific data are summarized in this section. An updated screening assessment is conducted to focus the BERA on the primary COPCs. Finally, the procedures for characterizing exposure and effects for the BERA are presented.
- **Section 5 through Section 11. Risk Characterization**: A risk analysis is presented for each ecological group of interest (*i.e.*, aquatic invertebrates, fish, aquatic plants, amphibians, terrestrial plants, terrestrial invertebrates, birds, and mammals) in these sections. Lines of evidence for each ecological receptor are evaluated and potential risks are characterized. The uncertainties with the assumptions and models utilized in the BERA are discussed and evaluated for each of the receptors.
- **Section 12. Baseline Ecological Risk Assessment Summary and Conclusions**: In this section, a summary of the results and conclusions of the BERA is provided for each group of ecological receptors. This summary identifies the potential risk drivers for each group and the areas of the site with the greatest potential risk.
- **Section 13. References**: This section documents literature and information sources used to support the BERA.
- **Appendices**: Supporting information and analyses are included as appendices.

2 Site Description

The problem formulation process of the BERA includes a review of the environmental setting, known or suspected COPCs, chemical fate or transport mechanisms, and ecological attributes to be considered (US EPA, 1997). A physical description of the site is pertinent to understanding the current ecological condition and to develop a CSM on which the BERA analysis is based. This section provides a description of the site and study area, Facility operations, previous environmental investigations, habitats, and aquatic and terrestrial ecological receptors likely to be present.

2.1 Site Location and Background

The East Helena Facility is a former custom Pb smelter located approximately three miles east of the City of Helena, Montana (Map 1). The Facility is situated on approximately 142 acres of property in East Helena, Montana. The Facility is located within the Helena Valley, which is situated in Lewis and Clark County. The Facility began operations in 1888 and produced Pb bullion from smelting of a variety of foreign and domestic concentrates, ores, fluxes, and other non-ferrous metal bearing materials. In addition to Pb bullion, the Facility produced Cu byproducts and food grade sulfuric acid. Plant operations were suspended in April 2001 and in August 2005 ASARCO filed for Chapter 11 bankruptcy protection. For more than 20 years, extensive site clean-up activities have been undertaken at the Facility, including the demolition of numerous structures. Ownership of the Facility was transferred from ASARCO to the Montana Environmental Trust Group, LLC, as Trustee for the Custodial Trust, in December 2009 as part of the larger ASARCO bankruptcy settlement agreement (Hydrometrics, 2010).

Figure 2.1
East Helena Facility Prior to Demolition Activities

The Facility is bounded to the south by Upper Lake, Upper Lake Marsh, and Lower Lake, to the east and northeast by Prickly Pear Creek, and to the north by Highway 12 (and the center of East Helena) and American Chemet (Map 2). The interior portions of the Facility are covered with buildings; paved areas; areas where Facility structures have been demolished, backfilled, graded and covered with a temporary synthetic liner; unpaved areas; and other features. There is also a large slag pile in the northeast portion of the Facility (Map 2). Land surrounding the Facility to the east and west consist primarily of agricultural and rangeland. The Facility itself offers only limited habitat, except for the onsite water bodies – Lower Lake and Upper Lake – and the marshes associated with Upper Lake. Prickly Pear Creek, which runs along the eastern boundary of the Facility, also provides aquatic and riparian habitat. Upper Lake (at the extreme southern end of the Facility) is fed through diversion of flow from Prickly Pear Creek and discharges *via* return flow to Prickly Pear Creek, seasonal discharge to the Wilson irrigation ditch, and through subsurface leakage to the local groundwater system. Wilson Ditch is an agricultural irrigation ditch extending from Upper Lake northwestward towards the Helena Valley. Prior to 1997, Wilson Ditch crossed the Facility in a buried concrete pipe. In 1997, the original pipe was replaced with an underground pipeline relocated immediately south of the Facility. The intake for Wilson Ditch is in the northern portion of Upper Lake.

Current land use in and around the Facility is presented on Map 3. Future site use of the Facility has not been determined at this time. However, potential future land use scenarios include, but are not limited to, one or more (including some combination) of the following:

- **Industrial Use(s)**. The Facility could potentially be reused for light manufacturing, warehousing, and/or distribution facilities. Additionally, facilities associated with reprocessing and/or recycling slag material might also be located at the site.
- **Commercial Use(s)**. In addition to the industrial use options, some or all of the Facility could be used for a variety of commercial activities.
- **Passive Recreational Use(s) and/or Open Space**. Following implementation of final corrective measures, the Facility could be partially and/or entirely covered with impermeable caps or covers and/or permeable vegetated covers such that some or all of the Facility could be dedicated open space and/or open to the public for limited recreational uses.
- **Agricultural Use(s)**. If capped with sufficient clean fill and vegetated cover, the Facility could be partially used for agricultural purposes (such as grazing and/or growing).

2.2 Previous Investigations

Several environmental studies have been performed in and around the Facility. Previous site characterization investigations have shown that Facility surface and subsurface soils contain elevated metals, of which As, Cd, Cu, Pb, and Zn show the highest concentrations (ACI, 2005). Limited data on aquatic habitat and exposure levels from onsite water bodies were previously collected, leading to the supplemental ecological field investigation that was performed in 2003 as part of the Supplemental Ecological Risk Assessment (US EPA, 2005a) and the 2010 ecological field investigation developed as part of the BERA Work Plan (Gradient, 2010). A number of other investigations have been conducted at the site that are pertinent to the BERA; these are summarized briefly in the sections below.

2.2.1 Remedial Investigation of Soils, Vegetation, and Livestock (1987)

The Remedial Investigation (RI) of Soils, Vegetation, and Livestock (CH2M Hill, 1987a) included the sampling and analysis of soils, plant tissues, and cattle resources from the site and throughout the Helena Valley. The purpose of the 1987 RI of soils, vegetation, and livestock was to characterize the nature and extent of contamination in soil, vegetation, and cattle in the Helena Valley and to identify remedial action alternatives. Although dated, the 1987 RI also contains an extensive site description, a brief summary of site operations, maps and aerial photographs of the site and surrounding areas, local wind data, maps depicting distribution of various metals, human population data, wildlife and endangered species information, and an analysis of soil properties.

No endangered species were reported to occupy the site at the time of this report. The 1987 RI Appendices included detailed sampling and analysis method descriptions, scientific names of plants sampled, soil descriptions and physical data, descriptions of the ranches and cattle sampled, statistical analysis results, and raw data for the soil, vegetation, and cattle investigations.

The objectives of the 1987 RI soil investigation were to:

- Determine whether soil metals were elevated due to site contamination;
- Map the spatial distribution of soil metals relative to the Facility; and
- Evaluate the horizontal and vertical distribution of metals in soil and investigate soil properties that influence this distribution.

A total of 157 soil sample locations were sampled at a depth of 0-4 inches. A subset of 47 locations were sampled to a depth of 30 inches at intervals of 4-8, 8-15, and 15-30 inches. A reference site located 27 miles southeast of the Facility was sampled to represent local background. Several metals occurred at concentrations exceeding background: As, Cd, Cu, Hg, Mn, Pb, Se, Ag, Sn, Tl, and Zn. A summary of surface soil concentrations reported by CH2M Hill (1987a) is presented in Table 2.1. Exceedances ranged from 1.3-27 times greater than background. Soil metal concentrations tended to be elevated east of the Facility based on kriging analysis, which is consistent with the prevailing wind direction in the Helena Valley, from west to east (an example of this analysis for Pb is presented in Figure 2.2). The highest metals concentrations occurred in the 0- to 4-inch layer, although some metals were elevated at depths as low as 30 inches. Extractable metal concentrations (*i.e.*, the portion of the soil elemental pool available for plant uptake) were also assessed and As, Cd, Cu, Pb, Mn, and Zn were reported as elevated above extractable concentrations in background soils.

Table 2.1
Surface Soil Metals Concentrations from the 1987 Remedial Investigation Study Area

Metal[a]	**Project Area Soils (n = 157)**		**Background Area Soils (n = 3)**	
	Geometric Mean	**Range**	**Geometric Mean**	**Range**
Al	12,197	7,300 – 26,900	16,871	14,500 – 20,700
Sb	0.28	0.27 – 1.5	0.27	0.27 – 0.27
As	41.6	13.0 – 570	16.5	15.0 – 18.0
Ba	132	69.0 – 590	130	110 – 142
Be	0.89	0.42 – 3.20	1.01	0.65 – 1.40
Cd	6.56	0.25 – 1.04	0.24	0.17 – 0.32
Cr	12.7	6.5 – 60.0	15.3	14.0 – 17.0
Co	8.6	4.8 – 16.0	8.4	7.0 – 10.0
Cu	41.4	12.0 – 1,070	16.3	16.0 – 17.0
Fe	13,695	1,000 – 25,800	15,248	14,500 – 16,300
Pb	201	13.0 – 8,300	11.6	10.0 – 13.0
Mn	458	204 – 1,810	336	270 – 410
Hg	0.71	0.05 – 16.0	0.08	0.09 – 0.12
Ni	11.2	5.5 – 22.0	13.3	13.0 – 14.0
Se	0.13	0.07 – 1.30	0.07	0.07 – 0.07
Ag	0.72	0.09 – 46.0	0.20	0.09 – 0.45
Tl	0.22	0.09 – 2.40	0.09	0.09 – 0.09
Sn	0.88	0.66 – 55.0	0.66	0.66 – 0.66
V	24.8	1.40 – 60.0	27.2	21.0 – 33.0
Zn	136.7	34.9 – 25,199	46.9	39.9 – 53.9

Note:

(a) data obtained from Table 3.1 in CH2M Hill (1987a); concentrations are reported in mg/kg dry weight; samples were collected at a depth of 0-4 inches.

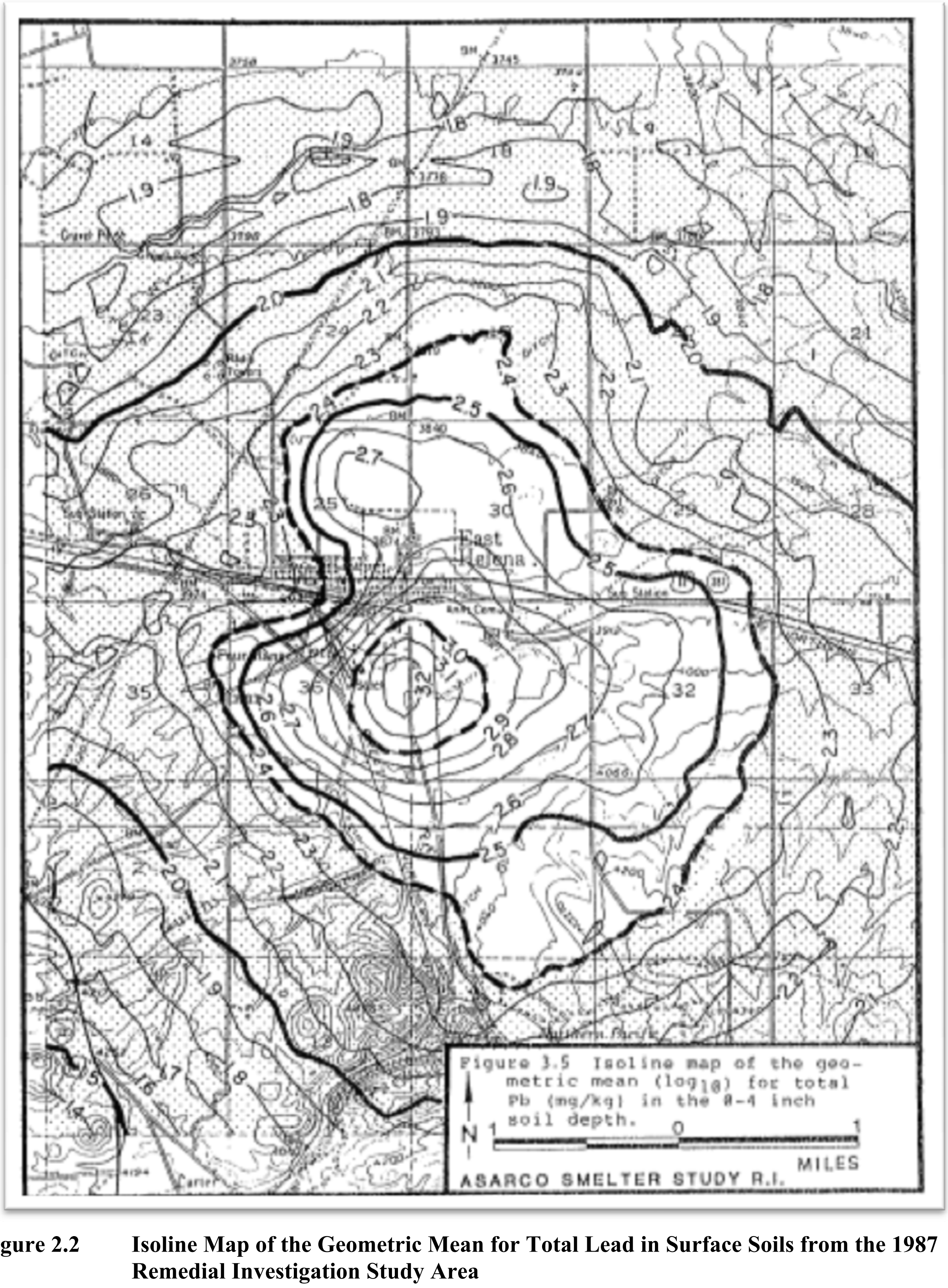


Figure 2.2 Isoline Map of the Geometric Mean for Total Lead in Surface Soils from the 1987 Remedial Investigation Study Area

The objectives of the 1987 RI vegetation investigation were to:

- Determine whether plants and grain heads in Helena Valley contained elevated metals;
- Describe metals concentrations in plants in terms of phytotoxicity benchmarks and allowable concentrations in forage for livestock consumption;
- Describe areal distribution of metals in plants; and
- Investigate the relationship between metals concentrations in soils and in plants.

The vegetation investigation compared plants and grains grown in the Helena Valley to the reference location 27 miles southeast of the Facility. Samples of forage, range grass, barley, and wheat were collected from 58 sites corresponding to soil sample locations. Alfalfa, needle and thread grass, winter wheat, and barley all had elevated metals concentrations (As, Cd, Cu, Pb, Hg, and Zn) relative to background (Table 2.2). Significant correlations were found between soil concentrations and total plant and grain-head metal concentrations for As, Cd, Cu, Hg, Pb, and Zn.

Table 2.2
Plant Metals Concentrations from the 1987 Remedial Investigation Study Area

Metal[a]	Sample Location	Geometric Mean Plant Concentrations (mg/kg dry weight)[b]				
		Alfalfa (plant)	Needle and Thread Grass (plant)	Winter Wheat (plant)	Winter Wheat (grain head)	Barley (grain head)
As	Project Area	0.33	0.89	1.23	0.16	0.70
	Background	0.07	0.50	0.20	0.07	0.70
Ba	Project Area	23.2	33.9	30.5	1.88	3.94
	Background	36.0	49.0	17.0	2.00	4.00
Cd	Project Area	0.60	0.60	0.56	3.44	0.46
	Background	0.25	0.35	0.35	0.35	0.35
Cr	Project Area	0.88	1.06	1.11	0.70	0.70
	Background	0.70	2.0	0.70	0.70	0.70
Co	Project Area	0.70	0.70	0.70	0.70	0.70
	Background	0.70	0.70	0.70	0.70	0.70
Cu	Project Area	6.16	3.93	3.48	3.34	3.32
	Background	2.0	1.0	3.0	3.00	2.00
Fe	Project Area	112.8	166.9	117.2	40.7	42.5
	Background	150.0	206.0	142.0	68.0	39.0
Pb	Project Area	3.78	8.16	1.29	0.88	0.39
	Background	0.80	0.80	0.10	0.07	0.43
Mn	Project Area	31.8	23.6	65.6	15.9	35.9
	Background	37.0	48.0	71.0	22.0	39.0
Hg	Project Area	0.09	0.13	0.07	0.03	0.02
	Background	0.06	0.05	0.13	0.014	0.014
Ag	Project Area	0.38	0.38	0.44	0.37	0.38
	Background	0.35	0.50	0.35	0.35	0.35
V	Project Area	0.76	0.89	0.81	0.70	0.70
	Background	0.70	2.00	0.70	0.70	0.70
Zn	Project Area	28.2	25.7	24.5	36.1	34.2
	Background	18.0	18.0	31.0	28.0	45.0

Notes:

(a) data obtained from Table 4.1 in CH2M Hill (1987a).

(b) Sample sizes are 16 (alfalfa), 12 (needle and thread grass), 10 (winter wheat plant), 14 (winter wheat grain head), 10 (barley grain head), and 1 (for all background samples).

The objectives of the 1987 RI livestock investigation were to:

- Determine whether cattle were exposed to site contaminants;
- Investigate the level of exposure in terms of the spatial distribution of site-related contaminants;
- Investigate the relationship between cattle exposure concentrations and soil and vegetation concentrations; and
- Describe the concentrations of metals in cattle tissue.

The livestock investigation looked at cattle whole blood, blood serum, and hair and compared metals concentrations in Helena Valley cattle herds to cattle herds from the reference location. Arsenic, Cd, Pb, and Zn were elevated in cattle whole blood compared to the reference location (Table 2.3). Significant relationships existed between cattle blood-lead concentrations and surface soil Pb concentrations, although this relationship was not significant for As, Cd, or Zn. Arsenic and Pb concentrations in cattle blood were greatest closer to the Facility and decreased with distance. This relationship was not significant for Cd or Zn. A relationship was also noted between cattle blood Pb and vegetation concentrations.

Table 2.3
Livestock Blood and Hair Metals Concentrations from the 1987 Remedial Investigation Study Area

Herd Number	Distance From Facility (miles)	Sample Size	Measure	Arithmetic Mean Concentrations[a]			
				As	Cd	Pb	Zn
01	1.4	16	Whole blood or Serum (µg/dL)	1.24	0.26	39	98
			Hair (mg/kg dry weight)	0.20	1.4	7.5	116
02	4.25	25	Whole blood or Serum (µg/dL)	0.37	0.42	11	89
			Hair (mg/kg dry weight)	0.23	0.27	2.0	103
03	3.32	25	Whole blood or Serum (µg/dL)	1.55	0.71	26	82
			Hair (mg/kg dry weight)	0.43	0.78	5.6	114
04	6.11	25	Whole blood or Serum (µg/dL)	0.22	0.43	12	100
			Hair (mg/kg dry weight)	0.19	0.28	1.6	108
05	5.06	25	Whole blood or Serum (µg/dL)	0.69	0.46	19	76
			Hair (mg/kg dry weight)	0.27	0.51	2.0	103
06	5.33	25	Whole blood or Serum (µg/dL)	0.28	0.18	9	93
			Hair (mg/kg dry weight)	0.30	0.17	1.1	110
08	1.68	14	Whole blood or Serum (µg/dL)	1.08	0.96	20	99
			Hair (mg/kg dry weight)	0.33	0.30	3.1	109
09	4.18	23	Whole blood or Serum (µg/dL)	0.69	0.37	10	84
			Hair (mg/kg dry weight)	0.11	0.28	1.8	103
07	26.7 (reference)	45	Whole blood or Serum (µg/dL)	0.23	0.46	5	86
			Hair (mg/kg dry weight)	0.15	0.05	0.69	104

Note:

(a) data obtained from Tables 5.1, 5.3, and 5.5 in CH2M Hill (1987a).

2.2.2 Toxicity of Arsenic, Cadmium, Lead, and Zinc in Soil, Plants, and Livestock (1987)

The assessment of the toxicity of As, Cd, Pb, and Zn in soil, plants, and livestock in Helena Valley was prepared by CH2M Hill (1987b). It presented a literature review that was conducted to assess candidate hazard levels for metals associated with the site and Helena Valley specifically. Hazard levels were developed to assess risk to plants and livestock from metals found in soil, plants, livestock, and water, and to determine potential impacts to agricultural resources. The literature review did not give greater importance to either field or lab studies and did not consider the synergistic effects of metals. Weight was added to studies that took place in Helena Valley and/or contained conditions and/or species similar to those present in Helena Valley.

The report listed background concentrations and toxicity data for each metal in numerous media in a series of tables. Media included livestock, plants, soil, and water. Regulatory criteria from other sources were also considered: land application of sewage sludge, coal overburden suitability for root-zone material, criteria defining hazardous wastes, and criteria for metal contaminants based on land use. The report also contained summaries of the toxicological mechanisms of each metal for both livestock and plants. However, the regulatory and toxicological information are outdated and may not be relevant today.

"Tolerable levels" for plants and livestock were selected on the basis of the maximum concentrations at which no toxicity was noted. Selection of "toxic concentrations" was based on results of individual studies, as well as criteria reported as toxic in the literature. A summary section and/or summary table for selected criteria and concentrations does not exist in this document, and much of the information it contains is likely outdated.

2.2.3 Toxicity of Copper, Mercury, Selenium, Silver, and Thallium in Soil and Plants (1987)

The assessment of the toxicity of Cu, Hg, Se, Ag, and Tl in soil and plants in Helena Valley was prepared by CH2M Hill (1987c) and contained similar information as the report described above for the metals in question. This volume addresses soil and plants and not livestock.

2.2.4 Process Pond Remedial Investigation/Feasibility Study (1989)

The Process Pond Remedial Investigation/Feasibility Study (RI/FS) was prepared by Hydrometrics and Hunter/ESE (1989) for ASARCO and addressed the first operable unit assigned to an accelerated schedule set by US EPA and ASARCO. The operable units for the site were listed as:

- Process Fluids (includes Process Ponds and Process Fluids Circuits sub-units);
- Groundwater;

- Surface Soils/Surface Water (includes onsite soil, residential East Helena soils, limited Helena Valley Soils, Prickly Pear Creek, Wilson Ditch, vegetation, cattle, fish, and waterfowl sub-units);
- Slag Pile; and
- Ore Storage Areas.

The Process Pond operable sub-unit, which along with the Process Circuit sub-unit composes the Process Fluids Operable Unit, consisted of four process ponds: Lower Lake, the former speiss granulating pond and pit, the former acid plant water treatment facility, and former Thornock Lake. The other operable units are covered in the 1990 Comprehensive RI/FS (Hydrometrics, 1990). The Process Pond investigation included a water-balance investigation of the main process-water circuit for Lower Lake and a physical characterization of each pond. Physical characterization included the sampling of sediment, soil, process water, and process fluids.

The endangerment assessment portion of the Process Pond RI/FS (Section 5.0 of the Process Pond RI/FS) identified the metals of concern for public health and the environment as As, Cd, Cu, Pb, and Zn. A non-site-specific toxicity assessment describing health and environmental hazards of each chemical of concern was given. These assessments included information on criteria and standards, toxicodynamics, and information on effects to aquatic and terrestrial organisms.

Volume II of the Process Pond RI/FS consisted of 16 Appendices that contain information such as photographs, chemical data, well boring and geological logs, groundwater data, *etc*.

2.2.5 Comprehensive RI/FS (1990)

The Comprehensive RI/FS (Hydrometrics, 1990) covered the following operable units of the site:

- Groundwater;
- Surface Soils/Surface Water (includes onsite soil, residential East Helena soils, limited Helena Valley Soils, Prickly Pear Creek, Wilson Ditch, vegetation, cattle, fish, and waterfowl sub-units);
- Slag Pile; and
- Ore Storage Areas.

The Process Fluids operable unit was evaluated in the 1989 Process Pond RI/FS. The Surface Soils/Surface Water investigation is summarized below. The other operable units are not relevant to ecological investigations and, therefore, are not summarized here.

The Surface Soils/Surface Water investigation addressed:

- Soil samples from the site and from other locations in East Helena;
- Water samples from Prickly Pear Creek, Upper Lake, and Wilson Ditch;
- Groundwater/surface water interactions at Prickly Pear Creek;
- Surface water drainage mapping and double-ring infiltrometer test;
- Vegetable samples from residential gardens and grain samples from Helena Valley;
- Helena Valley cattle;
- Fish in Prickly Pear Creek and Lake Helena;
- Waterfowl/sediment comparison literature review; and
- Biological inventory for Upper Lake.

The Surface Soils investigation was conducted to determine the nature and extent of metals in surface soils at the Facility and in the East Helena area to determine wind dispersion of soil particulates and to determine the amount of contaminated surface soil that could enter Prickly Pear Creek during a storm event. A summary of the soil concentrations is presented in Table 2.4. Additional soil studies were conducted for a child blood Pb investigation for residences in East Helena and those results are presented in Hydrometrics (1990). Facility (*i.e.*, the Upper Ore Storage Area, Lower Ore Storage Area, railroad tracks east and south of thawhouse, perimeter of slag pile, and bare areas within and outside of the Facility) soils were also collected to investigate spatial and concentration trends; the results are summarized in Table 2.5.

Table 2.4
Soil Metals Concentrations within the East Helena Residential Area (1984 and 1987)

Metal	Sample Size	Geometric Mean Concentration from Residential Area (mg/kg dry weight)	Geometric Mean Concentration from Background Area (mg/kg dry weight) (n = 3)
Sb	18	0.32	0.27
As	38	45.6	16.5
Cd	42	17.3	0.24
Cr	42	17.5	15.3
Cu	42	129.1	16.3
Pb	42	635.2	11.6
Mn	42	512.9	336.0
Hg	38	1.43	0.08
Se	18	0.15	0.07
Ag	42	2.68	0.20
Tl	18	0.28	0.09
Zn	42	354.0	46.9

Note:

Data obtained from Table 5-1-2 in Hydrometrics (1990).

Table 2.5
Soil Metals Concentrations at the Facility (1987)

Metal	Sample Size	Geometric Mean Concentration from Facility (mg/kg dry weight)	Geometric Mean Concentration from Background Area (mg/kg dry weight) (n = 3)
Sb	25	193.6	0.27
As	26	2985.0	16.5
Cd	26	1127.0	0.24
Cr	26	23.77	15.3
Cu	26	8492.0	16.3
Pb	26	13,552.0	11.6
Mn	24	968.3	336.0
Hg	21	9.94	0.08
Se	26	49.09	0.07
Ag	26	122.2	0.20
Tl	26	52.97	0.09
Zn	26	16,033.0	46.9

Note:

Data obtained from Table 5-1-9 in Hydrometrics (1990).

The Surface Water investigation was conducted to measure flow/seepage, surface water quality, and metals in sediment. A summary of water quality is provided in Table 2.6. The investigation also measured surface water/groundwater interrelationships, and it included an evaluation of surface water uses and an evaluation of flux of contaminated soils entering Prickly Pear Creek during runoff events. Surface water was sampled from Prickly Pear Creek, Upper Lake, and irrigation ditches. Sediment was sampled from Prickly Pear Creek, Wilson Ditch, and Upper Lake (Table 2.7). Surface water/groundwater interrelationships were investigated *via* continuous water-level recorders installed in monitoring wells located at Prickly Pear Creek in a shallow aquifer and an intermediate aquifer, and in East Helena north of Highway 12. Surface water drainage on the site, in catchment basins, and offsite runoff areas were assessed to determine frequency of water retention and fate of runoff.

Table 2.6
Metals Concentrations in Surface Water from the East Helena Study Area

Metal	**Mean Concentrations in Surface Water (mg/L) (November 1984 to September 1985)**		
	Prickly Pear Creek	**Upper Lake**	**Wilson Ditch**
As (Total)	0.021	0.0136	0.019
As (Dissolved)	0.016	0.0098	0.012
Cd (Total)	0.001	0.002	0.0042
Cd (Dissolved)	0.005	0.0016	0.0016
Cu (Total)	0.0146	0.0116	0.023
Cu (Dissolved)	0.007	0.0087	<0.008
Fe (Total)	0.374	0.477	0.792
Fe (Dissolved)	0.067	0.171	0.076
Pb (Total)	0.022	0.03	0.093
Pb (Dissolved)	0.006	0.021	0.0078
Mn (Total)	0.112	0.141	0.186
Mn (Dissolved)	0.072	0.111	0.137
Zn (Total)	0.066	0.055	0.078
Zn (Dissolved)	0.36	0.037	0.029

Note:

Data obtained from Tables 5-2-8, 5-2-11, and Appendix 5-2-1 in Hydrometrics (1990).

Table 2.7
Metals Concentrations in Sediments from the East Helena Study Area

Metal	Mean Concentrations in Sediment (mg/kg dry weight)		
	Prickly Pear Creek (November 1984 and June 1985) (n = 14)	**Upper Lake (November 1984 and June 1985) (n = 2)**	**Wilson Ditch (December 1987) (n = 4)**
Sb	<10	<10	--
As	31.36	174	832
Ba	88.57	105	--
Cd	6.61	56.5	167
Cr	82.14	60	--
Co	<10	17	--
Cu	89.79	305	571
Fe	24,936	39,625	20,820
Pb	386	2,750	4,277
Mn	1,464	850	2,363
Hg	0.937	8.75	--
Ag	2.64	8.25	--
V	<100	<100	--
Zn	896	2,338	3,003

Note:

Data obtained from Tables 5-2-17, 5-2-18, and 5-2-19 in Hydrometrics (1990).

The Vegetation investigation was conducted to determine commercial and residential production and consumption patterns of food crops and garden vegetables and to determine metal concentrations in plant tissue. Arsenic, Cd, Hg, and Pb were found to be elevated in vegetable tissues (Hydrometrics, 1990).

The Cattle investigation was conducted to determine production and consumption patterns of locally grown beef and to determine metals concentrations in beef. Muscle tissue concentrations of As, Cd, Pb, and Zn were found to be within typical ranges of national data. Cadmium concentrations were found to be elevated in cattle tissues.

Fish were sampled from Prickly Pear Creek and Lake Helena and analyzed for metals. In Prickly Pear Creek, brook trout and rainbow trout were targeted, but only brown trout were captured. In Lake Helena, carp, brown trout, and rainbow trout were targeted. No carp were captured, but brook trout, brown trout, white sucker, and longnose sucker were sampled. Metal concentrations for fish collected from Prickly Pear Creek are summarized in Table 2.8.

Table 2.8
Metals Concentrations in Fish Tissue Collected from Prickly Pear Creek

Parameter	Brown Trout Fillet Concentrations (mg/kg dry weight) (Collected on 11/18/87)						
	Sample #60995	Sample #60997	Sample #60996	Sample #60998	Sample #60994	Sample #60999	Sample #61000
Length (mm)	331	220	436	361	359	362	468
Weight (g)	789	91	1116	413	494	310	272
As	0.15	0.84	0.09	0.09	0.10	0.05	0.05
Cd	0.10	0.12	0.10	0.09	0.13	0.18	0.18
Cu	--	--	--	--	--	4.58	0.98
Hg	0.05	0.05	0.05	0.07	0.05	0.10	0.10
Pb	0.94	0.46	0.59	0.11	0.46	0.27	0.35
Zn	16.00	19.00	12.30	9.80	20.80	72.8	20.6

Note:

Data obtained from Tables 5-5-1 and 5-5-2 in Hydrometrics (1990).

A biological inventory of Upper Lake was conducted to map wetlands and inventory wildlife species (Western Technology and Engineering, Inc., 1989; Hydrometrics, 1990). Seven visits were conducted from mid-March to early June 1989. The results of the inventory suggested that the Upper Lake site supports a good diversity of wildlife species (*i.e.*, 79-82 species for birds, mammals, and reptiles were observed). A literature review was conducted to determine potential exposure pathways for waterfowl. Exposure *via* surface water and sediment were the media considered. The ultimate goal of the assessment was to determine potential exposure of humans to metals in waterfowl, and it was suggested that the Upper Lake area did not support sufficient numbers of waterfowl for people to consume the amounts of As, Cd, Hg, or Pb needed to adversely affect health.

The final recommendations for remedial activities provided by Hydrometrics (1990) included the following:

- **Process Fluid Circuits**: Replacement of existing pressure lines, drains, and sumps with a new process water transportation network, including secondary containment and leak detection systems.
- **Groundwater**: Continued monitoring with implementation of process pond alternatives as described by Hydrometrics and Hunter/ESE (1989).
- **Plant Site Soils/Ore Storage Area**: Pavement to prevent migration of metals to groundwater and soil pH adjustment. Also construction of an ore storage area to reduce airborne particulates.

- **East Helena Residential Soils**: Pavement of exposed soils to reduce dust, and excavation of soils in vegetable and flower garden plots.
- **Helena Valley Soils**: Installation of fencing to prohibit access; public education.
- **Prickly Pear Creek**: No action. No significant impacts were identified except As loading from Lower Lake, which was addressed by the Process Ponds RI/FS (Hydrometrics and Hunter/ESE, 1989).
- **Wilson Ditch**: Backfilling 4,000 ft of the ditch below the plant and creation of an alternate creek diversion.
- **Vegetation**: Removal of soil from garden plots; public education.
- **Cattle**: Public education regarding elevated levels of Cd in kidney and liver.
- **Fish**: No action. Metal concentrations were considered generally low/typical for fish in Montana.
- **Waterfowl**: No action. Potential risk to human receptors was considered low.
- **Slag Pile**: No action. Slag was not found to significantly impact groundwater, surface water, or air quality.

2.2.6 Metal Residues in Sediment and Biota from Prickly Pear Creek and Lake Helena (1997)

The US Fish and Wildlife Service (US FWS) issued a 1997 report titled "Biological Indices of Lead Exposure in Relation to Heavy Metal Residues in Sediment and Biota from Prickly Pear Creek and Lake Helena, Montana" (US FWS, 1997). This report investigated metal exposure in benthic invertebrates and fish in Prickly Pear Creek, both upstream and downstream of the site, and in mallard ducks in Lake Helena (downstream of site) and Canyon Ferry Lake (a reference site). The study also measured metals in sediment in Prickly Pear Creek and found no significant difference in concentrations of As, Cd, Cu, Pb, or Zn in samples collected upstream and downstream of the site. These metals were elevated in the vicinity and immediately downstream of the site, however. Sediment concentrations are summarized in Table 2.9.

Table 2.9
Sediment Concentrations Measured in Prickly Pear Creek and Reference Sites

	Geometric Mean Sediment Concentrations (mg/kg dry weight)							
	Prickly Pear Creek				Reference Sites			
Metal	**Upper Prickly Pear Creek (1991-1992) (n = 3)**	**Lower Prickly Pear Creek (1991-1992) (n = 5)**	**Mouth/ Delta of Prickly Pear Creek (1987) (n = 3)**	**Mouth/ Delta of Prickly Pear Creek (1991) (n = 2)**	**Canyon Ferry (1987) (n = 3)**	**Canyon Ferry (1992) (n = 1)**	**Lake Helena (1987) (n = 4)**	**Lake Helena (1992) (n = 2)**
Al	5,993	2,910	19,100	1,290	23,400	7,080	6,590	5,590
As	11.71	18.19	66.1	11.7	5.1	4.93	6.0	5.48
Be	0.22	--	1.43	--	1.1	0.22	0.47	--
B	--	--	5.3	3.74	8.4	<5.05	2.2	--
Cd	0.73	1.97	9.2	--	0.3	<0.20	0.7	0.26
Cr	12.4	7.4	19	6.03	18.7	10.80	8.2	20.8
Cu	30.7	32.7	95	5.55	15	5.68	12.7	10.27
Fe	10,240	7,580	23,500	2,930	18,740	8,140	9,030	4,560
Pb	77.2	127	221	30.4	14	6.81	13	24.7
Mg	3,063	1,899	10,790	920	11,840	4,730	3,160	1,530
Mn	526	490	697	149	223	161	161	123
Hg	--	--	0.43	--	0.02	<0.10	0.03	--
Ni	5.76	--	12.5	--	12.2	7.99	4.5	--
Se	--	--	0.57	--	0.41	<0.50	0.16	--
Zn	268	370	854	73	57	58.3	65	226

Source: US FWS (1997)

Whole-body fish and benthic invertebrate samples were collected and analyzed, and concentrations of As, Cu, Pb, and Zn were found to be significantly higher downstream of the site in stonefly larvae (Table 2.10). Significant differences were not observed in miscellaneous benthic invertebrates, rainbow trout, brook trout, and sculpin, although concentrations from animals taken below the site were elevated compared to above the site. (It is important to note that, throughout the US FWS report, differences between upstream and downstream datasets that were determined to not be statistically significant were still described as "elevated.")

Table 2.10
Tissue Concentrations Measured in Invertebrates and Fish from Prickly Pear Creek

	Geometric Mean Tissue Concentrations (mg/kg dry weight)							
	Aquatic Invertebrates		Stonefly Larvae		Brook Trout		Rainbow Trout	
Metal	Upper PPC (n = 4)	Lower PPC (n = 6)	Upper PPC (n = 3)	Lower PPC (n = 4)	Upper PPC (n = 3)	Lower PPC (n = 3)	Upper PPC (n = 4)	Lower PPC (n = 5)
As	15.9	19.2	7.4	16.9	0.98	--	1.62	1.63
Cd	2.74	6.31	2.58	4.80	0.32	0.38	0.47	1.05
Cu	79.9	130.1	44.8	72.4	15.2	17.2	17.1	9.9
Pb	35.1	47.7	24.8	68.5	1.1	0.46	2.88	3.02
Zn	336	247	356	480	198	156	140	151

Source: US FWS (1997)

Blood lead levels (BLLs) were measured in mallard ducks captured from Lake Helena downstream of the Facility (0.8 μg/g dry weight) and Canyon Ferry Reservoir reference area (0.3-1.1 μg/g dry weight). Lead in Lake Helena mallard blood was reported to be significantly higher than in reference mallards in Canyon Ferry Lake, yet a significance level of $p = 0.11$ is reported. Typically, a p-value greater than 0.05 is not considered significant.

Blood lead concentrations from rainbow and brook trout sampled downstream of the site were higher than those sampled upstream of the site. Blood lead concentrations of mountain sucker were not significantly different upstream and downstream of the site, and blood lead concentrations overall were lower than those observed in trout.

Delta-amino levulinic acid dehydratase (ALA-D) enzyme activity, which is inhibited by Pb, and hemoglobin levels in mallard blood were both significantly higher in mallards from Canyon Ferry Lake (reference site) than in Lake Helena (downstream of the site). Zinc protoporphyrin (ZPP) activity, which is another measure of Pb impairment, did not differ significantly in mallard blood samples taken from Lake Helena and Canyon Ferry Lake. In rainbow trout, brook trout, and mountain sucker, ALA-D activities were not significantly different in upstream and downstream portions of Prickly Pear Creek. Hemoglobin in mountain sucker was significantly higher in fish sampled downstream of the site. There were no significant differences in hemoglobin for rainbow or brook trout. Although trout exhibited higher Pb burdens than mountain sucker, ALA-D activity indicated no impairment.

The study concluded that some metals were elevated below the site relative to reference conditions and that this was partially reflected in the biota. Recommendations were made to continue cleanup of the Corbin-Wickes historical mining district to reduce metals input into Prickly Pear Creek and Lake Helena, monitor aquatic biota to document Pb exposure, and further investigate sediments in Lake Helena and Prickly Pear Creek.

2.2.7 Supplemental Ecological Risk Assessment (2005)

The Supplemental Ecological Risk Assessment (ERA) (US EPA, 2005a) was conducted by US EPA Region 8 to address data gaps in the 1987 RI. Specifically, the Supplemental ERA sought to gather data on the habitat and chemical concentrations in the onsite lakes (Lower Lake and Upper Lake), Prickly Pear Creek, and the Marsh area, as well as reference sites, including Canyon Ferry Reservoir and Prickly Pear Creek upstream of the site.

Data that were used in the Supplemental ERA included surface water, sediment, sediment porewater, aquatic plants, aquatic invertebrates, and fish. Samples were analyzed for metals, sediment toxicity (10-day survival and growth test with the amphipod *Hyalella azteca*), and benthic macroinvertebrate community. The Supplemental ERA addressed exposure to fish, benthic invertebrates, terrestrial plants, terrestrial soil invertebrates, wildlife (birds and mammals), and livestock. The Supplemental ERA used data collected by US EPA in its 2003 field study for surface water, sediment, sediment toxicity, sediment porewater, benthic invertebrate tissue, benthic invertebrate community assemblage, fish tissue, and aquatic plants (Table 2.11). US EPA also used fish tissue and benthic invertebrate tissue data collected earlier by the US FWS (1997). The Supplemental ERA used data from seven benthic invertebrate tissue samples collected by US FWS and three collected by US EPA. For fish tissue, the Supplemental ERA used data from 15 samples collected by US FWS and eight samples collected by US EPA.

Table 2.11
Samples Collected During the US EPA 2003 Ecological Field Investigation

	Number of Samples[a]							
Location	Surface Water	Bulk Sediment	Sediment Porewater	Benthic Invertebrates	Aquatic Plants/ Algae	Fish	Sediment Toxicity Tests	Benthic Invertebrate Community
Lower Lake	3	3	1	0	0	0	1	0
Upper Lake/Marsh Area	12	12	5	2	6	7[b]	5	2
Canyon Ferry Reservoir (reference)	2	2	2	1	1	1	2	1
Prickly Pear Creek	5	5	5	0	0	0	0	5

Notes:

(a) Source: US EPA (2005a).

(b) Includes 1 forage fish composite, 1 rainbow trout whole body, 2 rainbow trout fillets, 1 rainbow trout liver, 1 rainbow trout kidney, and 2 rainbow trout stomach contents.

The risk assessment for aquatic receptors incorporated several lines of evidence and applied a Hazard Quotient (HQ) approach. The lines of evidence considered for aquatic receptors included analysis of metals in surface water, sediment and sediment porewater, site-specific sediment toxicity testing with benthic invertebrates, evaluation of fish exposure *via* ingestion of food and incidental ingestion of sediment, and evaluation of body burdens of aquatic organisms.

For aquatic receptors, it was found that the risk of population-level effects to fish and benthic invertebrates was:

- Moderately high for fish and high for benthic invertebrates in Lower Lake;
- Minimal to low for fish and low for benthic invertebrates in Upper Lake and the Marsh area; and
- Minimal for fish and minimal to low for benthic invertebrates in Prickly Pear Creek.

For wildlife receptors, the exposure pathways considered were ingestion of metals in surface water, soil or sediment, and food. Based on studies conducted at an unrelated smelter site in Montana (Anaconda Smelter Site, Deer Lodge County), it was determined that invertivorous song birds would be the primary terrestrial receptor of concern. Waterfowl, piscivorous birds, and piscivorous mammals were also evaluated. Concentrations of metals in surface water, sediment, soil, and some food items were measured; concentrations of metals in some food items were estimated (*e.g.*, in Prickly Pear Creek, concentrations in aquatic plants were assumed to be equal to those measured in benthic invertebrates).

Food-chain modeling and an HQ approach were used to characterize wildlife risks. Estimated risk from ingestion of surface water was below the level of concern at all exposure areas. For food and sediment ingestion pathways, As, Cd, Cu, Pb, Se, and Zn were identified as metals of concern for wildlife receptors.

To characterize risks for terrestrial receptors in offsite upland areas, the Supplemental ERA relied heavily on data for soils, small mammals, bird eggs, nestlings, and food items collected at the Anaconda Smelter site in Deer Lodge County, Montana, and it did not incorporate site-specific data. At the Anaconda site, the primary receptors of concern were identified as insectivorous passerines for exposure to Pb at soil concentrations greater than 650 mg/kg. The spatial distribution of soil Pb concentrations above 650 mg/kg at the East Helena site was evaluated, and it was found that elevated Pb concentrations extended about 1 mile east of the site, compared to ¼ to ½ mile west of the site. The Supplemental ERA concluded that passerine insectivores may be adversely affected in areas close to the East Helena Facility where soil Pb concentrations exceed 650 mg/kg, assuming that exposure and toxicity are similar to the Anaconda site.

US EPA (2010a) cautioned against citing the 2005 Supplemental ERA study as a definitive representation of ecological risks due a number of data quality issues including, but not limited to, lack of UCLs on the means to evaluate exposure, lack of biota samples for some of the exposure areas, widely varying assumptions regarding metal bioavailability, and detection limits that were too high in some cases to evaluate potential risks. Further, a number of toxicity values used have been superseded by more recent values.

2.2.8 Phase I RCRA Facility Investigation Site Characterization Report East Helena Facility (2005) and Phase II RCRA Facility Investigation Site Characterization Work Plan East Helena Facility (2010)

As part of site investigations, RFI Work Plans (Phase I and Phase II) were developed for the East Helena facility (ACI, 2005; Hydrometrics, 2000, 2010). The goal of the RFI is to investigate the remaining elements of the site that are necessary to develop alternative corrective measures and that have not been addresses in previous investigations. During the Phase I, RFI soil sampling was conducted for the following areas:

- The former Lower Ore Storage Area in the western portion of the plant site (potentially impacted from ore and concentrate stored in the area prior to 1989);
- The former Upper Ore Storage Area in the area between Upper and Lower Lakes;
- Tito Park in the southeast portion of the plant site (potentially impacted from ore and concentrate stored in the area prior to 1989);
- Rail Corridor Areas;
- Miscellaneous unpaved areas within the plant site boundary; and
- Unpaved areas adjacent to the plant site boundary.

Under the Phase I RFI Work Plan, a total of 664 soil samples from 111 sampling locations were collected; summary statistics are shown in Table 2.12. In addition, results of soil leaching analyses showed As leachate concentrations were < 5.0 mg/L, with the highest test result for As being 0.22 mg/L. Five test results from samples from Rail Corridor Areas showed Cd leachate concentrations above 1.0 mg/L, with the highest test result being 9.8 mg/L. Groundwater modeling results showed the potential for groundwater quality impacts from surface soils is low (ACI, 2005).

Table 2.12
Phase I RFI Surface Soil Summary Statistics

	Soil Concentration (mg/kg-dry weight)									
	As		**Cd**		**Cu**		**Pb**		**Zn**	
Area	**Median**	**90th %**	**Median**	**90th %**	**Median**	**90th %**	**Median**	**90th %**	**Median**	**90th %**
Lower Ore Storage	197	1,496	38	646	401	2,461	2,277	13,093	2,576	12,258
Upper Ore Storage	962	3,180	353	1,310	2,003	5,307	11,531	25,887	5,757	13,210
Rail Corridor	526	3,511	276	1,646	1,368	9,166	6,700	39,780	8,750	25,446
Unpaved Plant Site	244	1,897	77	613	701	4,292	2,724	19,720	1,873	20,516
Unpaved Off-Plant	41	259	10	81	112	904	307	2,473	290	1,970

Surface water monitoring was conducted in Prickly Pear Creek, Upper and Lower Lake, and Wilson Ditch to evaluate the effectiveness of corrective measures implemented on Lower Lake and to evaluate any effects to Prickly Pear Creek water quality. Prickly Pear Creek water quality upstream of the Facility is generally good, but it has historically contained elevated concentrations of As and other metals as a result of upstream mining and land disturbances. Historically, Prickly Pear Creek has shown a minor As concentration increase as it flowed past Lower Lake and the increase has been attributed to elevated As concentrations in Lower Lake. Remedial actions implemented during the 1990s, including plant water treatment and Lower Lake sediment removal, have resulted in significantly lower As concentrations in Lower Lake. As a result, Prickly Pear Creek As concentrations at and downstream of the plant have also dropped in recent years and are now considered similar to upstream concentrations.

Overall objectives of the Phase II RFI site characterization (Hydrometrics, 2010) include:

- Defining current site conditions in terms of the magnitude and extent of metals-impacted soils, accounting for past and ongoing site remediation activities;
- Identifying and delineating source area(s) for the As and Se groundwater plumes;
- Evaluating the fate and transport of As and Se in the subsurface and the current status and predicted future behavior of the groundwater plumes;
- Conducting a preliminary assessment of groundwater containment/treatment alternatives to control groundwater plume migration; and
- Providing information and data required for completion of the human health and ecological risk assessment portions of the Phase II RFI and RCRA Corrective Measures Study.

Phase II RFI investigations were conducted concurrent with BERA investigations as described in Section 2.2.9.

2.2.9 Baseline Ecological Risk Assessment Work Plan and Ecological Site Investigation (2010)

Following a review of existing data, a BERA Work Plan was developed in coordination with the Custodial Trust, US EPA, and federal and state beneficiaries (Gradient, 2010; US EPA, 2010a). Several data gaps were identified in this Work Plan and these are summarized below:

- Present-day habitat descriptions, including current observations of species that are present, were not available for the site;

- Previous investigation did not analyze for the complete list of 19 metals (Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg [and MeHg], Ni, Se, Ag, Tl, V, and Zn);
- In some of the previous studies, including the Supplemental ERA (US EPA, 2005a), detection limits were not sufficiently low to adequately characterize ecological exposure and risk;
- Previous investigations did not adequately characterize all relevant exposure areas; and
- No sediment toxicity testing was conducted in Prickly Pear Creek.

Therefore, key objectives of the 2010 Ecological Site Investigation (Gradient, 2010) were to evaluate existing habitats and ecological conditions at the site, collect chemistry data for the full list of metals from abiotic and biotic media in areas likely to be inhabited by ecological receptors, and collect sediment samples from Prickly Pear Creek for toxicity testing. The targeted sampling areas included Prickly Pear Creek (upstream, downstream, and adjacent to the Facility), Prickly Pear Creek riparian zone, Upper Lake, Upper Lake Marsh, Lower Lake, Tito Park (upland area between Upper and Lower Lake), Wilson Ditch, and upland areas around the perimeter of the Facility (Map 2). The targeted sample matrices included surface water, sediment, soil, benthic and other aquatic invertebrate tissues, fish tissues (*i.e.*, forage, piscivorous, and game fish), amphibian tissues, and soil invertebrate tissues. The 19 metals (as described above) were analyzed in all matrices, and a subset of samples were analyzed for MeHg. Conventional parameters (*e.g.*, pH, total organic carbon [TOC], grain size, dissolved oxygen, *etc.*) were assessed in the relevant matrices. In addition, acid volatile sulfide (AVS) and simultaneously-extracted metals (SEMs) were analyzed in sediment samples to aid in the evaluation of toxicity to benthic invertebrates. Finally, a standard 10-day toxicity assay with either *Hyalella azteca* or *Chironomus dilutus* was performed using sediments collected from Prickly Pear Creek. A field investigation report describing the 2010 activities is provided in Appendix A. A summary of the number of samples collected during this investigation is presented in Table 2.13 and the locations of the samples are presented on Map 4. The results of the 2010 Ecological Site Investigation (Gradient, 2010) are described further and data are analyzed in the remaining sections of this BERA.

Table 2.13
Summary of Samples Collected During the 2010 Ecological Investigation

Matrix	**Prickly Pear Creek Upstream**[a]	**Prickly Pear Creek (adjacent/ downstream to site)**	**Upper Lake Marsh**	**Upper Lake**	**Lower Lake**	**Wilson Ditch**	**Walker Creek**[a] **(Pond/Marsh)**	**Tito Park**	**Site Perimeter**
Sediment	8	8	9	5	5	5	10	-	-
AVS/SEM	5	6	5	5	5	1	10	-	-
Sediment Toxicity Tests (10-day w/ *H. azteca* and *C. dilutus*)	4	6	-	-	-	-	-	-	-
Soil	-	4	-	4	4	-	5	5	13 [c]
Surface Water	8	7	9	5	5	5	11	-	-
Benthic Invertebrates	5	6	5	5	5	1	10	-	-
Other Aquatic Invertebrates	-	3	3	3	3	1	-	-	-
Forage Fish	-	3	4	5	3	1	-	-	-
Piscivorous Fish	-	5	-	10	-	-	-	-	-
Game Fish (fillet)	6	5	-	5	-	-	5	-	-
Amphibians	-	-	4 [b]	-	-	-	1	-	-
Earthworms	-	2	4 [d]	-	-	-	6	-	-
Terrestrial Invertebrates	-	2	-	1	2	-	-	2	4

Notes:

(a) Prickly Pear Creek upstream and Walker Creek areas were selected as reference sites.
(b) Amphibian samples were collected in the area between Prickly Pear Creek and Upper Lake Marsh.
(c) Includes soil samples from site perimeter, lower ore storage area, and unpaved areas.
(d) Earthworm samples collected near the diversion of Prickly Pear Creek in a riparian area.

2.3 Remedial Activities

A number of remedial activities have occurred at the Facility and these are summarized below by operable unit. Remedial activities have been discussed in previous documents (ACI, 2005; Hydrometrics, 1990; 2010).

Surface Soils and Ore Storage Unit

- **1989:** Construction of new ore storage building. Shallow soils removed and stored in Lower Ore Storage Area, deeper soils consolidated in berm along southeast corner of the storage yard.
- **May 1990:** New ore storage building began operation.
- **November 1992:** Monitoring well DH-8 in Lower Ore Storage Area is damaged.
- **October 1997:** Geomembrane cover is installed over stockpiled Lower Lake sediments as a temporary cover.

Smelter Stacks

- **2009:** Three process unit smelter stacks demolished.

Lower Lake

- **October-December 1989**: Bench-scale testing for the treatment of Lower Lake water.
- **1990**: Regular direct discharge of plant water to Lower Lake discontinued following installation of storage tanks. Occasional discharge of excess water from tanks to Lower Lake.
- **January-September 1990**: Pilot scale testing for *in-situ* treatment of Lower Lake water.
- **October 1991**: Bottom sediment core samples collected from Lower Lake.
- **April 1992**: Additional bottom sediment core samples collected from Lower Lake.
- **April 1993**: Construction of high-density sludge water-treatment plant started.
- **May 1993**: Acid plant reclaim water is discharged to Lower Lake during interim period prior to high density sludge (HDS) plant start-up.
- **August 1993**: Lab testing of Lower Lake sediment dewatering is completed.
- **November 1993**: Large-scale dredging and dewatering pilot testing of Lower Lake sediments.

- **January 1994**: High-density sludge water-treatment plant comes on-line. All untreated plant water discharges to Lower Lake cease.
- **May 1994**: Dredging of Lower Lake sediments begins.
- **November 1994**: Winter shutdown of Lower Lake dredging.
- **April 1995**: Spring startup of Lower Lake dredging.
- **November 1995**: Winter shutdown of Lower Lake dredging.
- **June 1996**: Spring startup of Lower Lake dredging.
- **August 1996**: Lower Lake dredging completed.
- **October 1996**: Start of HDS Treatment Plant optimization improvements.
- **November 1996**: MPDES permit issued for HDS plant discharge.
- **March 1997**: HDS treatment plant optimization improvements completed.
- **November 1997**: Modified Montana Pollutant Discharge Elimination System (MPDES) permit issued for HDS plant discharge, with final limits established for Pb, Hg, T1, and Sb (limits become effective in 1998 and 1999).
- **March 1998**: Zeolite pilot test for Tl removal in HDS effluent completed. Unsuccessful removal.
- **April 1998**: ASARCO contacts Montana Department of Environmental Quality (MDEQ) concerning final MPDES limits. MDEQ grants ASARCO six months of feasibility testing for technology to remove T1 and Sb.

Former Thornock Lake

- **October 1986**: Thornock Lake replaced with 93,000 gallon steel tank.
- **1986-1987**: Soil excavated from Thornock Lake Area.
- **November 1991**: Additional excavation of soils from former Thornock Lake Area. 407 cubic yards of excavated soils smelted.

Former Speiss Settling Pond and Granulating Pit

- **Fall 1988**: Speiss Pond lined with high-density polyethylene.
- **1989**: Constructed new Speiss settling tank with secondary leak detection to replace Speiss Pond. Soils excavated to 20 ft under portion of former Speiss Pond. 2,500 cubic yards of excavated soil stockpiled in the outside ore storage yard area for future smelting.
- **April 1991**: Water granulation of Speiss replaced with air granulation.
- **October 1992**: Completed Speiss pond remediation consisting of demolition of remaining pond and adjacent soil removal. Exposed leaking plant water drain line south of Speiss pit during remediation. Drain line temporarily repaired.

- **April 1993**: Additional temporary repairs to drain line south of Speiss pit.
- **May 1993**: Placement of new drain lines in Speiss pit Area. Plant water drain line south of Speiss pit permanently repaired.
- **August 1993**: Concrete cap poured over backfill material in former Speiss pond area.
- **June-July 1995**: Construction of new Dross Reverberatory Furnace building and Speiss Granulating pit.
- **July 1995**: Old Speiss pit removed. Soil excavated beneath pit to 17-ft depth (235 cubic yards removed).
- **August 1995**: Concrete cap placed over backfilled Speiss pit area.
- **2007**: Construct slurry wall and temporary cap around Speiss-dross plant subsurface soils.

Acid Plant Water

- **April 1991**: Eliminated wooden trough fluid transport system and settling dumpsters, reducing water losses. Settling pond remained in service.
- **November 1992**: Completed acid plant; water reclamation facility goes on-line.
- **February 1993**: Acid plant settling pond demolished.
- **May 1993**: Soil excavation and backfill of acid settling ponds completed.
- **February 1997**: 1,200 gallons sulfuric acid spilled at acid plant decolorization building.
- **February 15, 1997**: 20 gallons of scrubber blowdown water discharged from open packed scrubber pray tower. 10 gallons released to the environment.
- **September 1997**: Scrubber sump at acid plant re-bricked and secondary containment installed around scrubber complex.
- **November 30, 1997**: Sulfur trioxide emission release.
- **January 5, 1998**: 450 gallons of acid plant scrubber/blowdown water released in acid plant scrubber area.
- **January 27, 1998**: 500 gallons of sulfuric acid released immediately west of acid plant decolorization building.
- **January 28, 1998**: 300 gallons of sulfuric acid released to soil adjacent to sump.
- **April 21, 1998**: 400 gallons of sulfuric acid released from broken acid plant transfer line.
- **June 2, 1998**: 100-200 gallons of acid plant scrubber water released from acid plant water treatment area.
- **August 13, 1998**: 1,500 gallons of acid plant cooling water released from underground pipe leak.
- **September 23, 1998**: 10 gallons of sulfuric acid released from acid plant decolorization building.

- **October 3, 1998**: 30-50 gallons of sulfuric acid released from acid plant pump tank building.
- **October 8, 1998**: 30 gallons of sulfuric acid released from acid plant tail gas stack base.
- **October 12-13, 1998**: 5.1 and 10.4 pounds of As released to Lower Lake from the HDS water treatment plant.
- **November 20, 1998**: 200-300 gallons of sodium bisulfite solution discharged from the acid plant boiler room.
- **December 13, 1998**: 50-75 gallons of sulfuric acid discharged to acid decolorization containment area. No acid was released to the environment.
- **December 29, 1998**: 1,000 gallons of sulfuric acid released from broken acid transfer line.

Acid Plant Sediment Drying Area

- **1977-July 1991**: Acid plant sludge (sediments) sent to sediment drying pad for dewatering.
- **1988-89**: Soil samples collected from backhoe pits in area between Upper and Lower Lakes and east of acid plant sediment drying (APSD) pad.
- **December 1990**: Monitoring well DH-29 found buried in acid plant sludge during post-RI monitoring.
- **July 1991**: Acid plant sediments removed from former sediment drying pad between Upper and Lower Lakes. Dried acid plant sludge placed near acid plant water treatment facility.
- **November 1992**: Practice of placing acid plants sediments on outside drying pad discontinued following completion of acid plant water reclamation facility.
- **September 1993**: Former acid plant drying pad sealed.
- **1994**: A belt filter press set up in former APSD area to dewater dredged Lower Lake sediments. Dewatered sediments hauled to lower ore storage yard for temporary storage.
- **1995**: Belt filter used to dewater dredged Lower Lake sediments in sediment drying area. Dewatered sediments stockpiled in lower ore storage yard.
- **1996**: Dewatering of dredged Lower Lake sediments completed. Demobilization of belt filter presses and related equipment from area.
- **August-September 1996**: Shallow bore holes drilled and soil samples collected from beneath former sediment drying pad.
- **2001**: Soil stockpile and debris piles removed and placed in the Corrective Action Management Unit (CAMU) cover area between Upper and Lower Lake with 12-inch clay soil cover, grade, and compact.
- **2006**: Slurry wall and temporary cap constructed around acid plant subsurface soils.

Plant Water Circuit

- **1988**: Plant water-balance study initiated as part of RI/FS.
- **1989**: Plant water-balance study indicates extraneous water gains.
- **1990**: Installation of two, 1-million gallon plant water storage tanks.
- **April 1991**: Additional process water gains occur as a result of remediation activities at acid plant facility.
- **December 1991**: Reduction in plant circuit gains. Repaired and replaced pipes, reduced bleeder valves. New plant water balance study indicates net gain of about 40 GPM.
- **May 1993**: New plant water drain lines and wet well installed in Speiss pit area.
- **December 1997**: Water-proofing begins on plant water pump house to reduce groundwater inflow.
- **January 1998**: Water-proofing is completed on plant water pumphouse.
- **February 1998**: Loss in plant underground circuit. Pressurized underground piping replaced with above-ground system.
- **November 1998**: 10 gallons of plant water released from broken pipe by powerhouse.

Surface Water

- **1996**: Switch to use of Upper Lake water rather than Lower Lake water for dust control.
- **May-June 1997**: Wilson Ditch rerouted around plant site.
- **June-December 1997**: Plant stormwater system improvements are constructed.

2.4 Environmental Setting

The Facility is located in the Helena Valley in west central Montana (Map 1). The physical and ecological attributes of the Facility have been described in several investigational documents as part of ongoing site investigations (ACI, 2005; CH2MHill 1987a; Hydrometrics and Hunter/ESE, 1989; Hydrometrics, 2010; US FWS, 1997; US EPA, 2005a; Western Technology and Engineering, Inc., 1989; GEI and Gradient, 2010). The following sections provide a description of the climate, geology, hydrogeology, and ecological resources summarized from these sources.

2.4.1 Climate

The climate of Helena Valley and the East Helena area is described as modified continental. Seasons consist of cold winters, warm summers with thunderstorm activity, and a wet spring. Average minimum and maximum temperatures range from 48-83 F° in summer (June, July, August), 23-70 F° in fall (September, October, November), 11-35 F° in winter (December, January, February), and 23-65 F° in spring (March, April, May) (WRCC, 2010). The typical annual precipitation is 11.85 inches and most precipitation occurs from April through September (0.98-2.11 inches total per month) (WRCC, 2010). Average total snowfall is 49.7 inches, which occurs primarily in November through March (6.5-8.8 total inches per month) (WRCC, 2010). The surrounding mountains shelter Helena Valley from winds. The predominate average annual wind direction and speed (measured at the Helena Regional Airport) is from west to east at approximately 7 mph.

2.4.2 Geology

The Facility and the East Helena community are underlain by unconsolidated alluvium deposited by ancestral Prickly Pear Creek. The alluvial deposits are highly variable in composition, containing mixtures of cobbles, gravel, sand, silt, and clay within this unit (CH2MHill 1987a; Hydrometrics and Hunter/ESE, 1989). Underlying the alluvium are fine-grained Tertiary volcanic ash tuff deposits (CH2MHill 1987a; Hydrometrics and Hunter/ESE, 1989). These tuff deposits have low permeabilities and have weathered to a fine clay in some locations. The silt and clay soils are moderately calcerous and have little organic matter. Grassland soils in the valley are alluvial mollisols, inceptisols, and enticols. The hills and mountains of Helena Valley are comprised of folded and faulted sedimentary, metamorphic, and igneous rocks. There are numerous faults Helena Valley and it is an active seismic area (CH2MHill, 1987a; Hydrometrics and Hunter/ESE, 1989).

2.4.3 Hydrogeology

Groundwater is present in the unconsolidated Quaternary deposits throughout most of the site with the exception of the western edge where the Tertiary ash deposits form a shallow ridge (Hydrometrics, 2010). A perched groundwater system is also found in surficial slag/fill deposits on portions of the site where the slag and fill are underlain by relatively low permeability marsh deposits. The depth to groundwater in the vicinity of the Facility ranges from 10-60 ft, becoming deeper to the north and in areas away from Prickly Pear Creek (Hydrometrics, 2010). The groundwater flow direction is to the north and northwest (Hydrometrics, 2010). Site groundwater receives recharge from Upper Lake and Lower Lake in the plant area and from Prickly Pear Creek in the area immediately downstream of the plant site. Groundwater investigations have been documented elsewhere in the BERA (ACI, 2005; Hydrometrics, 2010) and the primary findings are as follows:

- The primary aquifer on and downgradient of the Facility is an unconfined to semiconfined aquifer occupying unconsolidated alluvial/colluvial sediments.
- The majority of the Facility is underlain by a single sand and gravel aquifer with the aquifer base defined by a low permeability silt/clay layer.
- In the northern portion of the Facility, the aquifer becomes thicker with discontinuous fine-grained (silt) lenses occurring within the primary upper aquifer.
- In previous investigations (ACI, 2005), the upper aquifer was divided into a shallow aquifer and deeper "intermediate" aquifer based on the presence of these fine-grained lenses.
- Groundwater flows in a north to northwest direction from the Facility toward and west of East Helena.
- Primary sources of groundwater recharge include seepage from Upper Lake on the Facility and seepage from Prickly Pear Creek north of the Facility. Other sources of recharge include precipitation recharge and groundwater inflow to the alluvial/colluvial aquifer from the surrounding foothills comprised of finer-grained tertiary sediments.
- Monitoring results have detected elevated As concentrations in the shallow aquifer, with the mapped plume trending from the Facility to the north and northwest. Previously identified As source areas include Lower Lake and the Speiss-Dross Plant Area, Former Acid Plant, and APSD areas. All of these source areas have been the focus of extensive remediation efforts, including the recent (2006/07) encapsulation of contaminated soils in the Speiss-Dross and APSD areas within slurry walls (keyed into the underlying silt/clay layer) and temporary caps.
- In the past few years, elevated concentrations of Se have also been detected in the shallow aquifer extending from the Facility to the north and northwest.

2.4.4 Ecological Resources

The Facility is located primarily on the Prickly Pear Creek alluvial plain and is bounded to the south by Upper Lake, Upper Lake Marsh, and Lower Lake, to the east and northeast by Prickly Pear Creek, and on the west and southwest by uplands or foothills (Map 2). The Prickly Pear Creek watershed is part of the Missouri River basin. Prickly Pear Creek flows along the east and northeast boundaries of the study area from its headwaters in the Elkhorn and Boulder Mountains (about 30 miles south and west of the site) northward to Lake Helena (approximately seven miles north of the Facility) (US FWS, 1997; Hydrometrics, 2010). Prickly Pear Creek has been impacted by historical mining activities (upstream of and not associated with the Facility) resulting in elevated concentrations of some metals in stream water and sediments upgradient from the Facility as documented in other investigations (MDEQ, 2006; US EPA, 1985a; US FWS, 1997). Further details on the areas and habitats that are the focus of the BERA are presented below.

Prickly Pear Creek (Includes Stream Reference Area)

Prickly Pear Creek flows along the eastern Facility boundary, north toward the town of East Helena (refer to Maps 1 and 2). Base flow in Prickly Pear Creek is typically 25-30 cubic ft per second (cfs). Peak flows near the site during spring and early summer runoff have ranged from near 50 to greater than 300 cfs. In general, Prickly Pear Creek is characterized by alkaline pH (average pH values for individual water quality monitoring stations range from 6.8-8.2) and moderately low concentrations of dissolved solids (average total dissolved solids [TDS] ranges from 158 to 192 mg/L).

Synoptic streamflow measurements have been recorded seasonally in Prickly Pear Creek over the past several years. Streamflow data from these sites indicate that rates of groundwater recharge to the creek (or creek losses to groundwater) are small in comparison to the overall streamflow rates. Similar to the streamflow data, the surface water and groundwater quality data suggest that any influence of groundwater on the creek water quality is subtle.

Prickly Pear Creek has been a source of water for agriculture, mining, and industrial use for more than a century (ASI, 2005), and its water quality is monitored regularly as part of the site's Comprehensive Post-RI/FS monitoring program. According to the Comprehensive RI/FS (Hydrometrics, 1990), the creek is influenced by acid mine drainage in mining areas toward its headwaters and by railroad and highway construction, residential subdivision development, agricultural diversion and dewatering, and municipal and industrial discharges. From July through September, Lower Prickly Pear Creek downstream of East Helena is severely dewatered by irrigation demands, and, during this time, it often becomes nearly or completely dry. The creek supports a trout fishery upstream of East Helena, but summer dewatering and sewage treatment effluents severely limit the creek's ability to support trout downstream of East Helena.

Figure 2.3
Prickly Pear Creek Adjacent to the Facility

The creek suffers numerous water quality impairments due to metals, sediment loads, nutrients, high temperatures, and lack of instream flow. Prickly Pear Creek is listed as chronically dewatered by the Montana Department of Fish, Wildlife and Parks (MFWP), and the MDEQ has issued numerous Total Maximum Daily Loads (TMDLs) or beneficial use impairments for the stream (Montana Water Trust, 2008).

Data on TMDLs and designated uses of Prickly Pear Creek were obtained from US EPA's Water Quality Assessment and TMDL information website. The overall status of Prickly Pear Creek is listed as "Impaired" as of reporting year 2006. Designated use groups with impaired status for the creek are listed as agricultural, aquatic life, cold water fishery, drinking water, industrial, primary contact recreation, and warm water fishery. The causes of impairment in Prickly Pear Creek are listed as alteration of riparian vegetation, ammonia inputs, metals, low-flow alterations, nutrient inputs, substrate alterations, sedimentation, and temperature impacts. US EPA's Water Quality Assessment listed sources that are likely contributing to impairment in the creek, including acid mine drainage and impacts from abandoned mine lands, sediment contamination due to legacy/historical pollutants, grazing in riparian zones, habitat modification, irrigation demands, and municipal treatment systems.

Seepage from Lower Lake *via* groundwater historically contributed to increased metals concentrations in the creek adjacent to the Facility. Although the Prickly Pear Creek channel is immediately adjacent to the Slag Pile, and erosion of slag is possible during extremely high flow events, long-term monitoring has not indicated measurable impacts on water quality over this reach due to the presence of the Slag Pile. The Comprehensive RI/FS (Hydrometrics, 1990) concluded that the only measurable impacts from the site to Prickly Pear Creek water quality were from seepage from Lower Lake.

Figure 2.4
Impounded Area of Prickly Pear Creek
East of Lower Lake

Habitat characterizations of Prickly Pear Creek upstream of and adjacent to the Facility have been conducted for ongoing site investigations (Western Technology and Engineering, Inc., 1989; US EPA, 2005a; GEI and Gradient, 2010). The most recent habitat examination was conducted as part of the 2010 ecological investigation supporting the BERA; a copy is provided in Appendix A. In 2010, a survey (see Appendix A for a copy of the field report) of Prickly Pear Creek adjacent to the Facility identified six different habitat types present in this reach (runs, low gradient riffle, high gradient riffle, scour middle artificial, damned main artificial, and bridge/dam outfall). Three of these habitat areas are associated with the damned area and bridge east of Lower Lake (Map 2). Stream widths varied widely throughout the reach (6-37 m), with the narrowest portions associated with the riffle habitats, intermediate portions associated with the run habitats, and widest portions associated with the areas adjacent to the dam. Average stream depths ranged from 40-65 cm with a maximum > 150 cm.

The predominant bank cover type present along Prickly Pear Creak includes willow, sedges, grasses, trees, gravels, cobbles, and boulders. Substrates above the dam were dominated by cobble while those below were dominated by sand. Percent fines by grid measurements followed the same trend, decreasing from a maximum of 31% to a minimum of 3% upstream of the dam, and increasing from 98% to 100% below the dam.

Terrestrial habitat features were also evaluated in the riparian area surrounding Prickly Pear Creek adjacent to the Facility. The areas east of the Slag Pile, Lower Lake, and Upper Lake are heavily disturbed. Average vegetation height was greater than 1 m and was dominated by a moderately-diverse assemblage of shrubs (*i.e.*, greater than 50%), though some grasses were also present as were a few scattered trees.

Prickly Pear Creek upstream of the Facility (south) was used as a stream reference area for the BERA. The 2010 ecological field investigation collected habitat and chemistry data from several locations along the upstream stretch of the creek (locations shown on Map 4; photographs in Appendix A). Two different habitat types were present in this reach: four runs, and two low gradient riffles. Stream widths were consistent throughout the reach, with both the average wetted (7-8 m) and bank widths (11-12 m) only varying by 1 m across the two habitat types. Average depths

Figure 2.5
Prickly Pear Creek Upstream of East Helena Facility

were 37-50 cm with a maximum depth of 78 cm. Eroding banks (3-9 m) were observed in the majority of the habitat units. The predominant bank vegetation type present along the upstream portions of Prickly Pear Creek was trees and grasses. Substrates were overwhelmingly sandy, with some areas of cobble and gravel. Percent fines varied between 14-40% fines by grid.

Terrestrial vegetation along the upstream portion of Prickly Pear Creek included trees, shrubs, and grasses. Average vegetation height was greater than 1 m in the immediate riparian zone where riparian trees and shrubs extended approximately 20 ft up the bank. Beyond this zone, herbaceous vegetation and grasses ranging from 0.15-1 m in height were present. A moderate diversity of five to 15 common plants was observed, though greater than 50% was shrubland in the riparian area immediately adjacent to the Creek.

Upper Lake Marsh

Upper Lake and its associated marsh lie at the southern end of the property (Map 2) and cover approximately 50 acres. The marsh is fed through a diversion of flow from Prickly Pear Creek. In general, the emergent marsh area is covered with water ranging from a few inches to 2 ft deep. The sediment in the marsh is reported to be anaerobic, which would be typical for this type of environment (US EPA, 2005a). From general observations made during the September 2008 site visit, the sediment in the lake appears to be fine-grained and mucky, and the lake supports emergent and submerged aquatic vegetation (Gradient, 2010).

The Upper Lake Marsh is comprised of two habitat zones: predominantly palustrine wetlands and forested stands along the diversion from Prickly Pear Creek (Western Technology and Engineering, Inc., 1989; GEI and Gradient, 2010). The riparian zone in the forested area has deciduous vegetation in the understory, sparse trees of mixed sizes, and only sparse or moderate quantities of woody shrubs and saplings and tall herbs, forbs, and grasses (Appendix A). Ground cover in the palustrine areas are heavily comprised of inundated vegetation, though sparse woody shrubs and seedlings, herbs, forbs, and grasses are also present. The shoreline substrate is

Figure 2.6
Upper Lake Marsh

heavily vegetated, though moderate amounts of fine soil/sediment are also present. The angle of the bank around the perimeter of the marsh is ≤ 30°. All marsh habitats consisted of a plant assemblage with low diversity including mostly cattails, plus one to two other shrub species and a few scattered trees. Correspondingly, average vegetation height was over 1 m.

The littoral zone bottom substrate is dominated by silt clay/muck materials, though at some sites sparse to moderate quantities of sand and woody debris can be found (Appendix A). Upper Lake Marsh substrates are black in color and have an anoxic odor. A sparse to moderate amount of submergent and floating macrophytes is present throughout. Sparse or moderate to very heavy density fish cover is present in the forms of aquatic weeds, snags, brush or woody debris, and overhanging vegetation. Finally, fish habitat includes both human and natural features, consisting of both open and covered areas made up of vegetated and/or mixed structures.

Upper Lake

Upper Lake is located at the extreme southern (hydrologically upgradient) end of the Facility (Map 2) and is fed through diversion of flow from Prickly Pear Creek. Upper Lake discharges *via* return flow to the creek, seasonal discharge to the Wilson irrigation ditch, and through subsurface leakage to the local groundwater system. Upper Lake has been identified as a significant source of recharge to the groundwater system underlying the Facility. Data from the Comprehensive RI/FS (Hydrometrics, 1990) showed that water quality in Upper Lake was essentially the same as Prickly Pear Creek upstream of the Facility. As noted in the Comprehensive RI/FS, historical mining impacts are well documented and are a major source of metals to Prickly Pear Creek. Elevated concentrations of metals occur in Upper Lake sediments, with higher concentrations than those in Prickly Pear Creek both upstream and downstream of the site.

Figure 2.7
Upper Lake Facing Southwest

Figure 2.8
Upper Lake Facing North

The open water portion of upper lake covers approximately 20 acres and depths range from 5-12 ft (Hydrometrics, 2010; Western Technology and Engineering, Inc., 1989; US EPA, 2005a). Habitat characterization was conducted in 1989 (Western Technology and Engineering, Inc., 1989) and in 2010 (see Appendix A for field report). The edges of the Upper Lake can be characterized as palustrine wetlands with an unconsolidated muddy bottom or aquatic bed with rooted vegetation (Western Technology and Engineering, Inc., 1989). The investigation in 2010 identified that the riparian zone had either deciduous vegetation or no vegetation at all in both the canopy layer and understory. Where vegetation was present, the canopy layer included a sparse number of trees with a diameter at breast height (DBH) ≤ 0.3 m, whereas trees with a DBH greater than or equal to 0.3 m were absent. The understory consisted entirely of woody shrubs and saplings; tall herbs, forbs, and grasses were absent. Ground cover was generally barren, though sparse herbs, forbs, grasses and woody shrubs and seedlings were observed at some Upper Lake areas. Inundated vegetation was observed to a moderate extent throughout the Upper Lake.

The shoreline substrate zone is predominantly fine soil/sediment and/or loose sand, though cobble/gravel and vegetated portions of the shoreline were also observed. The angle of the bank around the perimeter was steep (*i.e.*, between 30° and 75°) at all sites. The littoral zone bottom substrate is dominated by silt clay/muck materials, though at some sites sparse and/or moderate quantities of cobble, gravel, sand, and/or woody debris were also observed. Upper Lake substrates are black in color and have an anoxic odor. A heavy to very heavy amount of submergent and a sparse amount of floating macrophytes were observed throughout the Lake. Sparse or moderate to very heavy density fish cover was present in the forms of aquatic weeds, brush or woody debris, overhanging vegetation, and human structures. Finally, fish habitat included both human and natural features consisting of covered areas made up of vegetated structures.

The Upper Lake bank vegetation was (on average) greater than 1 m. Upland plant assemblages surrounding the lake were dominated by grasses and shrubs (*i.e.*, willows), while riparian plants included mostly cattails. Among these plants was a moderate diversity of five to 15 common species with 15-50% being shrubs and only a few scattered trees. Human influences are also apparent on the banks in the form of buildings, commercial facilities, walls/dikes/revetments, litter/trash dumps/landfills, roads/railroads, and pastures/hayfields.

Wilson Ditch

Wilson Ditch is an agricultural irrigation ditch extending from Upper Lake northwestward towards the Helena Valley (Map 2). Wilson Ditch is used to convey irrigation and stock water from Prickly Pear Creek to fields northwest of the site. Prior to 1997, Wilson Ditch crossed the Facility in a buried concrete pipe. In 1997, the original pipe was replaced with an underground pipeline relocated immediately south of the Facility. The new ditch route from Upper Lake eliminated the potential for water from the site to affect Wilson Ditch. Phase I RFI data collected in 2001 and 2002 showed that water quality in Wilson Ditch downstream of the Facility was the same as in Upper Prickly Pear Creek (ACI, 2005; Hydrometrics, 2010). In Wilson Ditch, water flows only during the irrigation season (approximately April-September). Measured flows in the ditch during those times are low, ranging from 1.46-8.26 cfs.

Aquatic habitat features were investigated near the underground outlet in the Northwest edge of the site (Appendix A). Three different habitat types were observed in this reach: three runs, four low gradient riffles, and one glide. Stream widths are consistent throughout this reach, ranging from 2-3 m. Average depths ranged from 14-20 cm, with a maximum depth of 28 cm (Appendix A).

Figure 2.9
Wilson Ditch Near Outlet

The predominant bank cover type present along Wilson Ditch includes willow, sedges, grasses, trees, and boulders. Substrates consisting of sand, gravel, and cobble are generally evenly distributed, although fines were recorded as the third most dominant substrate type in the downstream most run and the glide (Appendix A). Percent fines by grid measurements varied widely (9-69%) but generally increased downstream as the habitat transitioned to runs.

Average terrestrial vegetation height was between 0.15-1 meter, owing to the predominant vegetation type of grasses that were approximately 0.75 m tall (Appendix A). A few other herbaceous plants were also present, as were autumn olive shrubs and a few small patches of trees. Moderate species diversity existed among the plant assemblage present at Wilson Ditch, which appeared to be heavily influenced by human activity.

Lower Lake

Lower Lake is a former process water pond located immediately north of Upper Lake. It is a man-made lake covering approximately 7 acres with a capacity of 11 million gallons (Hydrometrics and Hunter/ESE, 1989). The lake was formed in the 1940s by dividing the northern portion of Upper Lake with a berm of fill for the purpose of storing process recirculation water (ACI, 2005). Lower Lake receives recharge from precipitation, groundwater inflow, and treated effluent from the Facility Water Treatment Plant. Outflow from Lower Lake occurs as seepage to the local groundwater system and evaporation. Seepage from Lower Lake has been identified as a historic source of metals loading to groundwater on the Facility and, possibly, to adjacent Prickly Pear Creek. Lower Lake was the focus of an extensive remediation program in the mid-1990s, including dredging of the lake sediments and placement of sediments in an onsite CAMU landfill. As a result, dissolved As concentrations in Lower Lake water have decreased from 10 to 90 mg/L prior to 1995, to approximately 0.20 to 0.30 mg/L today (ACI, 2005; Hydrometrics, 2010).

The relationship between Prickly Pear Creek and Lower Lake is important due to the proximity of Lower Lake to Prickly Pear Creek and the historical use of Lower Lake as a storage pond for excess process water. Extensive water resources monitoring has been conducted in the vicinity of Lower Lake since at least 1985. The seasonal water resources monitoring has generally included collection of groundwater and surface water elevation data, streamflow monitoring in Prickly Pear Creek, and water quality sampling in Lower Lake, Prickly Pear Creek, and the intervening groundwater system. Review and interpretation of these data has been presented in previous documents, including Hydrometrics (1999) and ACI (2005) and is summarized below.

Figure 2.10
Lower Lake Facing Northeast

Shallow groundwater (6-60 ft) is present in the alluvial aquifer beneath most of the former Facility and depths generally increase to the north. The depth to groundwater is shallowest near Upper Lake, Lower Lake, and Prickly Pear Creek. Fluctuations in groundwater levels tend to mirror fluctuations in Prickly Pear Creek (ACI, 2005). Groundwater levels generally begin rising in May in response to spring runoff and gradually increase over the next few months. There is a progressive decline in groundwater levels from September through April; however, water level trends often vary considerably in response to increases in stream flow in Prickly Pear Creek (ACI, 2005). Groundwater flow or seepage was reported from the eastern edge of Lower Lake to Prickly Pear Creek (ACI, 2005). A review of the water levels at the north end of the Facility suggested that some groundwater flow is lost as recharge to Prickly Pear Creek at the northeast boundary of the Facility. However, any gains or losses to Prickly Pear Creek were within the error of flow measurement of the creek, and flow gains or losses to the Creek were not measurable (ACI, 2005).

Monitoring well DH-11, located across Prickly Pear Creek to the northeast of Lower Lake, indicated an increasing trend in sulfate, chloride, and TDS concentrations over three years, corresponding to an increase for the same constituents observed in Lower Lake (ACI, 2005). The sulfate concentration trend indicated that the influence of Lower Lake on shallow groundwater may extend across Prickly Pear Creek in this region. However, As concentrations at DH-11 have typically been low at this location (<0.005 mg/L) even when Lower Lake previously exhibited elevated As concentrations. Examination of surface water concentration data indicated exceedances of water quality criteria in the area of Prickly Pear Creek influenced by Lower Lake seepage (ACI, 2005). This pathway is investigated further in the BERA.

Lower Lake has a gravel and sand bottom, limited presence of shoreline and aquatic vegetation, and it appears to provide very poor aquatic habitat (Gradient, 2010; Western Technology and Engineering, Inc., 1989; US EPA, 2005a; GEI and Gradient, 2010). In the 2010 ecological investigation (Appendix A), the riparian zone was characterized as having a limited amount of deciduous vegetation in the understory and, otherwise, no vegetation present in the canopy or understory. Where riparian vegetation was present, only sparse quantities of trees with a DBH < 0.3 m, woody shrubs and saplings, and tall herbs, forbs, and grasses were observed (Appendix A). Ground cover along the perimeter of Lower Lake is mostly barren with few herbs, forbs, and grasses. Sparse quantities of woody shrubs and seedlings, inundated vegetation, and herbs, forbs, and grasses also contributed to the ground cover in some areas (Appendix A). The shoreline substrate around Lower Lake consists of a mix of several materials, including boulders, cobble/gravel, loose sand, fine soil/sediment, vegetation, and other non-natural features. The angle of the bank around the perimeter is ≤ 30°.

Similar to the riparian zone shoreline substrate composition, the littoral zone bottom substrate is also a mix of materials, including boulders, cobble, gravel, sand, silt clay/muck, and woody debris. Lower Lake substrates are either black or brown in color and most have an anoxic odor. Macrophytes are generally absent in the lake and only a sparse amount of submergent and floating macrophytes have been observed (Appendix A). Fish cover is generally absent; however, a few areas have sparse or moderate to very heavy density fish cover in the form of brush or woody debris, rock ledges or sharp drop-offs, boulders, and human structures. Correspondingly, fish habitat is generally open with artificial structures making up the only covered areas.

Tito Park

South of Lower Lake, between Lower Lake and Upper Lake, is a disturbed, sparsely vegetated area (called "Tito Park" by Facility personnel) that provides minimal upland habitat (Map 2). The soils in this area are disturbed, and there is little cover for ecological receptors. Due to the availability of more desirable habitat in the marsh area surrounding Upper Lake and along the riparian edge of Prickly Pear Creek, it is unlikely that this disturbed area receives substantial use by ecological receptors.

Figure 2.11
Tito Park Facing West

Remediation activities in the area between Upper and Lower Lakes began in 1991/92 with removal of the acid-plant sediments from the sediment drying pad in the extreme western portion of this area. In 2001, additional stockpiled soils and debris piles were removed from the area between Upper and Lower Lakes and placed in the Phase I CAMU. The area was then regraded and capped with 12 inches of clay soil obtained from the Phase I CAMU clay liner stockpile (permeability of 10^{-7} cm/sec or less). The clay cap is graded so that stormwater runoff drains westward to the site, where the runoff is collected for treatment in the Facility water treatment plant. In 2006, a slurry wall was constructed in the extreme western portion of the site to isolate subsurface soils in the former acid plant area (ASARCO, 2008). The slurry-wall area is covered with a temporary plastic liner about 1 acre in area, and the temporary cap is to remain in place until a final site cap is constructed.

The Tito Park area was surveyed in 2010 (Appendix A). Average vegetation height was < 0.15 m, reflecting grasses as the predominant vegetation type. Species diversity was low, with only one shrub, two to three grasses, and one herbaceous species being present. There were no trees present in this heavily disturbed area, which was situated between two roads used to access the Facility and the Slag Pile. During the 2010 habitat characterization, a notable lack of terrestrial invertebrates (particularly earthworms) was observed in this area. This is likely due to the clay cap (clay soils are generally very dense and are therefore problematic for burrowing earthworms) and dry conditions in this area (Appendix A).

Site Perimeter

Facility operations and emissions may have affected upland areas both on and off the Facility (US EPA, 2005a; Gradient, 2010). Terrestrial habitat at the site is limited to onsite areas near buildings, former operations and stockpile areas (including the area between Lower and Upper Lakes, "Tito Park"), and the open ranchland adjacent to the Facility (Map 2). The onsite areas provide limited habitat for common species such as rabbits, squirrels, mice, and pigeons. The adjacent ranchland, which may have been affected by historical smelter emissions, likely provides habitat for deer, small mammals, and upland game birds and predators (including red-tailed hawks, coyotes, and foxes), and supports livestock (primarily cattle).

Figure 2.12
Site Perimeter (Northwest Corner)

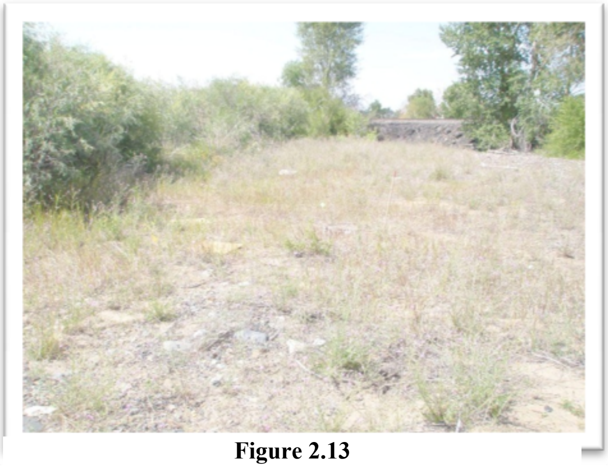


Figure 2.13
Site Perimeter (Northeast Corner)

On the eastern side of the Facility, terrestrial habitat features are similar to those observed near Prickly Pear Creek. Along the creek are vegetated areas with trees, shrubs, and grasses. Vegetation becomes more sparse with distance from the creek and turns to pastureland to the east. The north side of the Facility is bordered by US highway 12 and to the south by Upper Lake and Upper Lake Marsh. On the west side of the Facility are pastures and vegetated areas such as those surrounding Wilson Ditch. Vegetation is predominately comprised of grasses with a few other herbaceous plants and a small patches of trees. Notable signs of human activity around the site include paved roads, Facility buildings, other commercial and industrial facilities, private residences, and evidence of trespassing along the site perimeter (Appendix A).

Walker Creek (Lake Reference Area)

A lake reference area was identified during the 2010 ecological investigation for comparison to lake and upland areas sampled at the Facility. The Walker Creek watershed was suggested as a location with similar properties as locations onsite and with no known contamination sources by US EPA personnel. Walker Creek is located approximately 17 miles west of East Helena (Map 1). At this location, Walker Creek discharges to a small pond with marsh habitat along the fringes of the pond and creek input.

A habitat characterization of the Walker reference site was conducted in 2010 (Appendix A). The riparian zone has a mix of deciduous and coniferous vegetation in both the canopy layer and understory. The canopy layer includes a sparse or moderate number of trees with a DBH ≤ 0.3 m, whereas trees with a DBH ≥ 0.3 m were generally absent or sparse. The understory consists of woody shrubs and saplings to a moderate extent, and tall herbs, forbs, and grasses are present more sparsely. Ground cover at the Walker site is heavily comprised of herbs, forbs, and grasses, while woody shrubs and seedlings are present to a moderate or sparse extent. Inundated vegetation is present, and the shoreline substrate zone is predominantly vegetated, though sparse amounts of boulders, cobble/gravel, loose sand, and fine soil/sediment were observed around the Walker site (Appendix A).

Figure 2.14
Walker Creek, Pond, and Marsh

The littoral zone bottom substrate is dominated by sandy and/or silt clay/muck materials and some sites have sparse quantities of boulders, cobble, and gravel. All substrates were either brown or black in color and none emitted any kind of odor (Appendix A). Submergent and floating macrophytes were observed throughout the site. Sparse or moderate to heavy density fish cover was present in the form of aquatic weeds, brush or woody debris, overhanging vegetation, rock ledges or sharp drop-offs, and docks. Finally, fish habitat includes both human and natural features consisting of both open and covered areas, made up of vegetated, woody, and/or artificial structures (Appendix A).

Terrestrial vegetation height varied from 0.15-1 m where grasses and wildflowers were present (approximately 50% of habitat area) and was > 1 m were shrubs were present (the other approximately 50% percent of habitat area) (Appendix A). Species diversity was moderate in the area surrounding the lake where alternating sections of shrubs and grasses/wildflowers were present. No trees were observed in the riparian area immediately surrounding the Walker site, but evergreens approximately 50 ft tall were scattered throughout the area 10-15 ft beyond the riparian area.

2.5 Species Presence and Habitat Use

The ecological habitats at the Facility and surrounding areas have been modified by industrial and remedial activities. Still, many invertebrate, fish, bird, mammal, amphibian, reptile, and plant species use habitats that occur within the BERA study Area (Map 2). The following subsections present an overview of the various aquatic and terrestrial biological communities in the study area. The species reported to be present or observed at the site and corresponding habitat use are also described.

Benthic Invertebrates

Invertebrate communities in aquatic systems (such as Prickly Pear Creek, Upper Lake, Upper Lake Marsh, and Lower Lake) are functions of physical, chemical, and biological interactions. The composition of invertebrates in aquatic systems tend to be greatest where habitats are varied with some moderate, predictable disturbances (*e.g.*, seasonal flooding) (Thorp and Covich, 2010). Invertebrates in aquatic systems are predominantly benthic; those that burrow within a soft substrate are typically referred to as infauna, while those that live on the sediment or other hard surface are called epifauna. Benthic macroinvertebrate communities tend to be dominated by members of the phylum *Arthropoda*, which includes insects, mites, amphipods, copepods, and crayfish. Other phyla such as *Mollusca* (*e.g.*, clams, mussels, and snails), *Annelida* (*e.g.*, oligochaete worms, polychaete worms, and leeches), and *Platyhelminthes* (flatworms) are important members of the benthic community. Benthic invertebrates have varying feeding preferences, including grazers (which feed on periphyton and macrophytes), shredders (which process organic material), filter feeders (which process suspended organic material), predators (which prey on other invertebrates and small fish), and parasites (which feed on other organisms).

Qualitative and quantitative observations of benthic invertebrate communities have been conducted at the site by US EPA (2005a) and GEI and Gradient (2010). The primary benthic invertebrate taxa observed within the aquatic portions of the site included *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (collectively referred to as EPT), *Coleoptera*, *Diptera*, *Amphipoda*, *Odonata*, and *Hemiptera* (GEI and Gradient, 2010; US EPA, 2005a; US FWS, 1997). Other taxa encountered during site investigations included *Acari*, *Bivalvia*, *Crustacea*, *Gastropoda*, *Hirudinea*, *Megaloptera*, and *Tubificidae* (GEI and Gradient, 2010; Appendix A). A benthic community analysis was conducted by US EPA (2005a) and a number of benthic invertebrate species were identified in samples collected from Prickly Pear Creek, Upper Lake, and Upper Lake Marsh (Table 2.14). The 2010 ecological investigation (Appendix A) noted the same invertebrate taxa as reported by US EPA (2005a). In addition, invertebrate groups noted in Lower Lake in 2010 included *ephemeroptera*, *trichoptera*, *coleopteran*, *dipteral*, *odonata*, *amphipoda*, *hemiptera*, *acari*, *gastropoda*, and *hirudinae*. Samples from Wilson Ditch included *ephemeroptera*, *plecoptera*, *trichoptera*, *coleopteran*, *diptera*, *amphipoda*, *hemiptera*, *gastropoda*, and *hirudinae* (Appendix A). Based on these site investigations, it is apparent that aquatic portions of the site are able to support a diverse mix of benthic invertebrate species.

Table 2.14
Benthic Invertebrate Species Identified in Prickly Pear Creek, Upper Lake, and Upper Lake Marsh in 2003 (US EPA, 2005a)

Order[a]	Taxa	Species	Feeding Group[b]	Prickly Pear Creek (upstream)	Prickly Pear Creek (adjacent to site)	Upper Lake	Upper Lake Marsh
Acari	Unknown	Unknown	PR	x			
Amphipoda	Talilridae	*Gammarus spp.*	GC			x	
Amphipoda	Talilridae	*Hyalella azteca*	GC	x		x	x
Cladocera	Daphnia	Unknown	FC			x	
Coleoptera	Chrysomelidae	*Donacia spp.*	SH		x		
Coleoptera	Dytiscidae	Unknown	PR		x	x	
Coleoptera	Elmidae	*Cleptelmis ornata*	GC	x	x		
Coleoptera	Elmidae	*Cleptelmis ornata*	GC	x	x		
Coleoptera	Elmidae	*Heterlimnius corpulentus*	GC	x			
Coleoptera	Elmidae	*Heterlimnius corpulentus*	GC	x			
Coleoptera	Elmidae	*Lara spp.*	SH	x			
Coleoptera	Elmidae	*Optioservus quadrimaculatus*	SC	x	x		
Coleoptera	Elmidae	*Optioservus quadrimaculatus*	SC	x	x		
Coleoptera	Elmidae	*Stenelmis occidentalis*	SC, OM	x	x		
Coleoptera	Elmidae	*Zaitzevia parvula*	GC	x	x		
Coleoptera	Elmidae	*Zaitzevia parvula*	GC		x		
Coleoptera	Haliplidae	*Haliplus spp.*	SH			x	
Coleoptera	Haliplidae	*Haliplus spp.*	SH			x	
Decapoda	Unknown	Unknown	SH, OM			x	
Diptera	Ahericidae	*Atherix spp.*	PR		x		
Diptera	Ceratopogonidae	*Probezzia spp.*	PR	x			
Diptera	Chironomidae	*Nostocoladius spp.*	SH	x			
Diptera	Chironomidae	Unknown	PR, GC		x		
Diptera	Chironomidae	Unknown	PR, GC			x	x
Diptera	Dolichopodidae	*Dolichopus spp.*	PR	x			
Diptera	Muscidae	*Lisppoides spp.*	PR		x		
Diptera	Pelecorhynchidae	*Glutops spp.*	PR	x	x		
Diptera	Psychodidae	*Pericoma spp.*	GC	x			

Order[a]	Taxa	Species	Feeding Group[b]	Prickly Pear Creek (upstream)	Prickly Pear Creek (adjacent to site)	Upper Lake	Upper Lake Marsh
Diptera	Simuliidae	*Prosimulium spp.*	FC		x		
Diptera	Simuliidae	*Simulium spp.*	FC	x	x		
Diptera	Simuliidae	*Simulium spp.*	FC		x		
Diptera	Tipulidae	*Antocha spp.*	GC	x	x		
Diptera	Tipulidae	*Dicranota spp.*	PR	x			
Diptera	Tipulidae	*Hexatoma spp.*	PR		x		
Diptera	Tipulidae	*Tipula spp.*	SH		x		
Diptera	Tipulidae	*Tipula spp.*	SH				
Epemeroptera	Caenidae	*Caenis spp.*	GC				
Epemeroptera	Siphlonuridae	*Siphlonorus spp.*	GC			x	x
Ephemeroptera	Baetidae	*Baetis spp.*	GC, SC	x	x		
Ephemeroptera	Ephermerellidae	*Caudalella spp.*	GC	x			
Ephemeroptera	Ephermerellidae	*Ephemeralla spp.*	GC	x	x		
Ephemeroptera	Ephermerellidae	*Orunetla spp.*	SC, PR	x	x		
Ephemeroptera	Heotageniidae	*Slenonema spp.*	SC	x	x		
Ephemeroptera	Leptohyphidae	*Tricoythodes spp.*	CG		x		
Ephemeroptera	Leptophlebiidae	*Paraleptophlebia spp.*	GC	x	x		
Gastropoda	Ancylidae	*Ferrissia rivularis*	SC		x		
Gastropoda	Ancylidae	*Ferrissia rivularus*	SC				
Gastropoda	Lymnaeidae	Unknown	SC		x		
Gastropoda	Physidae	*Physella spp.*	SC	x	x		
Gastropoda	Physidae	*Physella spp.*	SC			x	x
Gastropoda	Planorbidae	Unknown	SC		x		
Gastropoda	Planorbidae	Unknown	SC			x	
Gastropoda	Plelcypoda	*Pisidium spp.*	FC		x		
Hemiptera	Corixidae	*Sigara spp.*	GC	x	x		
Hemiptera	Corixidae	*Sigara spp.*	GC			x	x
Hemiptera	Gerridae	*Trepobates spp.*	PR		x		
Hemiptera	Notonectidae	*Notonecta spp.*	PR			x	
Hirundinea	Unknown	Unknown	PR			x	
Odonata	Aeshnidae	*Aeshna spp.*	PR			x	x
Odonata	Aeshnidae	*Boyeria spp.*	PR			x	

Order[a]	**Taxa**	**Species**	**Feeding Group[b]**	**Prickly Pear Creek (upstream)**	**Prickly Pear Creek (adjacent to site)**	**Upper Lake**	**Upper Lake Marsh**
Odonata	Coenagrionidae	*Enallagma spp.*	PR			x	
Odonata	Gomphidae	*Ophiogomphus spp.*	PR		x		
Oligochaeta	Unknown	Unknown	GC	x		x	
Plecoptera	Chloroperlidae	*Sweltsa spp.*	PR	x			
Plecoptera	Nemouridae	*Malenka spp.*	SH	x			
Plecoptera	Nemouridae	*Zapada cinctipes*	SH	x	x		
Plecoptera	Nemouridae	*Zapada spp.*	SH	x			
Plecoptera	Perlidae	*Claassenia sabulosa*	PR		x		
Plecoptera	Perlidae	*Doroneuris theodora*	PR	x			
Plecoptera	Perlidae	*Hespperoperla pacifica*	PR	x	x		
Plecoptera	Perlodidae	*Megarcys spp.*	PR	x			
Plecoptera	Perlodidae	*Skwala spp.*	PR		x		
Plecoptera	Pteronarcyidae	*Pteronarcella badia*	SH		x		
Plecoptera	Pteronarcyidae	*Pteronarcys califomica*	SH	x	x		
Tricoptera	Brachycentridae	*Brachycentrus spp.*	FC, SC	x	x		
Tricoptera	Brachycentridae	*Micrasema spp.*	SH, GC	x	x		
Tricoptera	Glossosomatidae	*Glossosoma spp.*	SC	x	x		
Tricoptera	Helicopsychidae	*Arctopsyche spp.*	FC	x	x		
Tricoptera	Helicopsychidae	*Cheumatopsyche spp.*	FC		x		
Tricoptera	Helicopsychidae	*Helicopsyche borealis*	SC		x		
Tricoptera	Helicopsychidae	*Hydropsyche spp.*	FC	x	x		
Tricoptera	Hydroptilidae	*Agraylea spp.*	GC			x	
Tricoptera	Lepidostomatidae	*Lepidostoma spp.*	SH		x		
Tricoptera	Leptoceridae	*Oecetis spp.*	PR		x		
Tricoptera	Rhyacophilidae	*Dolophilodes spp.*	GC	x			
Tricoptera	Rhyacophilidae	*Rhyacophifa spp.*	PR	x	x		
Tricoptera	Rhyacophilidae	*Rhyacophila brunnea*	PR	x	x		

Notes:

(a) Data obtained from Appendix D of US EPA (2005a).

(b) Feeding groups: GC (gatherer/collector), SC (scraper), SH (shredder), F (filterer), PR (predator), OM (omnivore), PC (piercer).

Fish

The aquatic portions of the Facility and adjacent to the Facility offer a diverse mix of habitats (*e.g.*, stream, lake, and marsh conditions). The range and distributions of fish species is monitored by the State of Montana through the Natural Heritage program (http://mtnhp.org). Fish species that were identified as using habitat on or near the Facility (Table 2.15) can be grouped into the following feeding guilds:

- **Herbivores/omnivores** – fish that feed on vegetation or vegetation and invertebrates;
- **Benthic invertivores** – fish that feed primarily on benthic invertebrates;
- **Insectivore/Piscivore** – fish that feed primarily on invertebrates and insects in the water column and may eat other fish; and
- **Piscivores** – fish that feed primarily on other fish.

Table 2.15
Fish Species Potentially Present in Aquatic Habitat At or Near the Facility

Feeding Group	Common Name[a]	Species Name	Feeding Preferences[b]
Benthic invertivore	Mottled sculpin	*Cottus bairdi*	Predominantly benthic invertebrates
Benthic invertivore	Stonecat	*Noturus flavus*	Aquatic insects and small fish
Benthic invertivore	White sucker	*Catostomus commersonii*	Benthic invertebrates and detritus
Herbivore/omnivore	Common carp	*Cyprinus carpio*	Vegetation, detritus, and aquatic organisms
Herbivore/omnivore	Longnose dace	*Rhinichthys cataractae*	Aquatic insects and algae
Herbivore/omnivore	Longnose sucker	*Catostomus catostomus*	Algae and aquatic invertebrates
Herbivore/omnivore	Smallmouth Buffalo	*Ictiobus bubalus*	Aquatic insects, crustaceans, mollusks and plant material
Herbivores/omnivore	Fathead minnow	*Pimephales promelas*	Minute aquatic plants and animals
Insectivore	Bigmouth Buffalo	*Ictiobus cyprinellus*	Plankton, crustaceans, and dipteran larvae
Insectivore	Brook trout	*Salvelinus fontinalis*	Aquatic invertebrates and small fish
Insectivore	Brown trout	*Salmo trutta*	Aquatic invertebrates and small fish
Insectivore	Kokanee	*Oncorhynchus nerka*	Plankton and aquatic insects
Insectivore	Lake Chub	*Couesius plumbeus*	Plankton and small aquatic invertebrates
Insectivore	Mountain whitefish	*Prosopium williamsoni*	Aquatic and terrestrial insects
Insectivore	Rainbow trout	*Oncorhynchus mykiss*	Zooplankton, aquatic insects, and fish
Insectivore	Westslope Cutthroat Trout	*Oncorhynchus clarkia lewisi*	Aquatic insects and zooplankton
Insectivore	Yellow perch	*Perca flavescens*	Aquatic invertebrates and small fish
Piscivore	Burbot	*Lota lota*	Predominantly fish
Piscivore	Largemouth bass	*Micropterus salmoides*	Fish, frogs, and aquatic insects
Piscivore	Smallmouth bass	*Micropterus dolomieui*	Fish, frogs, crayfish, and aquatic insects
Piscivore	Walleye	*Sander vitreus*	Adults feed heavily on small fish and all ages consume aquatic invertebrates

Notes:

(a) The distribution of this species overlaps or is near the Facility according to the Montana National Heritage Tracker (http://mtnhp.org/Tracker/NHTMap.aspx).

(b) Feeding preferences reported in the Montana State Field Guide (State of Montana, 2010).

Although not all of the species listed in Table 2.15 have been observed at or near the Facility, several have been identified or collected during site investigations, including brook trout, brown trout, rainbow trout, mottled sculpin, white sucker, fathead minnow, and longnose dace (US FWS, 1987; US EPA, 2005a; GEI and Gradient, 2010). Most of these species were identified in either Prickly Pear Creek or Upper Lake and Upper Lake Marsh. Since Wilson Ditch is connected to Upper Lake, it is likely that some fish species may enter this water body during the times of the year when water flows in this drainage. A sample of forage fish was collected at the outlet of Wilson Ditch (Appendix A), suggesting that some fish are present in portions of Wilson Ditch during active water flow (approximately April through September). Prior to the 2010 ecological investigation, it was unknown whether fish were present in Lower Lake. Three samples of forage fish (primarily fathead minnows) were collected in 2010 from Lower Lake (Appendix A), indicating that some fish species are indeed present in this water body, even though metals concentrations are known to be elevated (US EPA, 2005a; Hydrometrics, 2010). Thus, a number of fish species are present at or near the Facility and may be exposed to metals or provide a source of metal exposure to higher trophic organisms (*e.g.*, birds, mammals, and humans).

Aquatic and Terrestrial Plants

Aquatic and terrestrial plant communities are used by ecological receptors for foraging, nesting habitat, breeding habitat, and refuge. Chemicals can adversely affect plant species and communities and/or be transferred from plants to higher trophic level species through consumption. The variable habitat (*e.g.*, marsh, riparian, pasture, and arid areas) surrounding the Facility allow for a diverse mix of plant species. Qualitative assessments of aquatic and terrestrial plants were conducted in 1989 and 2010 at the site (Western Technology and Engineering, Inc., 1989; GEI and Gradient, 2010). Dominant vegetation along Prickly Pear Creek included willows, sedges, grasses, and some trees (Appendix A). The wetland and marsh areas surrounding Upper Lake were dominated by willow (*Salix* spp.) and alder (*Alnus* spp.) stands, with some grasses in the drier areas, and cattails (*Typha* spp.) and reeds in the inundated areas (Western Technology and Engineering, Inc., 1989; GEI and Gradient, 2010). Forested wetlands in the southern portion of Upper Lake Marsh near the Prickly Pear Creek diversion included species such as aspen (*Populus tremuloides*), cottonwoods (*Populus deltoides*) and several grass species. Minimal vegetation was noted around Lower Lake, including some grasses, forbs, and shrubs (Appendix A). The Facility perimeter areas and Wilson Ditch were dominated by grasses, shrubs, and small patches of trees, including Russian Olive (*Elaeagnus angustifolia).* A list of the dominant vegetation noted during site investigations is presented in Table 2.16.

Table 2.16
Plant Species Identified At or Near the Facility

Common Name	Species Name
Alder	*Alnus* spp.
Aspen	*Populus tremuloides*
Blue Grama	*Bouteloua gracilis*
Bluebunch wheatgrass	*Agropyron spicatum*
Bluegrass	*Poa* spp.
Brome	*Bromus* spp.
Cattails	*Typha* spp.
Cheatgrass	*Bromus tectorum*
Common reed	*Phragmites communis*
Cottonwood	*Populus deltoides*
Currant	*Ribes* spp.
Needle-and-thread	*Stipa comata*
Rose	*Rosa* spp.
Russian Olive	*Elaeagnus angustifolia*
Ryegrass	*Elymus* spp.
Snowberry	*Symphoricarpos occidentalis*
Wheatgrass	*Agropyron* spp.
Willow	*Salix* spp.

Terrestrial Invertebrates

Terrestrial soil invertebrates provide a pathway for the transfer of contaminants in soils to wildlife that forage on these organisms. A rigorous analysis of terrestrial invertebrate species has not been conducted at the site. However, during sampling of terrestrial soil invertebrates in 2010, a number of taxa were identified (Table 2.17, Appendix A). While the purpose of the 2010 ecological sampling was to target soil invertebrates for use in evaluating risks to higher trophic level terrestrial receptors, collection of these organisms was generally unsuccessful (Gradient, 2010, Appendix A). The presence of earthworms was found to be particularly scarce in riparian and terrestrial areas (Appendix A). This may be due, in part, to the arid conditions of the soils at the time of sampling as well as the soil matrix. In some portions of the site (*e.g.*, Tito Park, Lower Lake, site perimeter), soils were completely dry and consisted of clay materials or were heavily compacted. In other areas (*e.g.*, Prickly Pear Creek, Upper Lake Marsh), soil transitioned from very dry and sandy to inundated with a dense willow root zone (Appendix A). All of these conditions are not ideal for earthworm habitat. Other soil invertebrates (*e.g.*, beetles, spiders, slugs) were also scarce and, despite a rigorous sampling effort, only a few of the targeted samples could be obtained over a two-week period (Appendix A). Jumping and aerial insects were observed more frequently during the 2010 ecological sampling event, and some samples were collected to evaluate metal exposure (Appendix A).

Table 2.17
Terrestrial Invertebrate Species Identified At or Near the Facility

Common Name	Species Group
Spiders	*Aranea*
Centipedes	*Chlopoda*
Beetles	*Coleoptera*
Snails, slugs	*Gastropoda*
True bugs	*Hemiptera*
Leaf hoppers	*Homoptera*
Wasps	*Hymenoptera*
Moths	*Lepidoptera*
Earthworms	*Lumbricidae*
Lacewings	*Neuroptera*
Dragonflies, damselflies	*Odonata*
Harvestmen (daddy longlegs)	*Opiliones*
Grasshoppers, crickets	*Orthoptera*
Caddisflies	*Trichoptera*

Birds

Numerous bird species inhabit the terrestrial and aquatic areas within and surrounding the Facility. Bird surveys have been conducted at the site during Spring of 1989 (Western Technology and Engineering, Inc., 1989), in 1992 and 1993 by the Audobon Society (see Gradient, 2010), and Summer of 2010 (Appendix A). Bird species that were identified as using habitat on or near the Facility were grouped into the following general feeding guilds:

- **Carnivores** – birds that feed mainly on small mammals, birds, reptiles and amphibians;
- **Insectivores** – birds that feed primarily on flying or terrestrial invertebrates and may eat small amounts of plant material,
- **Herbivores** – birds that feed predominantly on plant material;
- **Omnivores** – bird that feed mainly on plant material and insects;
- **Diving/probing carnivores and omnivores** – birds that usually swim on the water's surface or dive, or probe sediments to feed on invertebrates or a mix of invertebrates, fish, and occasionally plants from the sediment surface; and
- **Piscivores** – birds that feed predominantly on fish.

A summary of the bird species observed at the site, their feeding preferences, and residency status (*i.e.*, typical seasons when birds are present in the East Helena area) is presented in Table 2.18.

Table 2.18
Bird Species Identified At or Near the Facility

Feeding Group	Common Name	Scientific Name	Feeding Preferences[a]	Residency Status[a]
Carnivore	American kestrel	*Falco sparverius*	Large insects, small birds, rodents, and snakes	Year-round
Carnivore	Great horned owl	*Bubo virginianus*	Mammals and birds	Year-round
Carnivore	Loggerhead shrike	*Lanius ludovicianus*	Insects, amphibians, small reptiles, small mammals, and birds	Summer
Carnivore	Red-tailed hawk	*Buteo jamaicensis*	Small mammals and snakes	Year-round
Diving/Probing carnivore	American dipper	*Cinclus mexicanus*	Aquatic invertebrates, insects, and occasionally small fish	Year-round
Diving/Probing carnivore	Common goldeneye	*Bucephala clangula*	Aquatic invertebrates and fish	Year-round
Diving/probing carnivore	Lesser scaup	*Aythya affinis*	Mainly aquatic invertebrates	Year-round
Diving/Probing carnivore	Pied-billed grebe	*Podilymbus podiceps*	Fish, crustaceans and aquatic insects	Year-round
Diving/Probing carnivore	Red-necked grebe	*Podiceps grisegena*	Small fish, aquatic invertebrates, and amphibians	Summer
Diving/probing carnivore	Sandpiper spp.	*Calidris spp.*	Aquatic invertebrates	Summer
Diving/Probing Herbivore	Redhead	*Aythya americana*	Mainly aquatic plants	Summer
Diving/probing omnivore	Barrow's goldeneye	*Bucephala islandica*	Aquatic invertebrates, fish eggs, and some seeds and tubers	Year-round
Diving/probing omnivore	Cinnamon teal	*Anas cyanoptera*	Aquatic invertebrates and plants	Summer
Diving/probing omnivore	Common snipe	*Gallinago gallinago*	Aquatic invertebrates, earthworms, and plant material	Summer
Diving/probing omnivore	Franklin's gull	*Leucophaeus pipixcan*	Invertebrates and plant material	Summer
Diving/Probing omnivore	Gadwall	*Anas strepera*	Aquatic vegetation, seeds and aquatic invertebrates	Year-round
Diving/probing omnivore	Green-winged teal	*Anas carolinensis*	Aquatic invertebrates and plants	Year-round
Diving/probing omnivore	Ring-necked duck	*Aythya collaris*	Aquatic invertebrates and plants	Summer
Diving/probing omnivore	Ruddy duck	*Oxyura jamaicensis*	Aquatic invertebrates and plants	Summer

Feeding Group	Common Name	Scientific Name	Feeding Preferences[a]	Residency Status[a]
Diving/probing omnivore	Sandhill crane	*Grus canadensis*	Aquatic invertebrates and plants	Summer
Herbivore	American wigeon	*Anas americana*	Mainly plants (stems, leaves, grains, seeds)	Year-round
Herbivore	Canada goose	*Branta canadensis*	Seeds, berries and grain	Year-round
Herbivore	Chipping sparrow	*Spizella passerina*	Mainly seeds and fruits, some insects	Summer
Herbivore	House finch	*Carpodacus mexicanus*	Mainly plants (seeds, fruits, and leaf buds)	Year-round
Herbivore	House sparrow	*Passer domesticus*	Mainly grains, seeds, and few insects	Year-round
Herbivore	Mourning dove	*Zenaida macroura*	Mainly seeds	Year-round
Herbivore	Pine siskin	*Carduelis pinus*	Mainly seeds	Year-round
Herbivore	Red-winged blackbird	*Agelaius phoeniceus*	Mainly plant mater and some insects	Year-round
Insectivore	Barn swallow	*Hirundo rustica*	Flying insects	Summer
Insectivore	Cliff swallow	*Petrochelidon pyrrhonota*	Flying insects	Summer
Insectivore	Common yellowthroat	*Geothlypis trichas*	Insects and spiders	Summer
Insectivore	Eastern kingbird	*Tyrannus tyrannus*	Mainly insects	Summer
Insectivore	Golden-crowned kinglet	*Regulus satrapa*	Insects, mites and spiders.	Year-round
Insectivore	House wren	*Troglodytes aedon*	Terrestrial insects	Summer
Insectivore	Killdeer	*Charadrius vociferus*	Mainly terrestrial invertebrates (earthworms, grasshoppers, beetles, snails)	Summer
Insectivore	Marsh wren	*Cistothorus palustris*	Insects	Summer
Insectivore	Tree swallow	*Tachycineta bicolor*	Mainly flying insects	Summer
Insectivore	Willow flycatcher	*Empidonax traillii*	Insects	Summer
Insectivore	Wilson's warbler	*Wilsonia pusilla*	Mainly flying insects, spiders, beetles, and caterpillars	Summer
Insectivore	Yellow warbler	*Dendroica petechia*	Insects and arthropods	Summer
Omnivore	American crow	*Corvus brachyrhynchos*	Insects, amphibians, reptiles, small birds and mammals, birds' eggs, nestlings and fledglings, grain crops, seeds and fruits, carrion, and discarded human food	Year-round
Omnivore	American goldfinch	*Spinus tristus*	Seeds and insects	Year-round
Omnivore	American redstart	*Setophaga ruticilla*	Insects, seeds, and berries	Summer
Omnivore	American robin	*Turdus migratorius*	Insects, fruits, berries, and worms	Year-round
Omnivore	American tree sparrow	*Spizella arborea*	Spiders, seeds of grass, sedge, forbs, buds, and berries	Winter
Omnivore	Black-billed magpie	*Pica pica*	Ground-dwelling arthropods, seeds, and carrion	Year-round

Feeding Group	Common Name	Scientific Name	Feeding Preferences[a]	Residency Status[a]
Omnivore	Black-capped chickadee	*Poecile atricapillus*	Insects, seeds, and fruits	Year-round
Omnivore	Blue winged teal	*Anas discors*	Aquatic invertebrates, seeds, grains, duckweeds, and algae	Summer
Omnivore	Bohemian waxwing	*Bombycilla garrulus*	Fruits and insects	Winter
Omnivore	Brown-headed cowbird	*Molothrus ater*	Arthropods and seeds	Summer
Omnivore	California gull	*Larus californicus*	Insects, oligochaetes, crustaceans, amphibians, birds, and plant material	Summer
Omnivore	Cedar waxwing	*Bombycilla cedrorum*	Cedar cones, fruits, and insects	Year-round
Omnivore	Common raven	*Corvus corax*	Insects, fruits, grains, small animals, and carrion	Year-round
Omnivore	European starling	*Sturnus vulgaris*	Invertebrates, fruits, berries, grains, and seeds	Summer
Omnivore	Gray catbird	*Dumetella carolinensis*	Insects and fruit	Summer
Omnivore	Gray partridge	*Perdix perdix*	Grain, seeds, and insects	Year-round
Omnivore	Horned lark	*Eremophila alpestris*	Seeds and insects	Year-round
Omnivore	Lazuli bunting	*Passerina amoena*	Insects and seeds	Summer
Omnivore	Mallard	*Anas platyrhynchos*	Seeds, plants, and aquatic insects	Year-round
Omnivore	Mountain bluebird	*Sialia currucoides*	Insects and fruit	Summer
Omnivore	Mountain chickadee	*Poecile gambeli*	Insects and seeds	Year-round
Omnivore	Northern flicker	*Colaptes auratus*	Insects, fruits and seeds	Year-round
Omnivore	Northern oriole	*Icterus galbula*	Insects and fruits	Summer
Omnivore	Orange-crowned warbler	*Vermivora celata*	Insects, fruits and seeds	Summer
Omnivore	Red-breasted Nuthatch	*Sitta canadensis*	Insects and seeds	Year-round
Omnivore	Snow bunting	*Plectrophenax nivalis*	Seeds, buds, and invertebrates	Winter
Omnivore	Song Sparrow	*Melospiza melodia*	Seeds, fruits, and invertebrates	Year-round
Omnivore	Townsend's solitaire	*Myadestes townsendi*	Insects and seeds	Year-round
Omnivore	Veery	*Catharus fuscenscens*	Fruit and insects	Summer
Omnivore	Vesper sparrow	*Pooecetes gramineus*	Insects and seeds	Summer
Omnivore	Warbling vireo	*Vireo gilvus*	Insects and some fruit	Summer
Omnivore	Western kingbird	*Tyrannus verticalis*	Insects and berries	Summer
Omnivore	Western meadowlark	*Sturnella neglecta*	Grains, seeds, and insects	Summer
Omnivore	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	Aquatic insects, grains and seeds	Summer

Feeding Group	Common Name	Scientific Name	Feeding Preferences[a]	Residency Status[a]
Piscivore	American white Pelican	*Pelecanus erythrorhynchos*	Mainly fish	Summer
Piscivore	Belted kingfisher	*Megaceryle alcyon*	Mainly fish, also mollusks, crustaceans, insects, amphibians, reptiles, young birds, small mammals, and berries	Year-round
Piscivore	Common merganser	*Mergus merganser*	Mainly fish, but will also eat insects, mollusks, crustaceans, worms, frogs, small mammals, birds, and plants	Year-round
Piscivore	Double-crested Cormorant	*Phalacrocorax auritus*	Mainly fish	Summer
Piscivore	Great blue heron	*Ardea herodius*	Mostly fish and amphibians, reptiles, invertebrates, mammals, and birds	Year-round
Piscivore	Great egret	*Ardea alba*	Mainly fish and some amphibians, insects, and mammals	Summer
Piscivore	Osprey	*Pandion haliaetus*	Primarily fish	Summer

Note:

(a) Feeding preference and residency status information obtained from the Montana State Field Guide (State of Montana, 2010).

Mammals

Signs of mammals (*e.g.*, tracks, scat) or observations of mammals at or near the Facility have been recorded during Spring of 1989 and Summer of 2010 (Western Technology and Engineering, Inc., 1989; Appendix A). All of these species are year-round residents in Helena Valley. Mammals that were identified as using habitat at or near the Facility were grouped into the following general feeding guilds:

- **Carnivores** – mammals that feed mainly on small mammals, birds, reptiles and amphibians;
- **Invertivores** – mammals that feed primarily on terrestrial invertebrates and may eat small amounts of plant material;
- **Omnivores –** mammals that feed on plants and animals;
- **Herbivores** – mammals that feed predominantly on plant material; and
- **Piscivores** – mammals that feed predominantly on fish.

A summary of the mammals observed at or near the Facility and their feeding preferences are presented in Table 2.19.

Table 2.19
Mammals Identified At or Near the Facility

Feeding Group	Common Name	Scientific Name	Feeding Preferences[a]
Carnivore	Badger	*Taxidea taxus*	Mammals, birds, reptiles, amphibians, and some plants
Carnivore	Coyote	*Canis latrans*	Mammals, birds, invertebrates, plants, carrion
Carnivore	Red fox	*Vulpes vulpes*	Small mammals and birds
Herbivore	Beaver	*Castor canadensis*	Woody and herbaceous plants
Herbivore	Columbian ground squirrel	*Spermophilus columbianus*	Grasses, leaves, bulbs, fruits, and seeds
Herbivore	Mountain cottontail	*Sylvilagus nuttallii*	Plant material (sagebrush)
Herbivore	Muskrat	*Ondatra zibethicus*	Shoots, roots, bulbs, and leaves of aquatic plants
Herbivore	Northern pocket gopher	*Thomomys talpoides*	Underground plant parts
Herbivore	Porcupine	*Erethizon dorsatum*	Woody shrubs and trees, foliage, forbs, grasses, and sedges
Herbivore	Pronghorn	*Antilocapra americana*	Forbs and grasses
Herbivore	Red squirrel	*Tamiasciurus hudsonicus*	Buds, seeds, berries, conifer cones
Herbivore	Vole spp.	*Microtus spp.*	Grasses, sedges, herbaceous plants
Herbivore	Western jumping mouse	*Zapus princeps*	Seeds
Herbivore	White tailed jackrabbit	*Lepus townsendii*	Plant material
Herbivore	White-tailed deer	*Odocoileus virginianus*	Leaves, twigs, fruits, berries, and forbs
Herbivore	Yellow-pine chipmunk	*Tamias amoenus*	Fruits, leaves, and seeds
Invertivore	Masked shrew	*Sorex cinereus*	Terrestrial invertebrates
Omnivore	Deer mouse	*Peromyscus maniculatus*	Seeds and invertebrates
Omnivore	Raccoon	*Procyon lotor*	Carrion, mammals, birds, reptiles, insects, amphibians, grains, nuts, and fruits
Omnivore	Striped skunk	*Mephitis mephitis*	Small mammals, amphibians, reptiles, berries, fruits, garbage, carrion, and arthropods
Piscivore	Mink	*Mustela vison*	Fish, mammals, invertebrates, birds, reptiles, amphibians

Note:

(a) Feeding preferences obtained from the Montana State Field Guide (State of Montana, 2010).

Amphibians and Reptiles

Amphibian and reptile species have not been exhaustively characterized in the vicinity of the Facility. A few species were observed during site investigations, including garter snakes (*Thamnophis spp.*) in the riparian area of Prickly Pear Creek, Columbia spotted frogs (*Rana luteiventris*) in the area between Prickly Pear Creek and Upper Lake Marsh, and turtles (*Chrysemys spp.*) in Lower Lake (Western Technology and Engineering, Inc., 1989; Appendix A). Amphibian and reptile species known to be present in Helena Valley are presented in Table 2.20.

Table 2.20
Amphibians and Reptiles Potentially Present At or Near the Facility

Feeding Group	Common Name	Scientific Name	Feeding Preferences[a]
Amphibians			
Carnivore	Boreal chorus frog	*Pseudacris maculata*	Ants, spiders, flies, beetles, aphids and other insects (adult)
Carnivore	Columbia spotted frog	*Rana luteiventris*	Ground insects (adult)
Carnivore	Long-toed salamander	*Ambystoma macrodactylum*	Aquatic and terrestrial invertebrates
Carnivore	Northern leopard frog	*Rana pipiens*	Invertebrates (adult)
Carnivore	Plains spadefoot	*Spea bombifrons*	Terrestrial invertebrates (adult)
Carnivore	Western toad	*Bufo boreas*	Terrestrial invertebrates (adult)
Reptiles			
Carnivore	Common gartersnake	*Thamnophis sirtalis*	Amphibians, slugs, birds, and small mammals
Carnivore	Eastern racer	*Coluber constrictor*	Small mammals, lizards, and amphibians
Carnivore	Gophersnake	*Pituophis catenifer*	Rodents, rabbits, and birds
Carnivore	Prairie rattlesnake	*Crotalus viridis*	Small mammals and birds
Carnivore	Rubber boa	*Charina bottae*	Small mammals
Carnivore	Terrestrial gartersnake	*Thamnophis elegans*	Amphibians, slugs, leaches, and fish
Omnivore	Painted turtle	*Chrysemys picta*	Aquatic invertebrates and plant material

Note:

(a) Feeding preferences obtained from Montana State Field Guide (State of Montana, 2010).

Sensitive Species

Endangered, threatened, proposed, and candidate species have been listed for each Montana county by US FWS and the Montana Natural Heritage Program (MNHP). Threatened and endangered species are not expected to occur at the Facility or in the surrounding areas. Species that are listed as threatened or endangered by US FWS, the United States Forestry Service (US FS), and the Bureau for Land Management for Lewis and Clark County are summarized in Table 2.21 (MNHP, 2011; US FWS, 2010).

Table 2.21
Montana Species of Concern for Lewis and Clark County

Group	Scientific Name	Common Name	US FWS[a]	US FS[b]	BLM[b]
Mammals	*Corynorhinus townsendii*	Townsend's Big-eared Bat		S	S
Mammals	*Canis lupus*	Gray Wolf		S	S
Mammals	*Cynomys ludovicianus*	Black-tailed Prairie Dog		S	S
Mammals	*Euderma maculatum*	Spotted Bat		S	S
Mammals	*Gulo gulo*	Wolverine		S	S
Mammals	*Lynx canadensis*	Canada Lynx	LT	T	SPS
Mammals	*Martes pennanti*	Fisher		S	S
Mammals	*Myotis thysanodes*	Fringed Myotis			S
Mammals	*Synaptomys borealis*	Northern Bog Lemming		S	
Mammals	*Ursus arctos*	Grizzly Bear	LT	T	SPS
Mammals	*Mustela nigripes*	Black-footed ferret	LE	T	SPS
Birds	*Accipiter gentilis*	Northern Goshawk			S
Birds	*Aechmophorus clarkii*	Clark's Grebe			
Birds	*Ammodramus bairdii*	Baird's Sparrow			S
Birds	*Ammodramus savannarum*	Grasshopper Sparrow			
Birds	*Anthus spragueii*	Sprague's Pipit			S
Birds	*Aquila chrysaetos*	Golden Eagle			S
Birds	*Ardea herodias*	Great Blue Heron			
Birds	*Buteo regalis*	Ferruginous Hawk			S
Birds	*Calcarius mccownii*	McCown's Longspur			S
Birds	*Calcarius ornatus*	Chestnut-collared Longspur			S
Birds	*Carpodacus cassinii*	Cassin's Finch			
Birds	*Catharus fuscescens*	Veery			
Birds	*Certhia americana*	Brown Creeper			
Birds	*Cygnus buccinator*	Trumpeter Swan		S	S
Birds	*Dolichonyx oryzivorus*	Bobolink			S
Birds	*Dryocopus pileatus*	Pileated Woodpecker			
Birds	*Falco peregrinus*	Peregrine Falcon	DM	S	S
Birds	*Gavia immer*	Common Loon		S	S
Birds	*Gymnorhinus cyanocephalus*	Pinyon Jay			
Birds	*Haliaeetus leucocephalus*	Bald Eagle	DM		S
Birds	*Himantopus mexicanus*	Black-necked Stilt			
Birds	*Histrionicus histrionicus*	Harlequin Duck		S	S
Birds	*Lagopus leucura*	White-tailed Ptarmigan			
Birds	*Leucosticte tephrocotis*	Gray-crowned Rosy-Finch			
Birds	*Melanerpes lewis*	Lewis's Woodpecker			
Birds	*Nucifraga columbiana*	Clark's Nutcracker			
Birds	*Numenius americanus*	Long-billed Curlew			S
Birds	*Oreoscoptes montanus*	Sage Thrasher			S
Birds	*Otus flammeolus*	Flammulated Owl		S	S
Birds	*Picoides arcticus*	Black-backed Woodpecker		S	S

Group	Scientific Name	Common Name	US FWS[a]	US FS[b]	BLM[b]
Birds	*Podiceps auritus*	Horned Grebe			
Birds	*Spizella breweri*	Brewer's Sparrow			S
Birds	*Troglodytes troglodytes*	Winter Wren			
Birds	*Tympanuchus phasianellus*	Sharp-tailed Grouse			
Amphibians	*Bufo boreas*	Western Toad		S	S
Amphibians	*Bufo cognatus*	Great Plains Toad		S	S
Amphibians	*Spea bombifrons*	Plains Spadefoot		S	S
Fish	*Oncorhynchus clarkii lewisi*	Westslope Cutthroat Trout		S	S
Fish	*Salvelinus confluentus*	Bull Trout	LT	T	SPS
Fish	*Phoxinus eos*	Northern Redbelly Dace			
Fish	*Thymallus arcticus*	Arctic Grayling		S	S
Invertebrates	*Oreohelix alpina*	Alpine Mountainsnail			
Invertebrates	*Oreohelix elrodi*	Carinate Mountainsnail			
Invertebrates	*Margaritifera falcata*	Western Pearlshell		S	
Plants	*Amerorchis rotundifolia*	Round-leaved Orchis		S	
Plants	*Astragalus convallarius*	Lesser Rushy Milkvetch			S
Plants	*Atriplex truncata*	Wedge-leaved Saltbush			
Plants	*Botrychium ascendens*	Upward-lobed Moonwort		S	
Plants	*Botrychium sp. (SOC)*	Moonworts			
Plants	*Cardamine rupicola*	Cliff Toothwort			
Plants	*Carex livida*	Pale Sedge			
Plants	*Cirsium longistylum*	Long-styled Thistle			
Plants	*Cypripedium passerinum*	Sparrow's-egg Lady's-slipper		S	
Plants	*Delphinium bicolor ssp. calcicola*	Limestone Larkspur			
Plants	*Downingia laeta*	Great Basin Downingia			
Plants	*Draba densifolia*	Dense-leaf Draba			
Plants	*Drosera anglica*	English Sundew		S	
Plants	*Drosera linearis*	Linear-leaved Sundew		S	
Plants	*Eleocharis rostellata*	Beaked Spikerush		S	S
Plants	*Erigeron lackschewitzii*	Lackschewitz' Fleabane		S	
Plants	*Erigeron linearis*	Linear-leaf Fleabane			S
Plants	*Listera borealis*	Northern twayblade			
Plants	*Mimulus suksdorfii*	Suksdorf Monkeyflower			
Plants	*Phlox kelseyi var. missoulensis*	Missoula Phlox		S	S
Plants	*Physaria klausii*	Divide Bladderpod			
Plants	*Physaria saximontana var. dentata*	Rocky Mountain Twinpod			
Plants	*Polygonum austiniae*	Austin's Knotweed		S	S
Plants	*Saussurea densa*	Dwarf Saw-wort			
Plants	*Schoenoplectus subterminalis*	Water Bulrush		S	
Plants	*Scorpidium scorpioides*	Scorpidium moss		S	
Plants	*Solorina spongiosa*	Fringed Chocolate Chip Lichen			

Group	Scientific Name	Common Name	US FWS[a]	US FS[b]	BLM[b]
Plants	*Sphagnum fimbriatum*	Fringed Bogmoss			

Notes:

Source: MNHP (2011).

(a) US FWS Codes = LT - Listed threatened, XN - Experimental - Nonessential population, DM - Recovered, delisted, and being monitored, LE - Listed endangered.

(b) USFS/BLM Codes = S – Sensitive, T – Threatened, SPS – Special Status Species.

3 Problem Formulation

The BERA problem formulation represents Step 3 of the eight-step ERA process (Figure 1.1). As part of baseline problem formulation, a refinement of the screening-level problem formulation (as reported in the BERA Work Plan [Gradient, 2010]) is performed based on additional site information. This additional site information is used to establish the scope and goals of the BERA (US EPA, 1997). The baseline problem formulation process includes the following:

- Refining contaminants of potential concern;
- Further characterizing ecological effects of contaminants;
- Reviewing and refining information on contaminant fate and transport, complete exposure pathways, and ecological receptors potentially at risk;
- Selecting assessment endpoints; and
- Developing a conceptual model.

3.1 Chemicals of Potential Concern

Screening-level ERAs (SLERAs) for the East Helena Facility have been conducted previously (US EPA, 2005a; Gradient, 2010). These analyses have focused on a number of potential chemicals of interest (COIs), including Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn. The results of the screening-level risk analyses identified the following metals as potential risk drivers (*i.e.*, COPCs): Sb, As, Cd, Cu, Pb, Mn, Hg, Se, Tl, and Zn (US EPA, 2005a; Gradient, 2010). In addition, data gaps were identified with respect to detection limits and sample coverage in various ecological areas (Gradient, 2010). The baseline problem formulation allows for elimination of COPCs using additional data and more realistic exposure assumptions (US EPA, 1997; US EPA, 2001) than the conservative assumptions used in the SLERA. Additional analyses were performed using historic and recent 2010 data to refine COPCs and focus the BERA on the likely risk drivers at the site (see Section 4).

3.2 Ecological Effects Evaluation of Chemicals of Potential Concern

The primary COPCs are metals/metalloids present in various site media due to historic smelting and refining activities: Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn. Each of these metals are naturally present in soils, sediments, and surface waters. However, Facility-related activities have resulted in the release and accumulation of some of these metals in abiotic and biotic media in and around the Facility.

The toxicity of these metals to ecological receptors present at the site depends on a number of factors, such as: the doses to which organisms are exposed, the route of exposure, the characteristics of an individual organism (*i.e.*, age, size, life stage), the chemical form of the metal, and the chemical conditions of the site. Organisms have evolved homeostatic mechanisms that regulate the uptake and excretion of metals to maintain tissue concentrations within desirable ranges and to prevent toxicity (Kapustka *et al*., 2004). For certain metals and organisms, bioaccumulation is required to maintain the organism's health and normal function; this is the case for essential trace metals such as Cu, Cr and Zn. In other situations, bioaccumulation of metals produces residues in plants and animals that can cause direct toxicity (*e.g.*, Cu toxicity to aquatic organisms) or indirect toxicity to consumers (*e.g.*, Se toxicity in birds from foraging on plants that have accumulated Se). In addition, many metals (*e.g.*, Cu and Zn) are physiologically regulated by organisms and required for normal growth and function. The metabolism of an essential element can affect the metabolism of a non-essential metal, as in the case of calcium (essential) and Pb (non-essential) in the central nervous system (Kern *et al*., 2000). Non-essential metals, such as As, Hg, and Pb, are not required for biological processes and are therefore not naturally regulated by the body. These metals can cause toxicity at various exposure levels.

Metals at the site at certain doses and under certain exposure conditions have the ability to cause adverse effects to ecological receptors. These adverse effects can be manifested in many forms, such as disruption of cellular physiology, damage to organs, alteration of organ system function, growth impairment, reduced fecundity, altered behavior, developmental abnormalities, and/or reduced survival. Chronic dietary exposure to elevated levels of metals may cause a variety of effects in mammals and birds, including weakness, paralysis, conjunctivitis, dermatitis, decreased growth, liver and kidney damage, neurological damage, reproductive failure, and developmental effects in offspring, depending on the metal of concern (Eisler, 1988). The degree of toxicity and the rate of metal uptake are dependent on the chemical form and the geochemical properties of the medium where it is found. For example, the methylated form of Hg is more toxic to wildlife and more bioaccumulative than the ionic form. Water chemistry (pH, dissolved organic carbon, alkalinity, water hardness) can all affect metal speciation, bioavailability, and toxicity. For instance, water hardness affects the degree of toxicity of Cd, Cr, Cu, Pb, Ni, Ag, and Zn. The toxicity of these metals decreases with increasing water hardness due to competition of calcium and magnesium ions (which contribute to hardness) with metals for binding sites on the organism.

For the purposes of the BERA, and consistent with US EPA (1997) guidance, the primary effects evaluated herein are reductions in the survival, growth, and reproduction of ecological receptors. To assess potential effects of the metals/metalloids present at the site, toxicity reference values (TRVs) have been compiled to represent concentrations or doses that are not expected to significantly affect the survival, growth, and reproduction of the receptors under investigation. Additional information on the identification of these TRVs is presented in Appendix C.

3.3 Ecological Receptors Potentially at Risk

Ecological receptors that may be exposed to Facility-related metals occur in terrestrial systems such as the vegetated upland areas around the Facility perimeter, the sparsely vegetated area between Lower and Upper Lakes, the marshes surrounding Upper Lake, and the riparian corridor along Prickly Pear Creek, as well as in aquatic systems, including Prickly Pear Creek, Wilson Ditch, and Upper and Lower Lakes.

Categories of ecological receptors that are potentially affected include terrestrial plants, aquatic and wetland plants, soil fauna, aquatic invertebrates, reptiles and amphibians, fish, birds, and mammals. Each category encompasses a range of functional groups, such as terrestrial insectivores or piscivores, which differ by habitat utilization and food preferences. The particular species composition of aquatic and terrestrial communities varies among habitats at the Facility (see Section 2.4 and 2.5).

The selected ecological receptors represent the types of organisms most likely to be exposed to the COPCs at the Upper and Lower Lakes, Prickly Pear Creek, Upper Lake Marsh, Wilson Ditch, and upland habitats at the site. These receptors are representative of the key functional and structural components of the ecosystems under study. They are selected on the basis of:

- Relative abundance and ecological importance within the selected habitats;
- Availability and quality of applicable toxicological literature;
- Relative sensitivity to the COPCs;
- Trophic status;

- Relative mobility and local feeding ranges; and
- Ability to bioaccumulate COPCs.

The applied approach herein for selecting representative species for assessing wildlife exposures is a common practice in ERA (US EPA, 1997). The selected species are chosen to represent different feeding guilds. A guild is a group of animals within a habitat that use resources in a similar way. Coexisting members of guilds are similar in terms of habitat requirements, dietary habitats, and functional relationships with other species in the habitat. The guild approach allows focused integration of many variables related to potential exposure. These variables include characteristics of COPCs (toxicity, bioaccumulation, and mode of action) and characteristics of potential receptors (habitat, range, feeding requirements, and relationships among species). This approach evaluates potential exposures to all animals by considering the major feeding guilds found in a habitat. It is assumed that evaluation of the potential effects of COPCs on the selected representative species will be representative of potential effects of COPCs to other species within each feeding guild. The primary ecological receptor groups are discussed below and representative receptors are identified in Section 3.5

Benthic invertebrates are an important ecological receptor group in all aquatic areas on and near the Facility because they: have the greatest potential exposure to metals in sediments; provide a food source for fish, mammals, and birds; and are relatively immobile and, therefore, reflective of local conditions.

Fish are an important ecological receptor group in aquatic areas on and near the Facility because they: are in direct contact with surface water and some species are in close or direct contact with sediment; provide a food source for piscivorous birds and mammals; and are of societal value. Fish are present in Upper Lake and Upper Lake Marsh, Prickly Pear Creek, Lower Lake and Wilson Ditch. While some fish were observed in Wilson Ditch close to its connection point with Upper Lake, it can be assumed that Wilson Ditch typically does not provide adequate fish habitat given that it is dry for a significant period of the year (approximately October-March).

Amphibians (*e.g.*, Columbia spotted frog) are an important ecological receptor group in aquatic and riparian areas of the site. Amphibians may be exposed to metals through contact with surface water, sediment, soil, or prey items. They also provide a prey base for carnivorous birds and mammals and are of societal value. Amphibian species were observed along Prickly Pear Creek, Upper Lake and Upper Lake Marsh.

Terrestrial and wetland plant communities are an important ecological receptor group in aquatic, riparian, and upland areas of the site. Soil faunal communities are an important ecological receptor group in riparian and upland areas of the site. Terrestrial and wetland plant communities and soil faunal communities are important indicators of ecosystem health; they are in direct contact with metals in soil and sediment (and surface water in the case of wetland or aquatic plants), and they are at the base of aquatic and terrestrial food chains.

Piscivorous, omnivorous, herbivorous, and invertivorous/insectivorous birds and mammals that consume biota and plants at lower levels of the food chain are important ecological receptor groups for aquatic, wetland, and upland areas at the site. They are exposed to contaminants through multiple media (*e.g.*, sediment, surface water, wetland soil, plants, and prey), represent higher trophic levels, and, thus, provide an estimate of risk from bioaccumulative chemicals.

3.4 Exposure Pathways

An exposure pathway is the route a chemical takes from its source to its endpoint and the means by which it comes into contact with receptors. A complete exposure pathway consists of the following five elements (US EPA, 1997):

- A source of contamination;
- A mechanism of release, retention, or transport of a chemical to a given environmental medium (*e.g.*, sediment, water, soil);
- A point of contact with the environmental medium (*i.e.*, exposure point);
- A route of exposure at the point of contact (*e.g.*, incidental ingestion, direct contact); and
- A receptor population (potentially or actually exposed).

If any of these five elements are missing, the pathway is considered incomplete (*i.e.*, it does not present a means of exposure). Only those exposure pathways judged to be potentially complete are of concern and require evaluation in the BERA (exposure pathways for the site are described further in the CSM; Section 3.5). Additionally, exposure to naturally occurring metals is likely throughout the area, both beyond and within the Facility, through the pathways described above. Background exposures from naturally occurring chemicals or from non-Facility related sources (*e.g.*, atmospheric deposition, typical urban runoff) are characterized by measuring or estimating exposure at reference locations.

The sources of contaminants (metals) at the site are from former stack and fugitive emissions, process fluids, slag, and other wastes from historical smelter operation. Metals can be released and transported from these sources *via* wind and aerial deposition, surface water runoff and soil erosion, and leaching to groundwater. Once released to the environment, some of the metals may become dissolved or suspended in surface water, co-deposited with or adsorbed to sediments, incorporated into soil, or leached into groundwater. Consequently, metals can potentially enter the food web through uptake into plants and prey, which then could be consumed by higher trophic level ecological receptors.

Surface water and sediment may be affected by direct discharge (such as historical discharges to Lower Lake, a former process pond), surface runoff, and groundwater discharge to surface water. Aquatic ecological receptors (benthic invertebrates, fish, amphibians, and aquatic birds and mammals) may come in contact with metals in the sediments and surface water of Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch or through direct contact and ingestion of contaminated aquatic plants or prey.

Discharge from groundwater to surface water can present a significant pathway for exposure of aquatic organisms. According to the Phase I RFI (ACI, 2005), metals from historical site activities are present in groundwater beneath the Facility. Based on hydrogeologic information, the direction of groundwater flow beneath the Facility is generally to the north and northwest. However, local groundwater flow to Prickly Pear Creek occurs as seepage from Lower Lake through the earthen berm that separates the pond and the creek. As a result, there is a component of groundwater flow on the northeast side of Lower Lake that flows toward Prickly Pear Creek.

The primary exposure pathway for terrestrial plants is the uptake or absorption of metals incorporated into soil; for aquatic and wetland plant species, the primary exposure pathway is uptake or absorption *via* sediment and surface water. Soil fauna (represented by soil invertebrates) can be exposed through direct contact with metals in soil or through (incidental) ingestion of metals in soil.

Primary exposure pathways for wildlife receptors in the aquatic environments include the ingestion of surface water, consumption of contaminated plant material or prey, incidental ingestion of sediment during foraging or preening, and direct contact with surface water and sediment. Direct contact with sediment and surface water is a potential exposure pathway for birds and mammals, but this route is insignificant relative to the ingestion route. The exposure pathways for terrestrial and aquatic wildlife receptors that were investigated include indirect exposure *via* ingestion of metals in plants and prey and direct and incidental ingestion of metals in surface water, sediment, and surface soil.

3.5 Conceptual Site Model

A CSM is a planning tool used for identifying chemical sources, potentially affected environmental media, exposure pathways, and potential ecological receptors on which to focus a risk assessment. The ecological CSM describes the network of relationships between chemicals released from former Facility operations and the ecological receptors (plants and animals) that may be exposed to them through pathways such as direct contact or ingestion of food or water. The CSM examines the range of potential exposure pathways, identifies those that are present that may be important for ecological receptors, and eliminates those pathways that are incomplete or insignificant and, therefore, not expected to pose a significant risk. The geographical units, ecological receptor groups, and exposure pathways evaluated in the BERA are discussed below and depicted in the East Helena Facility CSM (Figure 3.1).

3.5.1 Ecological Exposure Units

There are a number of distinct habitats (*e.g.*, riverine, lacustrine, riparian, terrestrial) present on or near the Facility. Therefore, the site has been divided into units such that exposure conditions and ecological receptors can be evaluated separately. In addition, evaluation of potential risks *via* these distinct exposure units may aid and focus remedial decisions and activities. The ecological exposure units that are evaluated in the BERA are (Map 2):

- Prickly Pear Creek and Riparian areas;
- Upper Lake and Upper Lake Marsh;
- Wilson Ditch;
- Lower Lake;
- Tito Park; and
- Terrestrial areas along the site perimeter.

3.5.2 Ecological Receptors

It is not feasible to evaluate every plant, invertebrate, fish, bird and mammal species that may be present and potentially exposed to COPCs at the site. Consequently, receptors believed to be representative of broader groups of organisms were selected for evaluation (referred to as "representative receptors"). Representative ecological receptors were selected based on current information on habitat types present and potential for exposure to site media (discussed in Section 3.3). Each receptor was chosen to represent a trophic category and/or particular feeding behaviors that would represent different modes of exposure to COPCs. Thus, the species that were chosen for evaluation may represent hundreds of similarly exposed species in the area. The following criteria were used to select potential receptors:

- The receptor was present or likely to utilize habitats at the site.
- The receptor was important to either the structure or function of the ecosystem.
- The receptor was known to be either sensitive or highly exposed to COPCs at the site.

The following representative receptor groups were selected for assessment in the BERA:

- Benthic macroinvertebrate community;
- Fish;
- Amphibians;
- Aquatic/Riparian plants;
- Terrestrial plants;
- Soil invertebrates; and
- Wildlife
  - Aquatic omnivorous birds (*i.e.*, Mallard);
  - Piscivorous birds (*i.e.*, Belted Kingfisher);
  - Sediment-probing birds (*i.e.*, Sandpiper);[1]
  - Terrestrial omnivorous birds (*i.e.*, American Robin);
  - Terrestrial insectivorous birds (*i.e.*, Tree Swallow);
  - Piscivorous mammals (*i.e.*, Mink);
  - Terrestrial invertivorous mammals (*i.e.*, Shrew); and
  - Terrestrial herbivorous mammals (*i.e.*, Vole).[1]

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[1] The sandpiper and vole were not originally identified in the BERA Work Plan (Gradient, 2010) but were added in the BERA to address important exposure pathways (specifically sediment ingestion and terrestrial/riparian plant ingestion).

3.5.3 Exposure Pathways

The potential routes of exposure describe the means by which chemicals are transferred from a contaminated medium to ecological receptors (see also Section 3.4). The primary exposure pathways to each of these receptors is presented in Figure 3.1 and defined as either:

- **Complete and significant**: There is a direct link between the receptor and chemical *via* this pathway, and the specific pathway is considered to be potentially important. Pathways classified as complete and significant are evaluated in the BERA.
- **Complete and insignificant**: There is a direct link between the receptor and the chemical *via* this pathway; however, the significance of this pathway in terms of overall exposure is considered to be very low. For example, dermal and inhalation exposures for birds and mammals were not quantitatively addressed, because they are considered relatively minor exposure pathways in relation to direct uptake and/or bioaccumulation through the food chain. Pathways classified as complete and insignificant are not evaluated further in the BERA.
- **Incomplete**: There is no direct pathway between the receptor and the chemical. Pathways classified as incomplete are not evaluated further in the BERA.

Complete and significant exposure pathways at the site generally include exposures through contact with or ingestion of COPCs in sediments, soils, surface waters, plants and prey. Aquatic invertebrates may be exposed to chemicals in sediment and surface water through ingestion and direct contact. They may ingest sediment, biofilm, and surface water during feeding or burrowing, and they can absorb chemicals from sediment, sediment porewater, and surface water through their epidermis. Aquatic invertebrates also serve as a major route for food-chain transfer because they are prey for fish, amphibians, birds, and mammals. Fish may be exposed to chemicals in sediment and surface water through ingestion, dermal contact, and uptake through gills or by feeding on contaminated plants, aquatic invertebrates, or smaller fish. Fish also provide a significant route for food-chain transfer because they are prey for many fish-eating organisms and humans. Aquatic plants can absorb chemicals from soil/sediment and surface water through their roots, leaves, or stems, and can store these chemicals in their tissues. Plants also serve as a source of exposure to herbivorous organisms. Amphibians may be exposed to chemicals in soil/sediment and surface water through ingestion or dermal contact and by feeding on contaminated aquatic and terrestrial invertebrates. Amphibians are prey for a number of fish, reptiles, birds, and mammals, and this provides an avenue for the transfer of chemicals.

Terrestrial plants absorb and store chemicals from soils through root uptake. Some plants may accumulate contaminants to a small degree while others may hyperaccumulate certain metals. Plants may also store metals to varying degrees in roots, shoots, bulbs, or leaves. Depending on the feeding patterns of herbivorous organisms, some plants may provide an exposure route to COPCs at the site. Terrestrial invertebrates absorb chemicals from soils through their epidermis or ingestion during feeding or burrowing. Terrestrial invertebrates are a major route of food-chain transfer because they are prey for many birds, amphibians, and mammals. Birds and mammals may be exposed to chemicals in sediment, surface water, and soils and through incidental ingestion, dermal contact, inhalation of particulates, and ingesting contaminated prey or forage items. Ingestion of soils or sediments may result from consumption of prey or through grooming behaviors. Smaller birds and mammals can transfer chemicals as prey for larger carnivorous birds and mammals.

3.6 Assessment Endpoints

This section presents the rationale for selection of assessment endpoints for the BERA and discusses the ecological risk management goals for the site. US EPA states that "assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site" (US EPA, 1997). Ecological risk management goals are defined as a general statement about the desired condition of ecological values of concern (US EPA, 1998). The selection of the assessment endpoints should reflect the ecological risk management goals for the site.

The overall risk management goal for the Facility is to reduce ecological risks, if necessary, to levels that will result in the maintenance of healthy local populations and communities of plants and organisms. This is consistent with the first principle of ecological risk management outlined by US EPA (1999a) in its guidance, "Ecological Risk Assessment and Risk Management Principles for Superfund." Specific ecological risk management goals for the Facility are to:

- Maintain healthy, viable local fish and amphibian populations in Prickly Pear Creek, Upper Lake, and Upper Lake Marsh;
- Maintain healthy, viable local populations of invertebrates, birds, and mammals that use habitat associated with Prickly Pear Creek, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland habitats on or near the Facility; and
- Maintain healthy, viable local communities of terrestrial and aquatic/wetland plants associated with upland and aquatic habitats on or near the Facility.

The selection of the assessment endpoints should consider ecologically relevant receptor groups that are potentially highly exposed to the COPCs, attributes of the natural history of these receptors, and potentially complete exposure pathways (US EPA, 1997). The ecological receptors evaluated in each of the exposure areas are presented in Table 3.1. The assessment endpoints for the BERA are:

- Survival, growth, and reproduction of benthic invertebrate populations in Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch;
- Survival, growth, and reproduction of fish populations in Prickly Pear Creek, Lower Lake, Upper Lake, and Upper Lake Marsh;
- Survival, growth, and reproduction of amphibian populations in Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas of the site (Tito Park, Site Perimeter and Facility Soils);
- Survival, growth, and reproduction of aquatic plant communities in Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch;
- Survival, growth, and reproduction of aquatic avian and mammalian wildlife populations that frequent Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch;
- Survival, growth, and reproduction of soil faunal communities in the riparian zones of Prickly Pear Creek, Lower Lake, Upper Lake, and Upper Lake Marsh, and in upland areas of the site;
- Survival, growth, and reproduction of terrestrial plant communities in the riparian zones of Prickly Pear Creek, Lower Lake, Upper Lake, and Upper Lake Marsh, and in upland areas of the site; and
- Survival, growth, and reproduction of terrestrial avian and mammalian wildlife populations that frequent the riparian zones of Prickly Pear Creek, Lower Lake, Upper Lake, and Upper Lake Marsh, and the upland areas of the site.

Table 3.1
Ecological Receptors Assessed in Each Exposure Unit

	Ecological Exposure Units (Section 3.5.1)					
Receptor Group (Section 3.5.2)	**Prickly Pear Creek**	**Upper Lake/Marsh**	**Lower Lake**	**Wilson Ditch**	**Tito Park**	**Perimeter (East and West)**
Benthic invertebrates	x	x	x	x		
Fish	x	x	x			
Amphibians	x (including riparian)	x (including riparian)	x (including riparian)	x	x	x
Aquatic plants	x	x	x	x		
Aquatic birds/mammals	x	x	x	x		
Terrestrial plants	x (only riparian)	x (only riparian)	x (only riparian)		x	x
Terrestrial invertebrates	x (only riparian)	x (only riparian)	x (only riparian)		x	x
Terrestrial birds/mammals	x (only riparian)	x (only riparian)	x (only riparian)	x	x	x

Ecological risk questions should be based on the assessment endpoints and provide a basis for developing the study design and evaluating the results of the site investigation in the analysis phase and during risk characterization (US EPA, 1997). The BERA has been designed to answer the following ecological risk questions (based on the assessment endpoints) for the site, now and under future use scenarios:

- Survival, growth, and reproduction of benthic invertebrate populations
  - ▶ Are the concentrations of metals in sediments (and AVS/SEM), porewater, and surface water from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch greater than benchmarks for survival, growth, or reproduction of benthic invertebrates?
  - ▶ Is the survival or growth (*i.e.*, biomass) of benthic invertebrates, as indicated by *Hyalella azteca* and *Chironomus dilutus*, exposed to bulk sediments significantly lower than laboratory controls or reference sites?
  - ▶ Is the structure of benthic invertebrate communities at the site outside the range for communities from reference areas?
  - ▶ Are benthic invertebrates at the site exposed to metals concentrations in sediment, porewater, and surface waters that are significantly higher than concentrations at reference sites?
- Survival, growth, and reproduction of fish populations
  - ▶ Are the concentrations of metals in porewater, surface water, sediment, tissues, and prey items from Prickly Pear Creek, Lower Lake, Upper Lake, and Upper

    - Lake Marsh greater than benchmarks for survival, growth, or reproduction of fish?
    - Are fish at the site exposed to metals concentrations in sediment, porewater, and surface waters that are significantly higher than concentrations at reference sites?
- Survival, growth, and reproduction of amphibian populations
    - Are the concentrations of metals in sediment, porewater, surface water, soil, and biota from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas greater than benchmarks for survival, growth, or reproduction of amphibians?
    - Are amphibians at the site exposed to metals concentrations in sediment, porewater, surface water, soil, or biota that are significantly higher than concentrations at reference sites?
- Survival, growth, and propagation of terrestrial and wetland plant communities
    - Are the concentrations of metals in porewater, surface water, and soils from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas greater than benchmarks for survival, growth, or reproduction of plants?
    - Are plant communities at the site exposed to metals concentrations in porewater, surface water, and soil that are significantly higher than concentrations at reference sites?
- Survival, growth, and propagation of terrestrial invertebrate communities
    - Are the concentrations of metals in soils from upland areas greater than benchmarks for survival, growth, or reproduction of soil invertebrates?
    - Are terrestrial invertebrates at the site exposed to metals concentrations in soil that are significantly higher than concentrations at reference sites?
- Survival, growth, and reproduction of avian and mammalian wildlife populations
    - Are daily dietary COPC doses for birds and mammals that inhabit Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas at the site greater than TRVs for survival, growth, or reproduction?
    - Are COPC concentrations in site prey items greater than concentrations from reference sites?

To answer the risk questions for each assessment endpoint, a weight-of-evidence approach using multiple measures of effect are examined for each assessment endpoint. These include measures of exposure, effect, and receptor and ecosystem characteristics, as described below:

- Habitat characterization and ecological community observations to verify exposure pathways, characterize use of each habitat or exposure area by ecological receptors, and make observations regarding habitat quality and ecosystem and plant community health;

- Comparison of measured environmental concentrations in surface soil and sediment to screening benchmark values published in the scientific literature, technical literature, or government documents;
- Chemical and physical parameter measures such as pH, TOC, AVS and SEM, and grain size for sediment;
- Site-specific sediment toxicity tests to evaluate the effects of metals on survival and growth of benthic invertebrates;
- Measured concentrations of metals in sediment, prey fish, benthic invertebrates, and larger predatory fish to evaluate exposure and the potential for adverse effects on the survival and reproduction of higher-trophic-level fish;
- Wildlife exposure estimates from food-chain modeling (using measured or modeled concentrations in prey items, surface water, sediment, and surface soil) compared to TRVs from the scientific literature for endpoints related to survival and reproduction; and
- Statistical comparisons of measures of exposure and effects from areas affected by site-related metals to reference sites.

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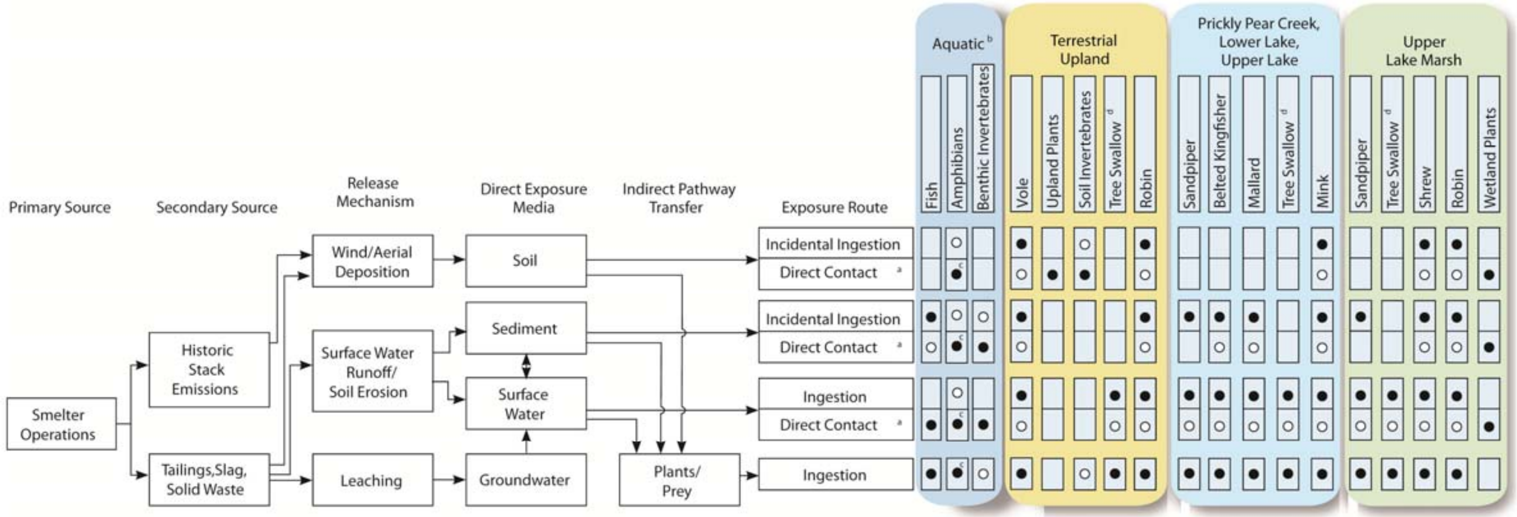

		Aquatic [b]			Terrestrial Upland					Prickly Pear Creek, Lower Lake, Upper Lake					Upper Lake Marsh				
	Exposure Route	Fish	Amphibians	Benthic Invertebrates	Vole	Upland Plants	Soil Invertebrates	Tree Swallow [d]	Robin	Sandpiper	Belted Kingfisher	Mallard	Tree Swallow [d]	Mink	Sandpiper	Tree Swallow [d]	Shrew	Robin	Wetland Plants
Soil	Incidental Ingestion		○		●		○		●					●			●	●	
	Direct Contact [a]		●[c]		○	●	●		○					○			○	○	●
Sediment	Incidental Ingestion	●	○	○	●				●	●	●	●		●	●		●	●	
	Direct Contact [a]	○	●[c]	●	○				○		○	○		○			○	○	●
Surface Water	Ingestion		○		●			●	●	●	●	●	●	●	●	●	●	●	
	Direct Contact [a]	●	●[c]	●	○			○	○	○	○	○	○	○	○	○	○	○	●
Plants/ Prey	Ingestion	●	●[c]	○	●		○	●	●	●	●	●	●	●	●	●	●	●	

● Complete; evaluated quantitatively

○ Complete but insignificant compared to other pathways; evaluated qualitatively.

☐ Incomplete

[a] Also includes absorption for plants

[b] Will be evaluated for Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch

[c] Evaluation of this exposure pathway for amphibians will be dependent on the available toxicity information

[d] Tree swallows primarily consume flying insects and are indirectly exposed to soils or sediments through the dietary parthway

Gradient

Conceptual Site Model

FIGURE 3.1

Date: 12/7/2011

4 Analysis Plan

The problem formulation (Section 3) phase leads into Steps 4 and 5 of the ERA process (see Figure 1.1). Steps 4 and 5 include the design and implementation of a BERA Work Plan and a Field Sampling and Analysis Plan (FSAP), which were finalized in 2010 (Gradient, 2010; GEI and Gradient, 2010; Appendix A). Step 6 of the risk assessment process (see Figure 1.1) includes an analysis of potential exposures and ecological effects at the site (US EPA, 1997, 1998). The analysis phase provides a connection between the problem formulation and the risk characterization by using the CSM and assessment endpoints as a framework for the analyses (US EPA, 1998). During Steps 4 and 5, an ecological investigation was performed to measure attributes that will be employed to quantify and predict changes of the assessment endpoints developed during the problem formulation (Section 3.6). There are three categories of measures: (1) exposure, (2) effect, and (3) ecosystem characteristics. Measures of exposure quantify chemical concentrations and follow their movement in the environment and contact or co-occurrence with the assessment endpoint. Measures of effect are quantifiable changes in an attribute of an assessment endpoint in response to a stressor (*e.g.*, growth or survival in a toxicity test). Measures of ecosystem characteristics are measures that influence the behavior and location of entities selected as the assessment endpoint, the distribution of a stressor, and life-history characteristics of the assessment endpoint or its surrogate that may affect exposure or response to the stressor (US EPA, 1998). The following sections describe the available data (*i.e.*, measures of exposure, effect, and ecosystem characteristics) that were utilized and the analyses that were performed to characterize risks to ecological receptors at the site.

4.1 Available Data for the Ecological Risk Assessment

As described in Section 2, a number of site investigations have been conducted to characterize the presence and distribution of metals throughout each of the exposure areas. In response to earlier investigations, interim remedial actions have been implemented to reduce contaminant release and transport (see Section 2.3). In order to assess baseline conditions in the risk assessment, the most current and ecologically relevant data were used to represent existing exposures to contaminants at the Facility. The most recent ecological investigations at the site occurred from 2000 through 2010 (ACI, 2005; US EPA, 2005a; GEI and Gradient; 2010 Hydrometrics, 2010), and data collected during this time period were utilized for exposure estimation in the BERA. Previous datasets collected in the 1980s and 1990s (see Section 2) were considered out of date and, in most cases, not relevant due to remedial actions that have been implemented since the data were originally collected.

Environmental data were collected from each CSM unit (Section 3.5.1) and also from reference areas for comparison; reference areas were the Prickly Pear Creek upstream, Walker Creek pond and marsh, and Canyon Ferry Reservoir. A summary of data used in the BERA is presented in Appendix B. Aquatic and terrestrial environmental media sampling stations are presented on Maps 5a, 5b, 6a, 6b, and 7. Datasets for surface water, sediment, sediment porewater, soil, and tissue chemistry are presented, as well as results of benthic community analyses and sediment toxicity tests (Appendix B). Habitat characterizations were conducted as part of the 2010 ecological investigation and are reported in Appendix A. Chemistry results for most samples include data for each of the 19 metal constituents targeted during the ecological investigations (*i.e.*, Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn). A summary of the number of samples available for each environmental medium and CSM unit is presented in Table 4.1.

4.2 Refined Screening Level Ecological Risk Assessment

SLERAs for the Facility have been conducted previously (US EPA, 2005a; Gradient, 2010). The results of these analyses identified the following metals as potential COPCs: Sb, As, Cd, Cu, Pb, Mn, Hg, Se, Tl, and Zn (US EPA, 2005a; Gradient, 2010). Several data gaps were identified in these prior screening analyses with respect to detection limits and sample coverage in various ecological areas of the Facility (Gradient, 2010). The problem formulation process allows for a refinement of preliminary COPCs using additional data and more realistic exposure assumptions (US EPA, 1997; US EPA, 2001). In general, the refined SLERA compared available data (Appendix B) to conservative toxicity benchmarks (Appendix C) for each ecological receptor group. The refined SLERA results in a scientific decision management point (SMDP) that identifies those chemicals that are either unlikely to pose a risk to ecological receptors, or have the potential to pose a risk to ecological receptors (US EPA, 1997). Those chemicals that are identified as potential risk drivers are evaluated further in the BERA using additional lines of evidence and more realistic exposure assumptions. Metals without appropriate screening benchmarks are also carried forward to the BERA.

Table 4.1
Number of Samples for Measurable Attributes Analyzed in the BERA

	CSM Units								
	Reference[a]					Site			
Matrix	Prickly Pear Creek (Upstream)	Canyon Ferry Reservoir	Walker Creek (Pond/ Marsh)	Prickly Pear Creek (adjacent to site)	Upper Lake/ Marsh	Wilson Ditch	Lower Lake	Tito Park	Site Perimeter
Measures of Exposure									
Surface Water	9	2	10	132	30	9	28	-	-
Sediment	8	2	10	13	26	5	8	-	-
Sediment Porewater	1	2	-	6	4	-	-	-	-
Soil	-	-	6	6	5	-	4	31	30
Benthic Invertebrates	5	1	10	5	12	1	5	-	-
Other Aquatic Invertebrates	-	-	-	3	6	1	3	-	-
Forage Fish	-	1	-	3	10	1	-	-	-
Piscivorous Fish	-	-	-	5	10	-	-	-	-
Game Fish (fillet)	6	-	5	5	8	-	-	-	-
Aquatic Plants/Algae	-	1	-	-	8	-	-	-	-
Amphibians	-	-	1	-	4	-	-	-	-
Earthworms	-	-	6	2	4	-	-	-	-
Terrestrial Invertebrates	-	-	-	2	1	-	2	2	4
Measures of Effect									
Sediment Toxicity Tests	4	2	-	6	6	-	1	-	-
Measures of Ecosystem and Receptor Characteristics									
Surface Water Characteristics (hardness, DO, pH)	9	2	10	132	30	9	28	-	-
Sediment Characteristics (AVS/SEM, grain size, TOC, pH)	5	-	10	6	10	1	5	-	-
Soil Characteristics (grain size, TOC, pH)	-	-	5	4	8	-	-	5	13
Habitat Reconnaissance	Y	-	Y	Y	Y	Y	Y	Y	Y
Qualitative Fish Health Field Observations	Y	-	Y	Y	Y	-	Y	-	-
Benthic Community Analyses	1	1	-	4	2	-	-	-	-

Note:

*(a) Prickly Pear Creek upstream, Canyon Ferry Reservoir, and Walker Creek areas were selected as reference sites during 2005 and 2010 ecological investigations (US EPA, 2005*a*; GEI and Gradient, 2010).*

The refined screening analysis was performed in the same manner for each ecological receptor group. The maximum concentration for each chemical and CSM unit was identified for each environmental medium representing a primary exposure pathway to the ecological receptor groups. The maximum value was compared to a conservative toxicity benchmark using the HQ method.

HQ = Environmental Concentration / Toxicity Benchmark

A HQ greater than 1.0 indicates that there is a likelihood of risk from exposure to a COPC at concentrations measured in the CSM unit. A HQ < 1.0 indicates, with a high degree of confidence, that minimal risk exists for the given COPC, since toxicity benchmarks were selected based on the lowest measurable concentration considered to be protective of the most sensitive organism relative to an exposure defined by the maximum concentration (Appendix C). The following sections describe the process and results for the refined screening analysis for each receptor group of concern. Detailed screening tables are provided in Appendix D.

4.2.1 Benthic Invertebrates

The refined SLERA evaluated the primary exposure pathways and media for benthic invertebrates: surface water (total, total recoverable, and dissolved), sediment, and dissolved porewater concentrations. Maximum concentrations for each metal analyte and CSM unit are presented in Appendix D. The conservative screening benchmarks were selected based on the following hierarchy:

- **Surface Water and Porewater**: The conservative benchmarks included the lowest value from either the US EPA freshwater ambient water quality criteria (AWQC) (US EPA, 2009) or MDEQ's (2008) freshwater quality criteria. These criteria are intended to protect 95% of aquatic species from acute effects and the majority of aquatic organisms from unacceptable chronic effects (US EPA, 1985b). In some cases, water quality criteria were not available and other conservative water quality benchmarks were adopted from US EPA's Great Lakes Initiative Clearinghouse (US EPA, 2010b). Details on these criteria are provided in Appendix C. Screening analyses for hardness-dependent metals (*i.e.*, Cd, Cr, Cu, Pb, Mn, Ni, Ag, and Zn) was conducted using sample-specific hardness adjustments. Typically, dissolved surface water concentrations are analyzed for aquatic life; however, criteria from MDEQ (2008) are based on the total recoverable fraction. Therefore, to provide a comprehensive analysis of surface water data, dissolved, total, and total recoverable fractions were compared to appropriate surface water benchmarks.
- **Sediment**: Sediment toxicity benchmark values are primarily based on the consensus-based threshold effect concentration (TEC) values published by MacDonald *et al*. (2000). The TEC value is the concentration below which adverse effects are not expected to

> occur (MacDonald *et al*., 2000). TECs are available for As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn. For metals without TECs, similar no effect or low effect sediment benchmarks were obtained from other sources (US EPA, 1996; Long and Morgan, 1990; Persaud *et al*., 1993). Appendix C provides details on each of the sediment benchmarks.

Comparisons of maximum sediment, porewater, and surface water concentrations to benchmarks are presented in Appendix D; the results are summarized below:

- **Surface Water**: Based on dissolved, total, and total recoverable concentrations, 12 of the 19 metals evaluated were above the reported benchmarks in at least one CSM unit, although the metals in each circumstance differed (Table 4.2).
- **Hardness-Dependent Metals**: Metals were evaluated, normalized for water hardness, on a sample-specific basis using dissolved, total, and total recoverable concentrations. Of the eight metals examined, only Cr and Ni did not exceed acute or chronic benchmarks in any of the CSM units for any of the surface water measures (Table 4.2).
- **Porewater**: Porewater concentrations were higher than the reported benchmarks for nine of the 19 metals (Table 4.2). Chromium, Cu, Ni, and Ag were the hardness-dependent metals that did not exceed acute or chronic criteria in porewater.
- **Sediment**: Metal concentrations in sediments were evaluated and 15 metals were above TEC values (Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Ag, and Zn) or did not have a sediment benchmark available for comparison (Ba, Be, Se, Tl, and V) (Table 4.2).

In surface water, porewater, and sediment, Cr and Co did not exceed the screening benchmark at any location; therefore, these metals will not be evaluated further for benthic invertebrates in the BERA. Concentrations of Ba, Be, and V did not exceed surface water benchmarks; however, sediment benchmarks were not available and, therefore, these metals are evaluated further in the BERA using other lines of evidence (*e.g.*, toxicity tests results). The following metals exceeded one or more of the screening benchmarks and are evaluated further in the BERA for benthic invertebrates: Al, Sb, As, Cd, Cu, Fe, Pb, Mn, Hg, Ni, Ag, Tl, and Zn.

Table 4.2
Summary of Screening Results for Aquatic Receptors

	Surface Water					
Metal	Dissolved	Total	Total Recoverable	Porewater	Sediment	Fish Dietary Items
Al	n	Y	Y	Y	n	no BM
Sb	Y	Y	n	Y	Y	no BM
As	Y	Y	Y	Y	Y	Y
Ba	n	n	n	n	Y (no BM)	no BM
Be	n	n	n	n	Y (no BM)	no BM
Cd	Y	Y	Y	Y	Y	Y
Cr	n	n	n	n	n	no BM
Co	n	n	n	n	n	no BM
Cu	Y	Y	Y	n	Y	Y
Fe	n	Y	Y	Y	n	no BM
Pb	Y	Y	Y	Y	Y	Y
Mn	Y	Y	n	Y	Y	no BM
Hg (including MeHg)	n	n	n	n	Y	no BM
Ni	n	n	n	n	Y	no BM
Se	Y	Y	Y	Y	Y (no BM)	Y
Ag	Y	Y	Y	n	Y	no BM
Tl	Y	Y	Y	n	Y (no BM)	no BM
V	n	n	n	n	Y (no BM)	no BM
Zn	Y	Y	Y	Y	Y	n

Notes:

Detailed screening tables provided in Appendix D.

Y = the maximum concentration exceeded the screening benchmark in at least one CSM unit and the metal is evaluated further in the BERA.

n = the maximum concentration did not exceed the screening benchmark in any CSM unit.

no BM = no benchmark was available for screening.

4.2.2 Fish

The refined SLERA evaluated the primary exposure pathway for fish, which is primarily uptake from surface water (total, total recoverable, and dissolved) *via* gill uptake. Other routes of exposures that were also evaluated included contact with dissolved porewater concentrations and dietary uptake (*via* invertebrates, aquatic plants, forage fish, and incidental sediment ingestion). Detailed screening tables are provided in Appendix D and a summary of the results is presented in Table 4.2. The conservative screening benchmarks were selected based on the following hierarchy:

- **Surface Water and Porewater**: The conservative benchmarks included the lowest value from either the US EPA freshwater AWQC (US EPA, 2009) or MDEQ's (2008) freshwater quality criteria. These criteria are intended to protect 95% of aquatic species from acute effects and the majority of aquatic organisms from unacceptable chronic effects (US EPA, 1985b). In some cases, water quality criteria were not available and other conservative water quality benchmarks were adopted from US EPA's Great Lakes Initiative Clearinghouse (US EPA, 2010b). Details on these criteria are provided in

Appendix C. Screening analyses for hardness-dependent metals (*i.e.*, Cd, Cr, Cu, Pb, Mn, Ni, Ag, and Zn) were conducted using sample-specific hardness adjustments. Typically, dissolved surface water concentrations are analyzed for aquatic life; however, criteria from MDEQ (2008) are based on the total recoverable fraction. Therefore, to provide a comprehensive analysis of surface water data, dissolved, total, and total recoverable fractions were compared to appropriate surface water benchmarks.

- **Dietary Items**: Dietary uptake was another route of exposure considered. Unfortunately, limited data exist for this type of analysis. Maximum concentrations of metals (As, Cd, Cu, Pb, Se, and Zn) in benthic invertebrates, aquatic plants, forage fish, and sediment were compared to dietary toxicity thresholds. Appendix C provides details on the dietary benchmarks and Appendix D provides the screening tables. For incidental sediment ingestion, a conservative ingestion rate of 10% (based on estimated ingestion for sucker species) was assumed based on information reviewed by US EPA (1999b, 2005a).

The results of the screening process are summarized below:

- **Surface Water**: Based on dissolved, total, and total recoverable concentrations, 12 of the 19 metals evaluated were above the reported benchmarks in at least one CSM unit, although the metals in each circumstance differed (Table 4.2).
- **Hardness-Dependent Metals**: Metals were evaluated, normalized for water hardness, on a sample-specific basis using dissolved, total, and total recoverable concentrations. Of the eight metals examined, only Cr and Ni did not exceed acute or chronic benchmarks in any of the CSM units for any of the surface water measures (Table 4.2).
- **Porewater**: Porewater concentrations were higher than the reported benchmarks for nine of the 19 metals (Table 4.2). Chromium, Cu, Ni, and Ag were the hardness-dependent metals that did not exceed acute or chronic criteria in porewater.
- **Dietary Items**: Of the five metals evaluated, As, Cd, Cr, Se, and Pb were found to exceed screening benchmarks in at least one CSM units (Table 4.2).

Barium, Be, Cr, Co, Ni, and V did not exceed the available water-based screening benchmarks in any CSM unit; therefore, these metals will not be evaluated further for fish in the BERA. Arsenic, Cd, Cu, Se, and Pb concentrations in dietary items exceeded benchmarks and are evaluated further in the BERA. The following metals exceeded one or more of the screening benchmarks and are evaluated further in the BERA for fish: Al, Sb, As, Cd, Cu, Fe, Pb, Mn, Hg, Se, Ag, Tl, and Zn.

4.2.3 Aquatic Plants

The refined SLERA evaluated the primary exposure pathway for aquatic plants, which is primarily contact with surface water, porewater, and sediment. The conservative surface water screening benchmarks are the same as those described above for fish (see Appendix C). Comparisons of maximum surface water and porewater concentrations to benchmark values are presented in Appendix D and are summarized below:

- **Surface Water**: Based on dissolved, total, and total recoverable concentrations, 12 of the 19 metals evaluated were above the reported benchmarks in at least one CSM unit, although the metals in each circumstance differed.
- **Hardness-Dependent Metals**: Metals were evaluated, normalized for water hardness, on a sample-specific basis using dissolved, total, and total recoverable concentrations. Of the eight metals examined, only Cr and Ni did not exceed acute or chronic benchmarks in any of the CSM units for any of the surface water measures.
- **Porewater**: Porewater concentrations were higher than the reported benchmarks for nine of the 19 metals. Chromium, Cu, Ni, and Ag were the hardness-dependent metals that did not exceed acute or chronic criteria in porewater.

A summary of the screening analysis is presented in Table 4.2. Barium, Be, Cr, Co, Ni, and V did not exceed the available water-based screening benchmarks in any CSM unit; therefore, these metals will not be evaluated further for aquatic plants in the BERA. The following metals exceeded one or more of the screening benchmarks and are evaluated further in the BERA for plants: Al, Sb, As, Cd, Cu, Fe, Pb, Mn, Hg, Se, Ag, Tl, and Zn.

4.2.4 Amphibians

Amphibians may be exposed through contact with surface water, porewater, sediment, soils, and dietary uptake. However, few federal or state standardized toxicity benchmarks have been developed for the protection of amphibian species. An analysis of available toxicity data for amphibians is presented in Appendix C. Based on available amphibian toxicity data, AWQC, SQGs, and ecological soil screening levels (EcoSSLs) for wildlife appear to be appropriately conservative and protective of most amphibian species. Therefore, these standard criteria are used for screening this ecological receptor group. Results for each environmental medium is described below and results are presented in Tables 4.2 and 4.3.

- **Surface Water**: Based on dissolved, total, and total recoverable concentrations, 12 of the 19 metals evaluated were above the reported benchmarks in at least one CSM unit, although the metals in each circumstance differed.
- **Hardness-Dependent Metals**: Metals were evaluated, normalized for water hardness, on a sample-specific basis using dissolved, total, and total recoverable concentrations. Of

the eight metals examined, only Cr and Ni did not exceed acute or chronic benchmarks in any of the CSM units for any of the surface water measures.

- **Porewater**: Porewater concentrations were higher than the reported benchmarks for nine of the 19 metals. Chromium, Cu, Ni, and Ag were the hardness-dependent metals that did not exceed acute or chronic criteria in porewater.
- **Sediment**: Metal concentrations in sediments were evaluated and 15 metals were above TEC values (Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Ag, and Zn) or did not have a sediment benchmark available for comparison (Ba, Be, Se, Tl, and V).
- **Soil**: Several metals did not exceed the soil screening benchmark for wildlife: Al, Ba, Be, Cr, Co, Mn, and Ni. All other metals exceeded the soil benchmark in at least one CSM unit.

A summary of the screening analysis is presented in Tables 4-2 and 4-3. In surface water, porewater, sediment, and soil analyses, Cr and Co did not exceed the screening benchmark at any location. The remaining metals exceeded one or more of the screening benchmarks and are evaluated further in the BERA for amphibians: Al, Sb, As, Be, Cd, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn.

4.2.5 Terrestrial Plants

The primary exposure pathway for terrestrial plants is contact or uptake of metals from surface soils. The primary screening toxicity values for terrestrial plants were selected from US EPA's EcoSSLs and supplemented with another source (Efroymson *et al.*, 1997a) if no EcoSSL was available (see Appendix C). The soil screening benchmarks represent concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. These values can be used to identify those COPCs in soils requiring further evaluation in a BERA (US EPA, 2003a. EcoSSLs specific to plants were used in the screening evaluation. Comparisons of maximum soil concentrations to benchmarks are presented in Appendix D. Of the 19 metals evaluated in soils, all but three exceeded plant benchmark values (Al, Be, and Ag). The following metals may pose a risk to terrestrial plants and are evaluated further in the BERA: Sb, As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Tl, V, and Zn.

Table 4.3
Summary of Screening Results for Terrestrial Receptors

	Soil Screening			Aquatic-Dependent Wildlife		
Metal	**Plants**	**Soil Invertebrates**	**Terrestrial Wildlife**	**Sediment Screening**	**Benthic Invertebrate Tissue Screening**	**Fish Tissue Screening**
Al	n	n	n	Y	Y	Y
Sb	Y	Y	Y	Y (no bm)	Y (no bm)	Y
As	Y	Y	Y	Y	Y	Y
Ba	Y	Y	n	n	n	n
Be	n	n	n	Y (no bm)	Y (no bm)	n
Cd	Y	Y	Y	Y	Y	Y
Cr	Y	Y	n	n	Y	n
Co	Y	n	n	n	n	n
Cu	Y	Y	Y	Y	Y	Y
Fe	Y	Y	Y	Y (no bm)	Y (no bm)	Y (no bm)
Pb	Y	Y	Y	Y	Y	Y
Mn	Y	Y	n	Y	Y	Y
Hg (including MeHg)	Y	Y	Y	Y	Y	Y
Ni	Y	n	n	n	n	n
Se	Y	Y	Y	Y	Y	Y
Ag	n	Y	Y	n	n	n
Tl	Y	Y	Y	Y	Y	Y
V	Y	Y	Y	n	n	Y
Zn	Y	Y	Y	Y	Y	n

Notes:

Detailed screening tables provided in Appendix D.

Y = the maximum concentration exceeded the screening benchmark in at least one CSM unit and the metal is evaluated further in the BERA.

n = the maximum concentration did not exceed the screening benchmark in any CSM unit.

no BM = no benchmark was available for screening.

4.3.6 Terrestrial Invertebrates

Terrestrial invertebrates are exposed to contaminants in soils through direct contact or ingestion while burrowing or feeding. EcoSSLs specific to soil invertebrates were used in the screening evaluation. If an EcoSSL was not available, soil invertebrate toxicity benchmarks were obtained from Efroymson *et al*. (1997b). Comparisons of maximum soil concentrations to benchmarks are presented in Appendix D. Of the 19 metals evaluated in soils, all but four exceeded benchmark values (Al, Be, Co, and Ni) in at least one CSM unit (Table 4.3). The following metals may pose a risk to terrestrial soil invertebrates and are examined further in the BERA: Sb, As, Ba, Cd, Cr, Cu, Fe, Hg, Pb, Mn, Se, Ag, Tl, V, and Zn.

4.3.7 Wildlife

Dietary exposure is the primary exposure pathway for most birds and mammals. Terrestrial feeding birds and mammals are exposed to contaminants in soils or transported from soils through the food chain. EcoSSLs represent concentrations of contaminants in soil that are protective of birds and mammals that commonly come into contact with soil or ingest biota that live in or on soil. EcoSSLs incorporate food-chain transfer of chemicals from soils to the common prey items of representative terrestrial feeding birds and mammals. Therefore, for the refined SLERA, maximum soil concentrations were compared to the lowest EcoSSL value for birds or mammals (Appendix D).

EcoSSLs generally address only ecological receptors in terrestrial upland habitats and do not incorporate feeding strategies and preferences of aquatic feeding birds and mammals. Therefore, an approach similar to EcoSSLs was developed for the refined SLERA. The primary exposure media by which aquatic-dependent wildlife are exposed to contaminants are through ingestion of benthic invertebrates, fish, and incidental ingestion of sediments. A conservative food-chain model was developed to calculate screening level concentrations for each of these media. The food-chain model is presented in Table 4.4 below; further details are presented in Appendix C. The food-chain model is used as a tool to screen sediment, aquatic invertebrate, and fish tissue chemistry and identify potential risk drivers. Metals that indicate a potential risk in any of these media are carried forward to the BERA, where a more detailed dietary exposure analysis is conducted using more realistic exposure assumptions.

Table 4.4
Food-Chain Model for Screening Exposure Media for Aquatic-Dependent Wildlife

Sediment Screening Level (mg/kg-dw) = NOAEL / (IR x DP / BW)

Tissue Screening Level (mg/kg-ww) = NOAEL / (IR x DP / BW)

	Representative Aquatic-Dependent Receptors			
Parameter	**Sediment Prober (Sandpiper)**	**Benthic Invertivore (Sandpiper)**	**Avian Piscivore (Belted Kingfisher)**	**Mammalian Piscivore (Mink)**
Medium =	Sediment	Aquatic Invertebrate Tissues	Fish Tissues	Fish Tissues
NOAEL – No observed adverse effect level (mg/kg-day)	chemical-specific	chemical-specific	chemical-specific	chemical-specific
BW – Body Weight (g)	52	52	150	550
IR – Food Ingestion Rate (g-/day dw)	9.01	9.01	23.53	29.52
IR – Food Ingestion Rate (g-/day ww)	33.0	33.0	85.33	98.86
DP – Assumed Diet Proportion	18% of food ingestion rate includes sediment	100% Benthic Invertebrates	100% Fish	100% Fish

Note:

See Table 4.5 for sources of body weight and food ingestion rates.

Comparisons of maximum soil, sediment and tissue concentrations to screening benchmarks are summarized in Table 4.3.

- **Soils**: Eleven of the metals examined were found to exceed soil screening benchmarks for wildlife in at least one CSM unit: Sb, As, Cd, Cu, Fe, Pb, Se, Ag, Tl, V, and Zn.
- **Sediment**: Metal concentrations in sediments were also evaluated based on an incidental ingestion pathway. Ten metals were above sediment benchmark screening values for wildlife: Al, As, Cd, Cu, Pb, Mn, Hg, Se, Tl, and Zn. Sediment benchmark values for wildlife could not be estimated for Sb, Be, and Fe; thus, these metals will be evaluated using other means in the BERA.
- **Dietary Assessment – Benthic Invertebrates and Fish**: The following metals exceeded screening benchmarks for tissues for at least one CSM unit (Table 4.3): Al, Sb, As, Cd, Cr, Cu, Pb, Mn, Hg, Se, Tl, V, and Zn. Benchmarks for wildlife were not available for Fe.

Based on each of these screening analyses, Ba, Co, and Ni were not found to exceed any of the criteria in any of the environmental media; therefore, these metals are not evaluated further for wildlife. The remaining metals are evaluated further using additional information on dietary preferences for wildlife.

4.3 Baseline Ecological Risk Assessment

A BERA analysis plan provides the specific approaches and methods for conducting the risk calculations used to evaluate the risk questions and assessment endpoints (US EPA, 1997). The primary components of the analysis plan include the exposure assessment, effects assessment, risk characterization, and uncertainty evaluation. The exposure assessment defines the methods used to quantitatively evaluate exposure concentrations in various media (*e.g.*, sediment, water, tissues). The effects assessment details the process for identifying toxicological benchmarks that should protect ecological receptors from unacceptable adverse effects on survival, growth, or reproduction. The risk characterization provides an integration of exposure and effects based on several different risk estimation methods (*i.e.*, lines of evidence). Finally, the uncertainty analysis provides a discussion of the uncertainty associated with assumptions used in the exposure or effects assessment and explores how the variability in these assumptions affects the risk estimates.

4.3.1 Exposure Assessment

The CSM (Figure 3.1) illustrates the routes of exposure for each of the ecological receptor groups considered in the BERA. Multiple exposure media may provide a pathway for ecological receptors to be exposed to metals from the site. The quantification of exposure for each receptor group and exposure pathway are described below.

Exposure Assessment for Benthic Invertebrates

Benthic invertebrates may be exposed to metals in sediment, porewater, and surface water. Due to the small home range of benthic invertebrates, risks from sediment exposures are evaluated on a sample-by-sample basis. Therefore, chemical concentrations at each sampled location (sediment, porewater, and surface water) are compared to toxicological benchmarks for survival, growth, and reproduction. The benchmarks are described in Appendix C and include SQGs and surface water quality criteria. Hardness-based surface water data are adjusted based on sample-specific hardness measures or, if unavailable, an average of hardness for the CSM unit.

Exposure Assessment for Fish

Fish are exposed to surface water, porewater, and prey items (including incidental sediment ingestion). For each medium, exposure point concentrations (EPCs) are estimated to represent the magnitude of exposure. EPCs are estimates of the average concentration in a medium that a receptor may be in contact with over time (US EPA, 1989). To account for uncertainty in estimating a true average concentration, US EPA recommends calculating the 95% UCL of the arithmetic mean concentration for each exposure area (US EPA, 1992, 2002). Typically, the lesser of the UCL or the maximum detected concentration is used as the EPC. The 95% UCLs were calculated in accordance with US EPA guidance (Singh *et al.*, 2009) using US EPA's ProUCL software (V.4.00.05). The ProUCL software provides several methods for estimating UCLs for datasets with multiple non-detects. For example, the Kaplan-Meier estimate method, also known as the Product Limit Estimate, can be used for datasets with multiple non-detects and multiple detection limits for the same compound in different samples (Singh *et al.*, 2009). Therefore, statistical techniques were used to incorporate non-detects rather than assuming a simple substitution method (*i.e.*, substituting one-half of the detection limit value as the "concentration" for a non-detected result). The preferred statistical method suggested by the ProUCL software is reported and used to estimate the 95% UCLs for the BERA. However, if the datasets are small (*i.e.*, fewer than five samples) or contain only one detected value, the ProUCL software does not recommend calculating a UCL. In these cases, the maximum value is used as the EPC. For hardness-dependent criteria, EPCs are compared to surface water criteria representing the range of hardness values measured in each CSM unit. Typically, dissolved surface water concentrations are analyzed for aquatic life; however, criteria from MDEQ (2008) are based on the total recoverable fraction. Therefore, to provide a comprehensive analysis of surface water data, dissolved, total, and total recoverable fractions were compared to appropriate surface water benchmarks for aquatic life.

Exposure Assessment for Amphibians

Amphibians are exposed to sediment, surface water, porewater, soils, and prey items. EPCs are estimated for each of these media. ProUCL software is used to estimate the 95% UCLs for metals for each of the exposure media, as described above. EPCs were then compared to the appropriate toxicity benchmarks for amphibians (see Appendix C).

Exposure Assessment for Aquatic and Terrestrial Plants

Aquatic plants are primarily exposed to metals through surface water or porewater contact/uptake, while terrestrial plants are primarily exposed to metals through soil contact/uptake. In the SLERA, maximum concentrations were evaluated for plant communities. In the BERA, additional exposure measures are evaluated (*i.e.*, mean, 95% UCL, and maximum concentrations) to characterize potential risks in each CSM unit. Following the methods described previously, 95% UCL concentrations were estimated in soils. The EPCs were then compared to the appropriate toxicity benchmarks for plants (see Appendix C).

Exposure Assessment for Soil Invertebrates

Terrestrial invertebrates are primarily exposed to metals through soil contact/uptake. In the SLERA, maximum concentrations were evaluated for soil invertebrate communities. In the BERA, additional exposure measures are evaluated (*i.e.*, mean, 95% UCL, and maximum concentrations) to characterize potential risks in each CSM unit. Following the methods described previously, 95% UCL concentrations were estimated in soils. The EPCs were then compared to the appropriate toxicity benchmarks for soil invertebrates (see Appendix C).

Exposure Assessment for Birds and Mammals

Wildlife may be exposed to metals in site media through a variety of exposure pathways, depending on habitat and feeding preferences. Exposure for each wildlife receptor was estimated quantitatively using a daily dose estimate approach (or food-web model). Food-web modeling is a standard approach that is consistent with US EPA's wildlife exposure guidance (US EPA, 1993). The general structure of the food-web exposure model is described by the following equation:

$$IR_{chemical} = \frac{\sum(C_i \times M_i \times A_i \times F_i)}{W}$$

Where:

$IR_{chemical}$ = total ingestion rate of chemical from all dietary components (mg/kg body weight/day)

C_i = the 95% UCL or maximum concentration of the chemical in a given dietary component

M_i = rate of ingestion of dietary component or inert medium (kg/day)

A_i = relative gastrointestinal absorption efficiency for the chemical in a given dietary component or inert medium (fraction)

F_i = fraction of the daily intake of a given dietary component (food or water) or inert medium (sediment or soil) derived from the specific water body or location (unitless area-use factor)
W = body weight of receptor species (kg)

The term $IR_{chemical}$ can be expanded to specify each ingestion medium, which includes one or more primary food item, drinking water, and incidentally ingested sediment or soil:

$$IR_{chemical} = \frac{\left[\sum\left(C_f \times M_f \times A_f \times F_f\right) + \left(C_w \times M_w \times A_w \times F_w\right) + \left(C_s \times M_s \times A_s \times F_s\right)\right]}{W}$$

This model provides an estimated total dietary exposure for chemicals resulting from consumption of food, water, and the incidental ingestion of sediment or soil on a mg/kg body-weight/day basis. For all receptors modeled, the exposure calculation conservatively assumes that 100% of the chemical in ingested food is absorbed ($A_i = 1$). $IR_{chemical}$ was calculated using the 95% UCL or the maximum concentration. In addition, a conservative area use factor of 1.0 was used for all receptors in all CSM units.

Wildlife receptors evaluated in the BERA include belted kingfisher, mallard, tree swallow, sandpiper, American robin, mink, vole, and short-tailed shrew. Each of these receptors provides a surrogate for wildlife species with similar feeding preferences and habit distributions. A receptor profile was generated for each species that summarizes the parameters used to calculate an average daily COPC dose. These parameters are body weight, normalized food ingestion rate, normalized sediment/soil ingestion rate, main dietary components, and foraging range for determining an area-use factor. A summary of the parameters for each receptor is presented in Table 4.5.

The *Wildlife Exposure Factors Handbook* (US EPA, 1993) provides ranges of typical body weights and ingestion rates of dietary components, as well as foraging areas for many wildlife species. Nagy (2001) provides more recent estimates of food ingestion rates for wild animals. Several publications provide estimates for sediment/soil ingestion rates for selected wildlife species (US EPA, 1993; Beyer *et al.*, 1994; Beyer and Fries, 2003). These sources were used to develop exposure factors for the wildlife receptors considered in this BERA. The estimates of food ingestion rates presented by Nagy (2001) were used for the wildlife receptors in this assessment, derived for the wildlife receptors as follows:

- The food ingestion rate for the tree swallow was estimated using the dry and fresh (wet) ingestion rate equation for insectivorous birds;
- The food ingestion rate for the sandpiper was estimated using the dry and fresh (wet) ingestion rate equation for the common sandpiper;
- The food ingestion rate for the belted kingfisher was based on dry and fresh (wet) allometric equations for carnivorous birds;
- The food ingestion rates for the American robin and mallard were estimated using the dry and fresh (wet) ingestion rate equations for omnivorous birds;
- The food ingestion rate for the short-tailed shrew was estimated using the dry and fresh (wet) ingestion rate equations for insectivorous mammals;
- The food ingestion rate for the vole was estimated using the dry and fresh (wet) ingestion rate equations for the herbivorous mammals; and
- The food ingestion rate for the mink was estimated using the dry and fresh (wet) ingestion rate equations for the carnivorous mammals.

Soil/sediment intake was estimated as a percentage of the diet for species similar to the receptors under investigation. The percentage of soil/sediment in the diet of the mink was taken from Beyer *et al.* (1994). Beyer *et al.* (1994) did not present percentages of soil/sediment in diets of the American robin, belted kingfisher, or short-tailed shrew. The percentage of soil in the diet of the American woodcock was used as a surrogate for the American robin, and the percentage of soil in the diet of the opossum was used as a surrogate for the short-tailed shrew. Beyer *et al.* (1994) did not publish percentages of soil/sediment in diets of piscivorous species such as the belted kingfisher; however, the belted kingfisher would likely have a lower percentage of soil/sediment in the diet than omnivorous water fowl such as blue-winged teal and ringnecked duck, which both have 2% soil in diet (Beyer *et al.*, 1994). Therefore, the percentage of soil/sediment in the diet of the belted kingfisher was assumed to be 1%. The sediment ingestion rate of the mallard, which dabbles in submerged aquatic vegetation, was reported as 3.3% in Beyer and Fries (2003). It was assumed that tree swallows would not come into contact with sediment or soil, because they forage aerially.

The water ingestion rates for the wildlife receptors, except for the short-tailed shrew, were estimated using the body-weight-normalized water ingestion rate equations published by Calder and Braun (1983). The water ingestion rate for the short-tailed shrew was taken from Chew (1951, as cited in US EPA, 1993).

Body weights for the chosen receptors were based on information included in the *Wildlife Exposure Factor Handbook* (US EPA, 1993). However, there was no body weight information specific to Montana or nearby regions. For example, the body weights for the American robin and tree swallow are averages reported from New York State studies. The body weights of the belted kingfisher and short-tailed shrew were from Ohio and northern Pennsylvania, respectively. The mink and mallard body weights were averages from throughout North America.

Dietary composition information was obtained from US EPA (1993) and Sample and Suter (1994). The feeding habits of wildlife species are highly variable depending on age, season, and location within the US (US EPA, 1993). To evaluate risks to wildlife receptors, proportions of food items were assumed based on feeding information provided in US EPA (1993) and Sample and Suter (1994). Food items comprising a large portion of the diet were assigned greater proportions, while smaller portions of the diet were assigned lesser proportions. In addition, food items were matched to the tissue types collected from the field (see Appendix B). For example, mink were reported to primarily feed on trout and other fish, amphibians, and some benthic invertebrates (*e.g.*, crustaceans). Thus, the diet was assumed to include primarily piscivorous fish (*e.g.*, trout), some smaller forage fish, amphibians, and other aquatic invertebrates (*e.g.*, bivalves were collected in during the 2010 sampling). Dietary composition is shown in Table 4.5.

Some components of the diets of wildlife species were not collected or minimally collected at the site (*e.g.*, terrestrial plants, earthworms, soil invertebrates). In order to estimate dietary doses, it was necessary to estimate the tissue concentrations of these prey items based on bioaccumulation models.

Table 4.5
Exposure Parameter Profiles for Wildlife Receptors

Receptor	Feeding Guild	Body Weight (BW) (g)	Food Ingestion Rate (FIR) Equations from Nagy (2001) (g/day)	Sediment/Soil Ingestion Rate (% of FIR)	Drinking Water Ingestion Rate (WIR) Equations from Calder and Braun (1983) (L/day)	Dietary Components[a]
Mallard (*Anas platyrhynchos)*	Avian Omnivore	1,040 (Nelson and Martin 1953, as cited in US EPA, 1993)	$FIR_{dry} = 0.670*(BW_g)^{0.627}$ $FIR_{wet} = 2.094*(BW_g)^{0.627}$	3.3% (Beyer and Fries, 2003)	$WIR = 0.059*(BW_{kg})^{0.67}$	34% Aquatic Plants 33% Benthic Invertebrates 33% Other Aquatic Invertebrates
Sandpiper (*Actitis spp.*)	Avian Benthivore	51.6 (Nagy, 2001)	$FIR_{dry} = 9.01$ $FIR_{wet} = 33.0$	18% (Average of sandpipers, Beyer *et al*., as cited by US EPA, 1993)	$WIR = 0.059*(BW_{kg})^{0.67}$	75% Benthic Invertebrates 25% Other Aquatic Invertebrates
American Robin (*Turdus migratorius)*	Avian Omnivore	77 (Clench and Leberman 1978, as cited by US EPA, 1993)	$FIR_{dry} = 0.670*(BW_g)^{0.627}$ $FIR_{wet} = 2.094*(BW_g)^{0.627}$	10.4% (Beyer *et al*., 1994)	$WIR = 0.059*(BW_{kg})^{0.67}$	25% Earthworms 25% Soil Invertebrates 25% Aerial/Foliar Invertebrates 25% Terrestrial Plants
Tree Swallow (*Tachycineta bicolor)*	Avian Insectivore	21 (McCarty, 1995)	$FIR_{dry} = 0.540*(BW_g)^{0.705}$ $FIR_{wet} = 1.633*(BW_g)^{0.705}$	0%	$WIR = 0.059*(BW_{kg})^{0.67}$	25% Benthic Invertebrates [b] 25% Soil Invertebrates 25% Aerial/Foliar Invertebrates 25% Terrestrial Plants
Belted Kingfisher (*Ceryle alcyon)*	Avian Piscivore	150 (Brooks and Davis, 1987, as cited by US EPA, 1993)	$FIR_{dry} = 0.849*(BW_g)^{0.663}$ $FIR_{wet} = 3.048*(BW_g)^{0.665}$	1.0% (Beyer *et al*., 1994)	$WIR = 0.059*(BW_{kg})^{0.67}$	50% Piscivorous Fish 20% Forage Fish 10% Benthic Invertebrates 10% Other Aquatic Invertebrates 10% Amphibians

Receptor	Feeding Guild	Body Weight (BW) (g)	Food Ingestion Rate (FIR) Equations from Nagy (2001) (g/day)	Sediment/Soil Ingestion Rate (% of FIR)	Drinking Water Ingestion Rate (WIR) Equations from Calder and Braun (1983) (L/day)	Dietary Components[a]
Short-Tailed Shrew (*Blarina brevicauda)*	Mammalian Insectivore	12 (Guilday, 1957, as cited by US EPA, 1993)	$FIR_{dry} = 0.373*(BW_g)^{0.622}$ $FIR_{wet} = 1.13*(BW_g)^{0.622}$	9.4% (Beyer *et al.*, 1994)	0.0027 (0.223 ml/g bw-day) Chew 1951, as cited by US EPA, 1993)	40% Earthworms 40% Soil Invertebrates 15% Aerial/Foliar Invertebrates 5% Terrestrial Plants
Meadow Vole (*Microtus pennsylvanicus*)	Mammalian Herbivore	37 (Myers and Krebs, 1971, as cited by US EPA, 1993)	$FIR_{dry} = 0.859*(BW_g)^{0.628}$ $FIR_{wet} = 2.606*(BW_g)^{0.628}$	2.4% (Beyer *et al.*, 1994, as cited by US EPA, 1993)	$WIR = 0.099*(BW_{kg})^{0.90}$	95% Terrestrial Plants 5% Soil Invertebrates
Mink (*Mustela vison)*	Mammalian Piscivore	550 (Silva and Downing, 1995)	$FIR_{dry} = 0.153*(BW_g)^{0.834}$ $FIR_{wet} = 0.469*(BW_g)^{0.848}$	9.4% (Beyer *et al.*, 1994)	$WIR = 0.099*(BW_{kg})^{0.90}$	50% Piscivorous Fish 20% Forage Fish 20% Amphibians 10% Other Aquatic Invertebrates

Notes:

(a) Dietary composition assumed based on information provided by US EPA (1993) and Sample and Suter (1994) and matched to the tissue sample types collected from the site.

(b) Tree swallows primarily consume flying insects that may have a growth stage within sediments or soils; however, they generally do not forage in the sediments and soils and thus incidental soil/sediment ingestion was not considered a complete pathway.

US EPA EcoSSL guidance (US EPA, 2003a) provides accumulation models for metals/metalloids in terrestrial plants and invertebrates estimated from soil concentrations. The models used in the BERA where field data were lacking are presented in Table 4.6.

Table 4.6
Uptake Equations for Metals

Metal	Uptake from Soil to Plants	Uptake from Soil to Earthworms
Al	$C_p = C_s$	$C_e = C_s$
Sb	$\ln(C_p) = 0.938 * \ln(C_s) - 3.233$	$C_e = C_s$
As	$C_p = 0.03752 * C_s$	$\ln(C_e) = 0.706 * \ln(C_s) - 1.421$
Ba	$C_p = 0.156 * C_s$	$C_e = 0.091 * C_s$
Be	$\ln(C_p) = 0.7345 * \ln(C_s) - 0.5361$	$C_e = 0.045 * C_s$
Cd	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	$\ln(C_e) = 0.795 * \ln(C_s) + 2.114$
Cr	$C_p = 0.041 * C_s$	$C_e = 0.306 * C_s$
Co	$C_p = 0.0075 * C_s$	$C_e = 0.122 * C_s$
Cu	$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	$C_e = 0.515 * C_s$
Fe	$C_p = C_s$	$C_e = C_s$
Pb	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	$\ln(C_e) = 0.807 * \ln(C_s) - 0.218$
Mn	$C_p = 0.079 * Cs$	$\ln(C_e) = 0.682 * \ln(C_s) - 0.809$
Hg	$C_p = C_s$	$C_e = C_s$
Ni	$\ln(C_p) = 0.748 * \ln(C_s) - 2.223$	none
Se	$\ln(C_p) = 1.104 * \ln(C_s) - 0.677$	$\ln(C_e) = 0.733 * \ln(C_s) - 0.075$
Ag	$C_p = 0.014 * C_s$	$C_e = 2.045 * C_s$
Tl	$C_p = C_s$	$C_e = C_s$
V	$C_p = 0.00485 * C_s$	$C_e = 0.042 * C_s$
Zn	$\ln(C_p) = 0.554 * \ln(C_s) + 1.575$	$\ln(C_e) = 0.328 * \ln(C_s) + 4.449$

Notes:

Source: US EPA (2003).

C_p = concentration in plants, C_s = concentration in soil, C_e = concentration in earthworms.

If no equation was available it was assumed that concentrations in tissues were equivalent to concentrations in soil.

Similarly, aquatic plant tissues (*e.g.*, rooted macrophytes) were only collected at a few locations from Upper Lake and Upper Lake Marsh and only for a subset of metals. Therefore, as with terrestrial plant tissues, it was necessary to estimate the concentrations of metals in aquatic plant tissues using an uptake model. Tissue concentrations of rooted macrophytes can be related to sediment concentrations, as demonstrated in several published journal articles (*e.g.*, Jackson *et al.*, 1991; Jackson, 1998). While it is known that aquatic plants accumulate chemicals from both sediment and water, concentrations of metals in sediments can be used reliably to estimate concentrations of chemicals in rooted aquatic plant tissues. An examination of a large dataset containing sediment and macrophyte concentrations from a variety of metals and metalloids was presented by Jackson *et al.* (1991) and Jackson (1998). These studies found a significant correlation ($r^2 = 0.75$) between sediment concentrations and rooted macrophytes using the following equation:

Log (plant COI concentration dry weight) = -0.08 + 0.9(Log [sediment COI concentration dry weight])

This regression equation is intended to be applied to metals in general and was used in the BERA to estimate the accumulation of COIs in aquatic macrophyte tissues for metals/metalloids measured in sediments at the site. Potential uncertainties with this approach are discussed in Section 11.2.

Finally, MeHg concentrations were measured in a subset of aquatic and terrestrial invertebrate tissues (see Appendix B, Table B-16). Dietary exposure of ecological receptors to MeHg was evaluated using measured tissue concentrations. In some cases, measured data were not available and were estimated from total Hg tissue concentrations using the following average methyl Hg percentages (average, by receptor group, of all MeHg tissue concentrations measured at the site): 25.1% for benthic invertebrates, 3.3% for other aquatic invertebrates, 6.27% for soil invertebrates, 10.9% for aerial/foliar invertebrates, and 14% for earthworms.

4.3.2 Effects Assessment

Two approaches are used in the BERA to evaluate potential effects on growth, survival, or reproduction. The primary approach is to characterize effects using chemical-specific and media-specific TRVs for each COPC. The TRVs provide reasonably conservative estimates of chemical concentrations that, if not exceeded, should protect ecological receptors from unacceptable adverse effects on survival, growth, or reproduction. The TRVs were developed from regulatory criteria and searches of the toxicological literature (see Appendix C). The second approach for evaluating effects is to measure direct toxicity to the organisms of interest. This method is specific to benthic invertebrates and was conducted using whole sediment bioassays (10-day tests using *Hyalella azteca* and *Chironomus dilutus*) and evaluations of community structure. Each of the media-specific TRVs and direct toxicity measures represent a line of evidence. The lines of evidence for each receptor group are summarized in Table 4.7.

4.3.3 Reference Site Comparison

The 2010 ecological site investigation (Gradient, 2010) was designed to allow for a statistical comparison of environmental media collected at the site to the same media collected from reference locations. In general, five or more samples of sediment, soil, benthic invertebrate, earthworm, and game fish tissues were collected from areas on or near the Facility and from two reference areas: Prickly Pear

Creek (upstream of the site) and Walker Creek. Only field data collected in 2010 was used for statistical analysis. Statistical analysis was conducted to determine if media concentrations on and near the Facility were significantly different from those at reference locations. Analysis was conducted using the graphing software SigmaPlot 11 (Systat Software, Inc). The significance level (*i.e.*, alpha level) of the statistical tests was set at 0.05. Each comparison was tested for normality (Shapiro-Wilkes test) and equal variance (Levene's test). If the sample data passed the criteria for normality and equal variance, then parametric testing was conducted. Parametric testing involved a one-way ANOVA followed by a Dunnett's test. If the sample data were not normally distributed, did not have equal variance, or did not have both, then a non-parametric test was used. Non-parametric testing involved using a Kruskal-Wallis followed by a Dunn's test. Both Dunnett's and Dunn's tests used a reference site as the control for comparison purposes. If samples were not normally distributed but had equal variance, both parametric and non-parametric techniques were employed to ensure that significant differences did not go undetected. Results of the statistical analysis are provided in Appendix E and discussed throughout Section 5 through 11.

Table 4.7
Lines of Evidence for the BERA Effects Assessment

Receptor Group	Exposure Media	Effect Benchmark
Benthic Invertebrates	Sediment	• SQGs • Comparison to reference sites
	AVS/SEM	• AVS/SEM SQGs • Comparison to reference sites
	Surface Water	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Porewater	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Tissue Residues	• Comparison to reference sites
	Whole Sediment Bioassays	• Direct toxicity measures (survival and biomass) • Comparison to reference sites
	Community Structure	• Species abundance and diversity • Comparison to reference sites
Fish	Surface Water	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Porewater	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Tissues	• CBR benchmarks • Dietary tissue benchmarks • Qualitative fish health observations • Comparison to reference sites
Amphibians	Sediment	• SQGs • Comparison to reference sites
	Surface Water	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Porewater	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Soil	• EcoSSLs • Comparison to reference sites
	Tissue Residues	• Comparison to reference sites
Aquatic Plants	Surface Water	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Porewater	• State and Federal freshwater water quality criteria • Comparison to reference sites
	Tissue Residues	• Comparison to reference sites
Terrestrial Plants and Soil Invertebrates	Soil	• EcoSSLs • Comparison to reference sites
	Tissue Residues	• Comparison to reference sites
Wildlife	Total Dietary Dose	• Dietary TRV
	Soil, Sediment, Prey Tissues	• Comparison to reference sites
	Avian Egg Residues	• Comparison to tissue benchmarks

4.3.4 Risk Characterization

The risk characterization is the final phase of the risk assessment process and includes risk estimation and risk description (US EPA, 1997). In the risk estimation step of the BERA, risks posed to ecological receptors are estimated by comparing the exposure measures or doses, (developed in the exposure assessment) to the measures associated with toxicological effects (developed in the effects assessment). The risk description will provide information for interpreting the risk results. In accordance with US EPA guidance (1997), a weight-of-evidence approach is used to interpret the results of the ecological investigation and their implications for the assessment endpoints. The risk characterization will also identify uncertainties, assumptions, professional judgments, and qualifiers associated with the risk estimates.

The estimation of risks to ecological receptors is based on an integration of all the lines of evidence from the exposure and effects assessments. Risks are often presented as HQs. This method simply compares exposure concentrations or doses of COPCs to effect benchmarks. For example:

$$HQ = (EPC \text{ or Dose})/TRV$$

Where:

EPC = Exposure Point Concentration in media (mg/L or mg/kg)

Dose = Total dietary dose (mg/kg-day)

TRV = Toxicity Reference Value, representing the concentration or dose at or above which adverse effects may occur (mg/L or mg/kg or mg/kg-day).

An HQ < 1 indicates that the chemical is unlikely to cause adverse ecological effects. HQs above 1 indicate some potential for adverse ecological effects but do not necessarily signify unacceptable risk. Other pieces of information, such as sources of uncertainty and site-specific exposure data, are weighted in the risk evaluation and the interpretation of the ecological significance of HQs. According to US EPA (1997), "As certainty in the exposure concentrations and the no observed adverse effect level (NOAEL) increase, there is greater confidence in the predictive value of the HQ model, and unity (HQ = 1) becomes a more certain pass/fail decision point." Therefore, HQs are determined by comparison to both the NOAEL and the lowest observed adverse effect level (LOAEL) TRVs, where available, to bracket the risk estimates and reflect the range of uncertainty that exists regarding the potential for adverse effects. Because the NOAEL represents a body weight normalized daily intake rate of a chemical that did not elicit any adverse responses in the test organism, exceedance of this value does not necessarily imply that adverse effects would occur. Exposure estimates that are below the NOAEL TRV identify conditions under which adverse ecological effects are unlikely to occur. The LOAEL is the minimum dose reported to elicit a statistically significant adverse effect in the test species in a pertinent laboratory study. Thus, an exposure rate in excess of the LOAEL TRV indicates some potential for adverse effects to an exposed individual or population.

For exposure estimates greater than the NOAEL TRV, but less than the LOAEL TRV, risk cannot be concluded definitively to be negligible because the true effect threshold is not known, only that it lies somewhere between the NOAEL and LOAEL. Furthermore, because the test endpoints measure individual-level responses, there is considerable uncertainty regarding how these effects, if any, would translate to population-level effects. Therefore, these uncertainties are assessed along with other lines of evidence, such as habitat quality, to interpret the ecological significance of HQs that exceed 1 and draw conclusions regarding ecological risk.

Quantitative and qualitative descriptions of ecological risks and threshold concentrations for adverse ecological effects are presented spatially by CSM unit. The significance of the results of the risk characterization are discussed in the final sections of the BERA – the uncertainty analysis – and in the summary and conclusions. The risks estimated for all ecological receptors are integrated and interpreted to evaluate their overall significance to the study area ecosystems, and to help identify what corrective measures, if any, may be required to reduce these risks.

4.3.5 Uncertainty Analysis

The risk characterization for each ecological receptor group includes a detailed evaluation of sources of uncertainty and the effects of these uncertainties on conclusions about the extent and magnitude of risks. Sources of uncertainty related to results of the risk assessment may include :

- Representativeness of sampling locations;
- Representativeness of exposure estimates;
- Representativeness of TRVs; and
- Uncertainty in correlating sediment concentrations and observed aquatic community responses.

Major sources of uncertainty and their effects on risk characterization conclusions are evaluated quantitatively (to the extent the data permit) or qualitatively in the uncertainty analysis.

5 Risk Characterization for Benthic Invertebrates

The refined SLERA for benthic invertebrates (Section 4.2.1) assessed a suite of exposure media, including surface water, porewater, and sediments. The results of the SLERA identified the following COPCs as requiring further assessment in the BERA: Al, Sb, As, Be, Ba, Cd, Cu, Fe, Pb, Mn, Ni, Hg, Se Ag, Tl, V, and Zn. Chromium and Co did not exceed any of the screening benchmarks evaluated; therefore, these chemicals pose negligible risks to benthic invertebrates and are not examined further in the BERA. The BERA examined several lines of evidence to evaluate the potential for COPCs to adversely affect the survival, growth, or reproduction of benthic invertebrate populations. Each line of evidence provides information to address the primary risk questions (as defined previously in Section 3.6):

- Are the concentrations of metals in sediments (and AVS/SEM), porewater, and surface water from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, and Wilson Ditch greater than benchmarks for survival, growth, or reproduction of benthic invertebrates?
- Is the survival or growth (*i.e.*, biomass) of benthic invertebrates, as indicated by *Hyalella azteca* and *Chironomus dilutus*, exposed to bulk sediments significantly lower than laboratory controls or reference sites?
- Is the structure of benthic invertebrate communities at the site outside the range for communities from reference areas?
- Are benthic invertebrates at the site exposed to metals concentrations in sediments, porewater, and surface waters that are significantly higher than concentrations at reference sites?

The BERA analysis and results are presented in the following sections and in detailed tables in Appendix E.

5.1 Lines of Evidence Evaluated

Sediment, surface and porewater chemistry, toxicity tests, and community analysis surveys were used to evaluate the potential risks of COPCs to benthic invertebrates. Each of these tools are used in a weight-of-evidence analysis to identify the most likely risk drivers in each of the CSM units.

5.1.1 Sediment

Sediment samples in the BERA were evaluated using three different techniques, including comparisons to SQGs) (probable effect concentrations, PECs), measures of metal bioavailability (SEM/AVS), and comparison to metals concentrations from reference sediments.

Sediment Quality Guidelines

SQGs were used to evaluate potential risks from metals in sediments to benthic invertebrates. The sediment PECs represent a concentration above which effects are expected to occur more often than not (MacDonald *et al*., 2000). To evaluate the potential toxicity due to mixtures, the mean PEC quotient (PECQ) method was utilized following procedures described by Ingersoll *et al*., (2001) (for further details see Appendix C). Table 5.1 summarizes the results for individual metals compared to PECs (where available) for each of the CSM units. Several COPC metals (Al, Sb, Ba, Be, Co, Fe, Mn, Se, Ag, V, and Tl) did not have PEC values developed by MacDonald *et al*. (2000), and thus are not included the PECQ analysis. Alternative sources of SQGs were available for Al, Sb, Fe, Mn, and Ag (see Appendix C) and these were used to screen against site sediment data. Aluminum, Fe, and Ni did not exceed the SQGs (*i.e.*, HQ <1.0) in any of the four CSM units (Table 5.1). Antimony concentrations for several stations from Lower Lake and Upper Lake/Marsh were greater than the SQG. Arsenic, Cd, Pb, Hg, Mn, Ag, and Zn exceeded the PEC in at least one sample in each of the four CSM units. Copper exceeded PECs in all areas except Wilson Ditch. Silver exceeded the SQG in all areas except Prickly Pear Creek. Sample specific results are presented in Tables E-1a and E-1b of Appendix E.

Table 5.1
Risk Characterization for Benthic Invertebrates Based on PEC Quotient Values

	Prickly Pear Creek			**Upper Lake/Marsh**			**Wilson Ditch**			**Lower Lake**		
Metal	**Max PECQ**	**% sites >PEC**	***n***	**Max PECQ**	**% sites >PEC**	***n***	**Max PECQ**	**% sites >PEC**	***n***	**Max PECQ**	**% sites >PEC**	***n***
Al	0.2	0	12	0.3	0	26	0.1	0	5	0.2	0	8
Sb	0.2	0	12	4	23	26	0.2	0	5	40	75	8
As	8	42	12	18	96	26	2	60	5	92	100	8
Cd	7	25	12	68	85	26	6	100	5	538	100	8
Cu	3	17	12	15	77	26	1	20	5	17	100	8
Fe	0.2	0	12	0.1	0	26	0.05	0	5	0.1	0	8
Pb	9	50	12	84	100	26	13	100	5	113	100	8
Mn	8	17	12	2	12	26	1	20	5	1	25	8
Hg	3	17	12	217	85	26	113	100	5	50	100	8
Ni	0.3	0	12	0.5	0	26	0.1	0	5	0.7	0	8
Ag	1	25	12	58	81	26	5	80	5	64	100	8
Zn	9	25	12	14	100	26	2	80	5	15	100	8

To assess the toxicity of sediments from multiple chemicals, mean PECQs were calculated for each sample. Using a database of 1,657 samples with high-quality matching sediment toxicity and chemistry data from across North America, Ingersoll *et al*. (2001) demonstrated that mean PECQs can be used to reliably predict toxicity of sediments on both a regional and national basis. PEC values for eleven metals (Al, Sb, Ba, Be, Co, Fe, Mn, Se, Ag, V, and Tl) were not available; therefore, the mean PECQs are not representative of potential toxicity associated with these metals. Table 5.2 summarizes the results of this analysis and Map 8 identifies the location and magnitude of the mean PECQs for each of the CSM units. Similar to Ingersoll *et al.* (2001), mean PECQ ranges were calculated and defined as follows: mPECQ<0.5 (low probability of sediment toxicity); mean PECQ=0.5-1.0 (moderate probability of sediment toxicity); mean PECQ >1.0-<5 (high probability of sediment toxicity); and mean PECQ > 5 (very high probability of sediment toxicity). Further detail on these probabilities is provided in Appendix C. The reference sites had mean PECQs that would indicate low potential for toxicity (Table 5.2). Most sediment stations in Prickly Pear Creek have metal concentrations associated with a low probability of sediment toxicity (5 out of 12), four stations with moderate probability (PPC_2), and three stations (PPC_2, PPC_3 and PPC_4) with a high probability of sediment toxicity (Map 8). Most stations from Upper Lake and Upper Lake Marsh had concentrations of metals associated with a moderate to very high probability of sediment toxicity (Map 8). All stations along Wilson Ditch have metals concentrations associated with moderate to high probability of sediment toxicity (the station furthest away from the

Facility had a very high probability of sediment toxicity). All stations within Lower Lake have metals concentrations associated with a high/very high probability of toxicity to benthic organisms.

Table 5.2
Risk Characterization for Benthic Invertebrates Based on Mean PEC Quotient Values

		Mean PEC Quotient[a]		
CSM Unit	**Sample Number**	**Minimum**	**Mean**	**Maximum**
Reference Area				
Canyon Ferry Reservoir	2	0.21	0.24	0.26
Prickly Pear Creek (Upstream)	9	0.18	0.35	0.52
Walker Creek (Pond/Marsh)	10	0.07	0.08	0.09
Facility				
Prickly Pear Creek	12	0.24	1.05	4.84
Upper Lake/Marsh	26	0.49	10.91	32.48
Wilson Ditch	5	0.98	5.19	15.77
Lower Lake	8	2.52	30.95	102.70

Note:

(a) Mean PEC quotient calculated using the following metals: As, Cd, Cr, Cu, Hg, Pb, Ni, and Zn.

Metal Bioavailability (SEM/AVS Analysis)

The bioavailability of metals is an important factor to consider when evaluating potential toxicity in sediments (US EPA, 2005b, 2007). US EPA (2005b) has developed an equilibrium partitioning sediment benchmark procedure that accounts for the bioavailability of metals in sediments and relates this measure to biological responses observed in benthic organisms. Equilibrium partitioning theory predicts that metals partition in sediment between AVS, principally Fe monosulfide, interstitial (pore) water, benthic organisms, and other sediment phases such as organic carbon (US EPA, 2005b). The difference between the sum of the molar concentrations of simultaneously extracted metal (SEM) (ΣSEM, metal simultaneously extracted during the AVS extraction procedure) minus the molar concentration of AVS is a predictor of sediment toxicity for certain divalent metals (Cd, Cu, Pb, Ni, Ag, Cr, and Zn) (US EPA, 2005b). The use of $(\Sigma SEM\text{-}AVS)/f_{oc}$ (f_{oc} is the fraction of organic carbon) further reduces variability associated with predicting sediment toxicity by accounting for the additional partitioning of metals to organic carbon (US EPA, 2005b). The metal's SEM/AVS benchmark relates potential sediment toxicity to seven divalent metals (Cd, Cu, Cr, Pb, Ni, Ag, and Zn) and is driven by four assumptions:

1. A sediment with AVS > 0.0 is not expected to cause adverse biological effects due to Cr or Ag.
2. A sediment in which $(\Sigma SEM - AVS)/f_{oc} < 130$ μmols/g_{oc} is expected to pose low risk of adverse biological effects due to Cd, Cu, Pb, Ni, and Zn.

3. A sediment in which 130 µmols/g_{oc} < (ΣSEM - AVS)/f_{oc} < 3,000 µmols/g_{oc} may have adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.
4. A sediment in which (ΣSEM - AVS)/f_{oc} > 3,000 µmols/g_{oc}, is expected to cause adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.

A total of 22 sediment samples from the four CSM units and 15 from reference sites were analyzed using this criteria. The results are presented in Table 5.3 and in Appendix E. Reference sites were categorized as having either low or moderate risk based on ΣSEM - AVS concentrations. Similarly, a majority of study sites had low (45% of sites) to moderate risk (45% of sites), while two sites in Upper Lake and Upper Lake Marsh (UL_23 and UL_24) were categorized as having high potential risk. These two Upper Lake and Upper Lake Marsh stations also had mean PECQs that indicated a high potential for sediment toxicity (Map 8). Additionally, most sites had detectable concentrations of AVS; thus, biological effects due to Cr or Ag are unlikely (see Appendix E, Table E-2).

Table 5.3
Risk Characterization for Benthic Invertebrates Based on SEM/AVS Concentrations

CSM Unit	Low Risk[a,b]	Potential Risk	Expected Risk
Reference Area			
Walker Creek	10	0	0
Prickly Pear Creek (upstream)	0	5	0
Facility			
Prickly Pear Creek	1	5	0
Lower Lake	4	1	0
Upper Lake/Marsh	5	3	2
Wilson Ditch	0	1	0

Notes:

(a) SEM/AVS results refer to the following metals Cd, Cu, Pb, Ni, or Zn.
(b) Risk measures:
A sediment in which (ΣSEM -AVS)/foc < 130 µmols/goc is expected to pose low risk due to Cd, Cu, Pb, Ni, or Zn.
A sediment in which 130 µmols/goc < (ΣSEM - AVS)/foc < 3,000 µmols/goc may have adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.
A sediment in which (ΣSEM - AVS)/foc > 3,000 µmols/goc, is expected to cause adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.

Reference Comparison

A reference comparison was conducted to determine if sediment concentrations on and near the Facility were significantly different from reference site sediment concentrations (as described in Section 4.3.3). Prickly Pear Creek site samples were compared to Prickly Pear Creek reference samples upstream of the site. Upper Lake and Upper Lake Marsh and Lower Lake samples were compared to Walker Creek

(Pond/Marsh) site samples. A summary of the results are provided in Table 5.4 (details in Appendix E, Table E-3). In Prickly Pear Creek, metal concentrations in sediment were not significantly different near the Facility than upstream of the Facility at reference locations (only Mn was significantly lower near the Facility). Al had significantly lower concentrations in Lower Lake sediments, while Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Se, Ag, Tl, and Zn were all significantly higher when compared to Walker Creek sediments. In Upper Lake and Upper Lake Marsh sediments, Sb, As, Cd, Cu, Pb, Hg, Mn, Ni Ag, Se, and Zn were all significantly higher than reference sediments. Iron and V concentrations in sediments were significantly lower in Wilson Ditch sediments when compared to reference sediments, while Cd, Hg, Pb, Mn, and Ag were all significantly higher.

Table 5.4
Comparison of Site Sediment Concentrations to Reference Sediment Concentrations

Result	Prickly Pear Creek	Lower Lake	Upper Lake/Marsh	Wilson Ditch
Significantly higher than reference concentrations	-	Sb, As, Cd, Cu, Pb, Mn, Ni, Hg, Se, Ag, Tl, Zn	Sb, As, Cd, Cu, Hg, Pb, Mn, Ni, Se, Ag, Zn	Cd, Hg, Pb, Mn, Ag
Significantly lower than reference concentrations	Mn	Al, V	-	Fe, V
No significant differences	Al, Sb, As, Ba, Be, Cd, Cu, Fe, Pb, Hg, Ni, Se, Ag, Tl, V, Zn	Ba, Be, Fe	Al, Ba, Be, Fe, Tl, V	Al, Sb, As, Ba, Be, Cu, Ni, Se, Tl, Zn

5.1.2 Surface Water

Surface water (dissolved, total, and total recoverable) chemistry was used to evaluate potential risks of COPCs to benthic invertebrates. All three fractions were compared to the relevant surface water criteria from US EPA or MDEQ (see Appendix C). For each CSM unit, the 95% UCL of the water concentration for each metal was compared to water quality benchmarks (see Appendix E, Tables E-4, E-5a, and E-5b). Hardness-based metals were also compared to 95% UCL concentrations based on minimum, mean, and maximum hardness concentrations. In addition, surface water concentrations on and near the Facility (dissolved and total recoverable concentration) were statistically compared to reference site waters (as described in Section 4.3.3). Results are summarized by CSM unit below and in Table 5.5.

- **Prickly Pear Creek**: Metal concentrations in surface water (total, total recoverable, or dissolved) from Prickly Pear Creek did not exceed acute water criteria except for Hg (HQ = 2) and Ag (HQ = 2 at mean hardness). Chronic criteria were exceeded for Al, Cd, Hg, Pb, and Ag. Exceedances for Hg and Ag were based on maximum detection limits, as the frequency of detection was low. However, the maximum detection limits are from historic data; recent data from 2010 used detection limits for these metals that would not indicate an exceedance of chronic criteria, except a slight exceedance for Ag based on dissolved concentrations (HQ = 2). Chronic exceedances for Al, Cd, and Pb were generally low (HQ = 2-5). Dissolved surface water concentrations of As, Fe, Pb, and Mn from Prickly Pear Creek were significantly greater than upstream stations, while Cu and Zn were not significantly different from upstream (see Appendix E, Table E-6). Total recoverable surface water concentrations of As, Pb, and Mn from Prickly Pear Creek were also significantly greater than upstream stations (see Appendix E, Table E-7).

- **Upper Lake and Upper Lake Marsh**: Concentrations of Cd, Cu, and Pb exceeded acute water criteria at all hardness levels (minimum, mean, and maximum) as total concentrations. All other metals were below acute water criteria. Chronic criteria were exceeded for Al, Cd, Cu, Fe, Pb, Se, and Ag. Exceedances for Se were based on maximum detection limits, as the frequency of detection was low. However, detection limits from the 2010 sampling event would not indicate an exceedance of the chronic criterion for Se. Chronic exceedances for Al, Cu, Fe, and Ag were generally low (HQ = 2-5). Cadmium and Pb chronic exceedances were generally high (HQs > 10) for total recoverable or total concentrations. However, dissolved concentrations of Cd and Pb did not exceed acute or chronic criteria (except for Pb at a minimum hardness, HQ = 2). Dissolved surface water concentrations of As, Pb, and Zn from Upper Lake and Upper Lake Marsh were significantly greater than the Walker Creek site, while Fe and Cu were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd, Pb, and Zn were also significantly greater than reference area concentrations (Appendix E, Table E-7).

- **Wilson Ditch**: No acute criteria were exceeded in samples collected from Wilson Ditch (excluding total Cd, in which two of the four the samples were below detection limits). Chronic criteria were exceeded for Cd and Pb. Chronic HQs ranged from 4-16 and 5-35 for Cd and Pb, respectively (Appendix E, Table E-5b). Dissolved surface water concentrations of As, Pb, and Zn from Wilson Ditch were significantly greater than the Walker Creek site, while Fe and Cu were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd were also significantly greater than reference area concentrations (Appendix E, Table E-7).

- **Lower Lake**: Concentrations of Cd, Cu, and Se exceeded acute water criteria. All other metals were below acute water criteria. Chronic criteria were exceeded for Sb, Cd, Cu, Pb, Se, Ag, and Tl. Chronic exceedances for Cu, Ag, and Tl were generally low (HQ = 2-6) (Appendix E, Tables E-5a and E-5b). Chronic exceedances for Cd, Pb, and Se were generally high (HQs > 10) (Appendix E, Tables E-5a and E-5b). Dissolved surface water concentrations of As, Cu, and Pb from Lower Lake were significantly greater than the Walker Creek site, while Fe, Mn, and Zn were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd and Pb were also significantly greater than reference area concentrations (Appendix E, Table E-7).

Table 5.5
Summary of Surface Water Quality Standard Exceedances

CSM Unit	Measure	Exceeded Acute Criterion	Exceeded Chronic Criterion
Prickly Pear Creek	Surface Water (Total)	Hg, Ag	Al, Cd, Hg, Pb, Ag
	Surface Water (Total Recoverable)	-	Cd, Pb
	Surface Water (Dissolved)	Hg	Cd, Hg, Ag
	Porewater (Dissolved)	-	Cd, Pb, Se, Ag
	Piezometer (Dissolved)	As, Zn	As, Zn
Upper Lake/Marsh	Surface Water (Total)	Cd, Cu, Pb	Al, Cd, Cu, Fe, Pb, Se, Ag
	Surface Water (Total Recoverable)	Cu	Al, Cd, Cu, Pb, Fe, Ag
	Surface Water (Dissolved)	-	Pb, Se, Ag
	Porewater (Dissolved)	-	Cd, Fe, Pb, Se, Ag
Wilson Ditch	Surface Water (Total)	Cd	Cd, Pb
	Surface Water (Total Recoverable)	-	Cd, Pb
	Surface Water (Dissolved)	-	Cd, Pb
	Porewater (Dissolved)	-	-
Lower Lake	Surface Water (Total)	Cd, Cu, Se	Sb, Cd, Cu, Pb, Se, Ag, Tl
	Surface Water (Total Recoverable)	Cd, Cu	Cd, Cu, Pb, Se, Tl
	Surface Water (Dissolved)	Cd, Se	Sb, Cd, Cu, Pb, Se, Ag, Tl
	Porewater (Dissolved)	As	Al, Sb, As, Cd, Pb, Se, Ag

5.1.3 Porewater

Porewater chemistry was evaluated to determine if concentrations of metals were greater than acute and chronic benchmarks for benthic invertebrates. Since porewater data were limited, maximum concentrations were evaluated when 95% UCLs could not be calculated. Due to low sample size, statistical analysis was not conducted on the porewater dataset. A majority of the metals analyzed in porewater have HQs <1 when based on acute benchmarks. Some metals did exceed acute or chronic benchmarks, however, as described below.

- **Prickly Pear Creek**: Porewater concentrations did not exceed any acute water criteria. Chronic criteria were exceeded for Cd, Pb, Se, and Ag. Exceedances for Pb, Se, and Ag were based on maximum detection limits as the frequency of detection was low. Chronic exceedances for Cd and Ag were generally low (HQ = 3-8) (Appendix E, Table E-5b). Piezometer samples were also collected in 2010 to investigate potential groundwater movement from Lower Lake to Prickly Pear Creek. Arsenic and Zn concentrations in these samples exceeded acute and chronic criteria (Appendix E, Tables E-5a and E-5b).
- **Upper Lake and Upper Lake Marsh**: Chronic criteria were exceeded for Cd, Fe, Pb, Se, and Ag (Appendix E, Tables E-5a and E-5b). Exceedances for Cd and Se were based on maximum detection limits, as the frequency of detection was low.
- **Lower Lake**: Arsenic in porewater from Lower Lake exceeded acute water criteria. Chronic criteria were exceeded by Al, Sb, As, Cd, Pb, Se, and Ag. Exceedances for Pb and Ag were based on maximum detection limits, as the frequency of detection was low.

Chronic exceedances for As and Cd were generally high (HQ ≥ 8) (Appendix E, Tables E-5a and E-5b).

5.1.4 Tissue Chemistry

Metal concentrations in tissue residues of invertebrate samples were analyzed for metals on and near the Facility as well as at reference locations. Invertebrate body burdens in Prickly Pear Creek were compared to those from upstream locations, while body burdens in Lower Lake and Upper Lake and Upper Lake Marsh were compared to those from Walker Creek (Pond/Marsh) (Table 5.6). In Wilson Ditch, only one invertebrate sample was taken, and thus no statistical analysis was conducted. Body burdens of Sb, As, Cd, Cu, Pb, Hg, Se, Ag, and Zn in this one location in Wilson Ditch were three or more times greater than those from reference locations. Lower Lake had the greatest number of metals associated with significantly higher body burdens when compared to reference locations. Statistical analysis is presented in Appendix E (Table E-8).

Table 5.6
Benthic Invertebrate Body Residue Concentrations Compared to Reference Sites

	Prickly Pear Creek	Upper Lake/Marsh	Lower Lake
Significantly higher than reference concentrations	Sb, Hg, Pb, Ag, V	As, Cd, Pb, Se, Ag, and Zn	Sb, As, Cd, Pb, Hg, Se, Ag, Tl, Zn
Significantly lower than reference concentrations	-	Ba, Fe	Ba, Fe
No significant differences	Al, As, Ba, Be, Cd, Cu, Fe, Mn, Ni, Se, Tl, Zn	Al, Sb, Be, Cu, Mn, Hg, Ni, Tl, V	Al, Be, Cu, Mn, Ni, V

5.1.5 Sediment Toxicity Tests

Sediments were collected from Upper Lake and Lower Lake in 2003, and from Prickly Pear Creek in 2010 for sediment toxicity testing (*e.g.*, growth and mortality) (see Appendix B, Table B-17 for results). In 2003, two samples from a reference area (Canyon Ferry Reservoir) and one laboratory control were compared to seven locations on or near the Facility (one in Lower Lake and six in Upper Lake and Upper Lake Marsh) (US EPA, 2005a). Testing conducted in 2003 used the epi-benthic amphipod *Hyalella azteca*. In 2010, Prickly Pear Creek upstream locations (four reference sites) and a laboratory control were compared to six Prickly Pear Creek stations adjacent to the Facility using both *H. azteca* and the benthic chironomid *Chironomus dilutus*. Mortality in all but two locations was below 20% (indicative of control level survival) and not significantly different from reference location survival. In 2003, Lower Lake (LL-1) exhibited 75% survival in *H. azteca* testing, and in 2010, Prickly Pear Creek (PPC-102) exhibited 45% survival. Only PPC-102 was significantly different from laboratory controls or reference locations ($p < 0.05$). Similarly, PPC-102 exhibited decreased growth, as biomass was significantly lower ($p < 0.05$). This decrease in growth was not observed in the 2003 LL-1 site sediment bioassay. The 2010 bioassays with *C. dilutus* did not demonstrate significant effects on mortality or growth at any of the sampled locations. However, high variability was noted in the bioassay for PPC-102, as survival ranged from 10-90% between test replicates.

PPC-102 did not have elevated sediment metal concentrations that would identify it as having a high probability of toxicity: the mean PECQ for this station was 0.58 (although As was elevated in this sample; PECQ = 1.3) and the SEM/AVS analysis indicated a low probability of toxicity. Surface water and porewater concentrations also suggest that metals are not the source of toxicity as concentrations were in most circumstances below detection limits (*e.g.*, dissolved concentrations in surface water were below detection limits for 13 out of 19 metals). Additionally, concentrations of metals that were above reporting limits were in most circumstances comparable to those of the reference area (within a factor of 2). Upon further examination, PPC-102 had higher TOC content (1.6%) and a higher proportion of clay content (20.7%), while the other investigated sites had lower TOC content (ranging from 0.3-0.7%) and a lower proportion of clay content (ranging from 2-6.3%). Other contaminants, such as non-polar organics, bind to this organic matter and could be a potential source of the observed toxicity. Additionally, *H. azteca* were not found in the four sites examined from Prickly Pear Creek but were present in the reference site area (PPC-1) in the 2003 biological survey. Collectively, these results suggest that habitat and sediment characteristics, or perhaps contaminants other than metals, could be the potential source of sediment toxicity. The results from sediment toxicity tests and sediment chemistry analyses are presented in Table 5.7.

A limited number of sediment toxicity tests have been conducted at the site in 2003 and 2010 (Table 5.7). In Lower Lake, mean PECQs appear to be decreasing from 2003 to 2010, however, sediment toxicity testing is not available to confirm if toxicity has also decreased in response (Table 5.7). Sediment toxicity tests were conducted in Prickly Pear Creek, upstream, adjacent to, and downstream of the site. Sediment toxicity tests were not performed in 2010 for Upper Lake/Marsh or Wilson Ditch. Several locations in Upper Lake/Marsh and Wilson Ditch had elevated mean PECQs, suggesting the potential for sediment toxicity at these locations (Table 5.7).

Table 5.7
Summary of Sediment Toxicity Analyses

Location	***H. azteca (10-Day)***		***C. dilutus (10-Day)***			
Sample ID (Date)	**Mean Survival**	**Mean Biomass**	**Mean Survival**	**Mean Biomass**	**Mean PECQ**[a]	**ΣSEM-AVS/foc (µmol/goc)**[b]
Lower Lake						
LL_1 (2003)	75%	0.174	-	-	55.6	-
LL_2 (2003)	-	-	-	-	56.3	-
LL_3 (2003)	-	-	-	-	102.7	-
LL-21 (2010)	-	-	-	-	17.7	434
LL-22 (2010)	-	-	-	-	6.2	-127
LL-23 (2010)	-	-	-	-	2.7	-788
LL-24 (2010)	-	-	-	-	2.5	-710
LL-25 (2010)	-	-	-	-	4.0	-58
Prickly Pear Creek						
PPC_2 (2003)	-	-	-	-	1.1	-
PPC_3 (2003)	-	-	-	-	2.9	-
PPC_4 (2003)	-	-	-	-	4.8	-
PPC_5 (2003)	-	-	-	-	0.6	-
PPC-102 (2010)	45%	0.06	89%	1.27	0.6	-286
PPC-103 (2010)	90%	0.11	89%	1.03	0.3	559
PPC-22 (2010)	95%	0.11	86%	1.06	0.3	635
PPC-23 (2010)	-	-	-	-	0.5	-
PPC-24 (2010)	91%	0.12	96%	1.14	0.4	2409
PPC-5 (2010)	94%	0.11	91%	1.01	0.2	1275
PPC-7 (2010)	89%	0.12	95%	0.92	0.5	891
PPC-8 (2010)	-	-	-	-	0.3	-
Upper Lake/Marsh						
UL-21 (2010)	-	-	-	-	32.5	751
UL-22 (2010)	-	-	-	-	5.7	-1550
UL-23 (2010)	-	-	-	-	26.0	6254
UL-24 (2010)	-	-	-	-	9.6	3094
UL-25 (2010)	-	-	-	-	17.1	-3136
ULM-1 (2010)	-	-	-	-	5.0	746
ULM-2 (2010)	-	-	-	-	2.4	274
ULM-3 (2010)	-	-	-	-	19.4	-544
ULM-4 (2010)	-	-	-	-	20.4	-1292
ULM-5 (2010)	-	-	-	-	5.8	-478
ULM-6 (2010)	-	-	-	-	4.6	-
ULM-7 (2010)	-	-	-	-	0.8	-
ULM-8 (2010)	-	-	-	-	0.9	-
ULM-9 (2010)	-	-	-	-	0.5	-

Location	*H. azteca (10-Day)*		*C. dilutus (10-Day)*			
Sample ID (Date)	**Mean Survival**	**Mean Biomass**	**Mean Survival**	**Mean Biomass**	**Mean PECQ** [a]	**ΣSEM-AVS/foc (µmol/goc)** [b]
ULM_1 (2003)	-	-	-	-	10.7	-
ULM_10 (2003)	98%	0.22	-	-	17.9	-
ULM_3 (2003)	90%	0.278	-	-	5.7	-
ULM_4 (2003)	98%	0.201	-	-	4.3	-
ULM_7 (2003)	95%	0.242	-	-	1.7	-
ULM_11 (2003)	-	-	-	-	30.6	-
ULM_12 (2003)	98%	0.247	-	-	28.9	-
ULM_2 (2003)	-	-	-	-	2.1	-
ULM_5 (2003)	-	-	-	-	5.7	-
ULM_6 (2003)	95%	0.171	-	-	17.0	-
ULM_8 (2003)	-	-	-	-	6.0	-
ULM_9 (2003)	-	-	-	-	2.4	-
Wilson Ditch						
WD-2 (2010)	-	-	-	-	5.1	1572
WD-3 (2010)	-	-	-	-	2.0	-
WD-4 (2010)	-	-	-	-	2.1	-
WD-25 (2010)	-	-	-	-	1.0	-
WD-26 (2010)	-	-	-	-	15.8	-

Notes:

(a) Mean PECQ<0.5 = low probability of sediment toxicity; mean PECQ=0.5-1.0 = moderate probability of sediment toxicity; mean PECQ >1.0-<5 = high probability of sediment toxicity; and mean PECQ > 5 = very high probability of sediment toxicity.

(b) Risk measures:

A sediment in which (ΣSEM -AVS)/foc < 130 µmols/goc is expected to pose low risk due to Cd, Cu, Pb, Ni, or Zn.

A sediment in which 130 µmols/goc < (ΣSEM - AVS)/foc < 3,000 µmols/goc may have adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.

A sediment in which (ΣSEM - AVS)/foc > 3,000 µmols/goc, is expected to cause adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.

5.1.6 Community/Habitat Data

Rapid bioassessment protocols (RBP) were used in 2003 and 2010. In 2003, benthic invertebrate communities were examined at several locations in Prickly Pear Creek were compared to an upstream location (PPC-1), while locations in Upper Lake and Upper Lake Marsh were compared to Canyon Ferry Reservoir. When compared to the reference area, Prickly Pear Creek locations had lower numbers of total species (*i.e.*, diversity), a lower number of EPT species (*i.e.*, pollution-sensitive species), and a lower relative abundance of species (*i.e.*, proportion of species relative to the total). While the overall numbers for stations on or near the Facility were lower than those for the reference area, a high percentage of EPT species were present (ranging from 43-52%). Upper Lake samples had a higher number of total species, a higher number of EPT species, and a higher relative abundance of total species than the reference area. The Upper Lake and Upper Lake Marsh area, however, had similar abundances, number of EPT species, and relative abundances as the reference area. Whether this is indicative of favorable conditions in the Upper Lake and Upper Lake Marsh or a result of potentially impaired conditions in the selected reference area is unknown.

Based on the RBP assessment (which included habitat characterization only) in 2010, habitat characteristics are variable for each CSM unit (Table 5.8). Prickly Pear Creek was comparable in most circumstances to its upstream reference locations. Lower Lake and Upper Lake and Upper Lake Marsh sediment characteristics were generally comparable to Walker Creek, while Wilson Ditch differed with respect to TOC, pH, and clay content. Habitats for Prickly Pear Creek and Wilson Ditch were also analyzed based on abiotic factors such as bank stability, sediment deposition, and pool variability (see Appendix A). This categorization was based upon a scoring scheme that would characterize site habitats as optimal, suboptimal, marginal, or poor. Prickly Pear Creek (upstream, below the dam east of Lower Lake, and above the dam) and Wilson Ditch were categorized as suboptimal habitats (ranging from 114-144 out of a possible score of 200) (Table 5.8).

Table 5.8
Summary of Physical Characteristics of Sediments and Habitat

CSM Unit	TOC	pH	% Sand	% Clay	RBP Score (out of 200)
Reference Areas					
Prickly Pear Creek (upstream)	0.2-1.3	7.1-7.7	73-90	2-6	137
Walker Creek	0.4-2.3	6.48-7.13	62-79	7-11	Not Assessed
Facility					
Prickly Pear Creek	0.3-1.6	7.06-7.48	65-92	2-18	144 (above dam) 114 (below dam)
Lower Lake	1.1-2.7	7.7-9.49	57-78	10-26	Not Assessed
Upper Lake/Marsh	1-5	6.78-7.69	1-78	8-30	Not Assessed
Wilson Ditch	3-5.1	7.49-7.75	24-55	16-24	117

5.2 Uncertainty Analysis

Potential sources of uncertainty with the risk assessment for benthic invertebrate communities may include imprecise estimates of exposure and effects. Further details on these uncertainties and the effects on interpretation of the risk characterization are provided below.

Exposure Estimates

The exposure estimates for benthic invertebrates relied on current and historical sediment, surface water, and porewater data. To estimate exposure in these CSM units, 95% UCL concentrations were estimated for all three media types and for each CSM unit. In most cases, sufficient data were available to estimate 95% UCLs ($n > 5$), however, not all CSM units had equal numbers of sample. In addition, for some metals (see Appendix B) insufficient data were available for the CSM unit to estimate a 95% UCL. As a substitute for the concentration of non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. Since US EPA's ProUCL software accounts for non-detects, it was not necessary to use a non-detect substitution method for datasets with sufficient sample size to estimate a 95% UCL. As a result, some exposure estimates for CSM units with low sample sizes may be under- or overestimated. A number of surface water samples had non-detected concentrations, and therefore maximum detection limits were used to compare to surface water criteria. Risk estimates based on detection limits are overestimates and not necessarily indicative of risk, since true concentrations are unknown.

All three matrices (sediment, surface water, porewater) used exposure estimates that assumed 100% bioavailability of metals from site matrices. A number of factors affect metal bioavailability in aquatic environments, such as pH, organic matter content (dissolved and total), aging, temperature, humidity, and chemical form (US EPA, 2007). Thus, the use of total metals concentrations for estimating exposure, as was conservatively used in the BERA, is likely to overestimate exposure and potential risk. The use of AVS/SEM concentrations to estimate metal bioavailability in sediments and the results of the sediment toxicity tests confirmed this, since nearly all locations had low to moderate risk even though some metals exceeded various benchmarks when assuming 100% bioavailability.

Exposure to some metals in surface water is dependent on hardness concentrations. Hardness and metal concentrations typically vary with season. Hardness concentration data is summarized for each of the CSM units in Table 5.9. Mean hardness values for Prickly Pear Creek, Upper Lake and Upper Lake Marsh, and Wilson Ditch are similar across the months sampled, which is likely due to the input of Prickly Pear Creek to Upper Lake and Upper Lake Marsh at the diversion south of the Facility. Hardness concentrations are lowest in the spring and summer and increase through the fall and winter. Hardness concentrations at Lower Lake follow this trend; however, concentrations are generally higher at all times of the year compared to the other CSM units. Some months of the year have not been sampled for all CSM units from 2000-2010, and, therefore, there is some uncertainty in the exposure assessment for aquatic receptors. However, the current data indicate that the summer months have the lowest hardness; therefore, the worst-case exposure concentrations are likely to have been incorporated into the risk assessment.

Table 5.9
Seasonal Variation in Water Hardness Concentrations

	Prickly Pear Creek				Upper Lake/Marsh				Wilson Ditch				Lower Lake			
Month	**N**	**Min**	**Mean**	**Max**	**N**	**Min**	**Mean**	**Max**	**N**	**Min**	**Mean**	**Max**	**N**	**Min**	**Mean**	**Max**
1	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-
2	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-
3	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-
4	15	63	86	109	0	-	-	-	0	-	-	-	3	154	184	204
5	34	50	81	233	1	76	76	76	0	-	-	-	5	128	282	608
6	10	50	51	52	0	-	-	-	4	50	56	62	2	114	136	158
7	5	59	60	66	0	-	-	-	0	-	-	-	1	104	104	104
8	7	81	87	92	14	83	91	107	5	87	91	95	5	103	105	108
9	0	-	-	-	12	107	119	157	0	-	-	-	3	180	197	207
10	31	92	108	139	1	104	104	104	0	-	-	-	5	122	210	457
11	25	100	113	200	1	127	127	127	0	-	-	-	4	148	204	278
12	5	119	122	128	0	-	-	-	0	-	-	-	0	-	-	-

Toxicity Benchmarks

The toxicity benchmarks used for evaluating potential risks to benthic invertebrates relied primarily on consensus SQGs (*i.e.*, PEC values), US EPA's (2009) AWQC, and MDEQ's (2008) water quality standards (for surface and porewater matrices). These benchmarks do not necessarily encompass all of the various benthic taxa potentially present in the sampled areas nor the various life stages and niches that the various taxa may possess. Additionally, these benchmarks do not fully account for bioavailability (SEM/AVS for sediments; dissolved organic matter for surface waters). Finally, sediment concentrations in several locations resulted in elevated mean PECQs but toxicity was not always observed. Therefore, mean PECQs used in the benthic invertebrate evaluation may not be predicting sediment toxicity accurately at this site.

Several surface water benchmarks (*e.g.*, Sb, Ag, and Tl) were obtained from US EPA's (2010b) GLI clearinghouse in the absence of finalized criteria from US EPA or the State of Montana. These benchmarks are secondary acute and/or chronic values and are derived using a US EPA methodology to develop criteria for the Great Lakes. This methodology allows for the derivation of aquatic benchmarks with fewer data than required for the derivation of AWQC. In this method, chronic water quality criteria for the protection of aquatic life are derived based on acute toxicity data and using a number of conservative safety factors. Therefore, any risks identified in surface waters from Sb, Ag, and Tl should be considered uncertain.

5.3 Weight-of-Evidence Summary and Conclusions

The potential risk to benthic invertebrates posed by metal COPCs in sediment, surface water, and porewater were evaluated using several lines of evidence. Table 5.10 presents the chemistry analysis results for each CSM unit, and Table 5.11 presents a weight-of-evidence summary using all lines of evidence evaluated. A summary of the key results for each CSM unit is provided below:

- **Prickly Pear Creek**: Metal concentrations in Prickly Pear Creek sediments were elevated above sediment benchmarks at a small number of locations. Further analysis using mixture toxicity (*i.e.*, mean PECQs) and metal bioavailability (*i.e.*, SEM/AVS) metrics indicated that sediment metal concentrations are indicative of a low probability of toxicity to benthic invertebrates. This is corroborated further by the sediment toxicity results, where only one station exhibited significant toxicity and only in one of two species tested. Sediment, surface water, and tissue concentrations for most metals were similar to upstream concentrations at most stations. Habitat quality in Prickly Pear Creek may be a contributing factor to differences in community metrics and potential toxicity. Analysis of piezometer readings at two stations in Prickly Pear Creek suggest that As and Zn are elevated and possibly influenced by groundwater transport from Lower Lake. Overall, the potential risks to benthic invertebrates in Prickly Pear Creek are considered low. Arsenic, Cd, and Pb are the primary risk drivers.

- **Upper Lake and Upper Lake Marsh**: Bulk sediment concentrations of several metals exceeded benchmarks in the Upper Lake and Marsh (Table 5.10). Mean PECQ concentrations also suggested that metal concentrations present a moderate to high probability of toxicity. However, SEM/AVS concentrations at most stations were indicative of a low probability of toxicity, and sediment toxicity tests did not show any toxicity to *H. azteca*. Thus, bulk sediment concentrations may be over-predicting risk in this CSM unit. The stations with the highest potential for risk are located on the northern side of Upper Lake closest to the Facility (Map 8). Surface water and porewater concentrations for some metals exceeded benchmarks (Table 5.11). Several metals were also consistently elevated in sediments, surface waters, and benthic tissues compared to reference sites (*i.e.*, As, Cd, Cu, Pb, Ag). Arsenic, Cd, Cu, Pb, and Ag are the primary risk drivers in this CSM unit, as they are consistently elevated in sediments, surface waters, and tissues.
- **Wilson Ditch**: Fewer lines of evidence were available for Wilson Ditch (Tables 5.10 and 5.11). Several metals exceeded sediment and surface water benchmarks (*e.g.*, Cd and Pb). In addition, metal concentrations in sediment, surface water, and invertebrate tissues were found to be greater than those in reference areas (*i.e.*, Cd, Hg, Pb, and Ag). The pattern of metal concentrations and benchmark exceedances were very similar to Upper Lake, which feeds into Wilson Ditch. Based on the available information, As, Cd, Pb, and Ag are the primary risk drivers in this CSM unit.
- **Lower Lake**: Bulk sediment concentrations of several metals exceeded benchmarks in Lower Lake (Table 5.10). Mean PECQ concentrations also suggested that metal concentrations present a moderate to high probability of toxicity. However, SEM/AVS concentrations at most stations indicated a low probability of toxicity, and the sediment toxicity testing showed borderline significant toxicity to *H. azteca*. Thus, bulk sediment concentrations may be over-predicting risk in Lower Lake. Surface water and porewater concentrations for some metals exceeded benchmarks (Table 5.10). Several metals were also consistently elevated in sediments, surface waters, and benthic tissues compared to reference sites (*i.e.*, Sb, As, Cd, Cu, Hg, Pb, Ag, and Zn). Most metals exceeded benchmarks or reference area concentrations in one of the metrics evaluated. The likely risk drivers in this CSM unit include Sb, As, Cd, Cu, Pb, Ag, and Zn.

In summary, the metals of primary concern (*i.e.*, COCs) for benthic invertebrates can be summarized as follows:

- As, Cd, Hg, and Pb are COCs for all aquatic areas on or near the Facility;
- Sb, Cu, Ag, and Zn are COCs for most aquatic areas on or near the Facility; and
- Al, Ba, Be, Fe, Mn, Ni, Se, Tl, and V are metals that are expected to pose negligible risks (due to minimal or no predicted toxicity, no consistently significant differences from

reference areas, or significant uncertainty associated with toxicity benchmarks) on or near the Facility.

Table 5.10
Risk Characterization for Benthic Invertebrates

Metal	Prickly Pear Creek				Upper Lake/Marsh				Wilson Ditch			Lower Lake			
	SD	SW	PW	T	SD	SW	PW	T	SD	SW	T	SD	SW	PW	T
Al		x				x								x	
Sb				x	xx						x	xx	x	x	x
As	x		x		xx			x	x		x	xx		x	x
Ba															
Be															
Cd	x	x	x		xx	xx		x	xx	xx	x	xx	xx	x	x
Cu	x				xx	x					x	xx	xx		
Fe						x	x								
Hg	x			x	xx				xx		x	xx			x
Pb	x	xx		x	xx	xx	x	x	xx	xx	x	xx	xx		x
Mn	x				xx										
Ni															
Se								x			x		x	x	x
Ag			x	x	xx	x	x	x	xx		x	xx	x		x
Tl													x		
V				x									x		
Zn	x		x		xx			x	x		x	xx			x

Notes:

Each column represents the results of chemistry evaluations (benchmark and reference comparisons) as follows:

SD – an "x" indicates measured sediment concentrations exceeded sediment benchmarks, where available. In addition, an "xx" indicates that metal concentrations exceeded a benchmark and were also significantly greater than reference concentrations.

SW – an "x" indicates measured (dissolved, total or total recoverable) surface water concentrations (95% UCL) exceeded acute or chronic benchmarks, where available. In addition, an "xx" indicates that metal concentrations (dissolved or total recoverable) exceeded a benchmark and were also significantly greater than reference concentrations.

PW – an "x" indicates measured porewater concentrations exceeded acute or chronic benchmarks, if available. No porewater data were collected for Wilson Ditch.

T – an "x" indicates measured onsite benthic invertebrate tissue concentrations were significantly greater than reference area concentrations.

Table 5.11
Weight-of-Evidence Analysis for Benthic Invertebrates

CSM Unit	Lines of Evidence	Weight of Evidence[a] --	0	+	COCs[b]
Prickly Pear Creek	Sediment Benchmark Comparison – PECs			+	As, Cd, Hg, Pb
	SEM/AVS Analysis			+	
	Sediment – Reference Comparison	-			
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Benthic Invertebrate Tissue (body burdens)			+	
	Sediment toxicity tests	-		+ (1 station)	
	Community/habitat data analysis			+	
Upper Lake/Marsh	Sediment Benchmark Comparison – PECs			+	As, Cd, Hg, Pb, Cu, Ag
	SEM/AVS Analysis			+	
	Sediment – Reference Comparison			+	
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Benthic Invertebrate Tissue (body burdens)			+	
	Sediment toxicity tests	-			
	Community/habitat data analysis		0		
Wilson Ditch	Sediment Benchmark Comparison – PECs			+	As, Cd, Hg, Pb, Ag
	SEM/AVS Analysis			+	
	Sediment – Reference Comparison			+	
	Surface Water Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Benthic Invertebrate Tissue (body burdens)			+	
	Community/habitat data analysis		0		
Lower Lake	Sediment Benchmark Comparison – PECs			+	Sb, As, Cd, Cu, Pb, Hg, Ag, and Zn
	SEM/AVS Analysis	-			
	Sediment – Reference Comparison			+	
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Benthic Invertebrate Tissue (body burdens)			+	
	Sediment toxicity tests			+ (only 1 station tested)	
	Community/habitat data analysis		na		

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence.
na – not assessed

6 Risk Characterization for Fish

The refined SLERA for fish (Section 4.2.2) involved the assessment of a suite of potential exposure media including surface water, porewater, and dietary uptake (*via* invertebrates, aquatic plants, forage fish, and incidental sediment ingestion). The following metals exceeded one or more of the screening benchmarks and are evaluated further in the BERA for fish: Al, Sb, As, Cd, Cu, Fe, Pb, Mn, Hg, Se, Ag, Tl, and Zn. Several metals were found to pose negligible risks to fish and are not examined further in the BERA: Ba, Be, Cr, Co, Ni, and V. The BERA examined several lines of evidence to evaluate the potential for COPCs to adversely affect the survival, growth, or reproduction of fish populations. Each line of evidence provides information to address the primary risk questions (as defined previously in Section 3.6):

- Are the concentrations of metals in porewater, surface water, sediment, tissues, and prey items from Prickly Pear Creek, Lower Lake, Upper Lake, and Upper Lake Marsh greater than benchmarks for survival, growth, or reproduction of fish? Are fish at the site exposed to metals concentrations in sediment, porewater, and surface waters that are significantly higher than concentrations at reference sites?

6.1 Lines of Evidence Evaluated

Surface and porewater chemistry, tissue body burdens, prey item chemistry, and habitat analysis were used to evaluate the potential risks of COPCs to fish. The results presented here for surface water and porewater are the same as those reported for benthic invertebrates, since the benchmarks and exposure concentrations were the same. Each of these tools are used in a weight-of-evidence analysis to identify the most likely risk drivers in each of the CSM units.

6.1.1 Surface Water

Surface water (dissolved, total, and total recoverable) chemistry was used to evaluate potential risks of COPCs to fish. For each CSM unit, the 95% UCL of the water concentration for each metal was compared to water quality benchmarks (see Appendix E for detailed results). Hardness-based metals were also compared to 95% UCL concentrations based on minimum, mean, and maximum hardness concentrations. In addition, surface water concentrations from on or near the Facility (dissolved and total recoverable concentrations) were statistically compared to concentrations from reference locations (as described in Section 4.3.3). Surface water results are summarized by CSM unit.

- **Prickly Pear Creek**: Metal concentrations in surface water (total, total recoverable, or dissolved) from Prickly Pear Creek did not exceed acute water criteria except for Hg (HQ = 2) and Ag (HQ = 2 at mean hardness). Chronic criteria were exceeded for Al, Cd, Hg, Pb, and Ag. Exceedances for Hg and Ag were based on maximum detection limits, as the frequency of detection was low. However, the maximum detection limits are from historic data; recent data from 2010 used detection limits for these metals that would not indicate an exceedance of chronic criteria, except a slight exceedance for Ag based on dissolved concentrations (HQ = 2). Chronic exceedances for Al, Cd, and Pb were generally low (HQ = 2-5). Dissolved surface water concentrations of As, Fe, Pb, and Mn from Prickly Pear Creek were significantly greater than upstream stations, while Cu and Zn were not significantly different from upstream (Appendix E, Table E-6). Total recoverable surface water concentrations of As, Pb, and Mn from Prickly Pear Creek were also significantly greater than upstream stations (Appendix E, Table E-7).

- **Upper Lake and Upper Lake Marsh**: Concentrations of Cd, Cu, and Pb exceeded acute water criteria at all hardness levels (minimum, mean, and maximum). All other metals were below acute water criteria. Chronic criteria were exceeded for Al, Cd, Cu, Fe, Pb, Se, and Ag. Exceedances for Se were based on maximum detection limits, as the frequency of detection was low. However, detection limits from the 2010 sampling event would not indicate an exceedance of the chronic criterion for Se. Chronic exceedances for Al, Cu, Fe, and Ag were generally low (HQ = 2-5). Cadmium and Pb chronic exceedances were generally high (HQs > 10) for total recoverable or total concentrations. However, dissolved concentrations of Cd and Pb did not exceed acute or chronic criteria (except for Pb at a minimum hardness, HQ = 2). Dissolved surface water concentrations of As, Pb, and Zn from Upper Lake and Upper Lake Marsh were significantly greater than the Walker Creek site, while Fe and Cu were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd, Pb, and Zn were also significantly greater than reference area concentrations (Appendix E, Table E-7).

- **Wilson Ditch**: No acute criteria were exceeded in samples collected from Wilson Ditch (excluding total Cd, in which two of the four the samples were below detection limits). Chronic criteria were exceeded for Cd and Pb. Chronic HQs ranged from 4-16 and 5-35 for Cd and Pb, respectively (Appendix E, Table E-5b). Dissolved surface water concentrations of As, Pb, and Zn from Wilson Ditch were significantly greater than the Walker Creek site, while Fe and Cu were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd were also significantly greater than reference area concentrations (Appendix E, Table E-7).

- **Lower Lake**: Concentrations of Cd, Cu, and Se exceeded acute water criteria. All other metals were below acute water criteria. Chronic criteria were exceeded for Sb, Cd, Cu, Pb, Se, Ag, and Tl. Chronic exceedances for Cu, Ag, and Tl were generally low (HQ = 2-6) (Appendix E, Tables E-5a and E-5b). Chronic exceedances for Cd, Pb, and Se were generally high (HQs > 10) (Appendix E, Tables E-5a and E-5b). Dissolved surface water concentrations of As, Cu, and Pb from Lower Lake were significantly greater than the Walker Creek site, while Fe, Mn, and Zn were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd and Pb were also significantly greater than reference area concentrations (Appendix E, Table E-7).

6.1.2 Porewater

Porewater chemistry was evaluated to determine if concentrations of metals were greater than acute and chronic benchmarks for fish. This is likely a very conservative estimate of exposure, since most fish species have minimal contact with sediments and sediment porewater. Since porewater data were limited, maximum concentrations were evaluated when 95% UCLs could not be calculated. Due to low sample size, statistical analysis was not conducted on the porewater dataset. A majority of the metals analyzed in porewater have HQs < 1 when based on acute benchmarks. Some metals did exceed acute or chronic benchmarks, however, as described below.

- **Prickly Pear Creek**: Porewater concentrations did not exceed any acute water criteria. Chronic criteria were exceeded for Cd, Pb, Se, and Ag. Exceedances for Pb, Se, and Ag were based on maximum detection limits, as the frequency of detection was low. Chronic exceedances for Cd and Ag were generally low (HQ = 3-8) (Appendix E, Table E-5b). Piezometer samples were also collected in 2010 to investigate potential groundwater movement from Lower Lake to Prickly Pear Creek. Arsenic and Zn concentrations in these samples exceeded acute and chronic criteria (Appendix E, Tables E-5a and E-5b).
- **Upper Lake and Upper Lake Marsh**: Chronic criteria were exceeded for Cd, Fe, Pb, Se, and Ag (Appendix E, Tables E-5a and E-5b). Exceedances for Cd and Se were based on maximum detection limits, as the frequency of detection was low.
- **Lower Lake**: Arsenic in porewater from Lower Lake exceeded acute water criteria. Chronic criteria were exceeded by Al, Sb, As, Cd, Pb, Se, and Ag. Exceedances for Pb and Ag were based on maximum detection limits, as the frequency of detection was low. Chronic exceedances for As and Cd were generally high (HQ ≥ 8) (Appendix E, Tables E-5a and E-5b).

6.1.3 Tissue Chemistry

Fish tissue concentrations were compared to critical body residues (CBRs) for several metals (see Appendix C for description of benchmarks and Appendix E, Table E-10, for data analysis). None of the fish tissue samples collected from Prickly Pear Creek or Wilson Ditch had concentrations of any metal above the CBRs (Table 6.1). A majority of the samples collected from Upper Lake and Upper Lake Marsh also did not have metal concentrations exceeding CBRs (Table 6.1). Four of the 51 fish samples had metal concentrations of either Al, As, Cd, Pb, Hg, Se, or Zn above the CBR. However, some exceedances of As, Cd, and Se were due to elevated detection limits. Mercury concentrations in a rainbow trout fillet sample collected from Upper Lake and Upper Lake Marsh (0.217 mg/kg-ww) were slightly above the CBR (0.2 mg/kg-ww). Concentrations of Al, As, Cd, Fe, Pb, and Se exceeded the CBR in one sample from Lower Lake (Table 6.1). The Se body burden (1.73 mg/kg-ww) in one Lower Lake fish sample was slightly above the Se CBR (1.58 mg/kg-ww); the other two samples were below the CBR (*i.e.*, 0.67 and 1.40 mg/kg-ww). Thus, with a few exceptions, concentrations of metals in fish tissues are below CBRs. However, it should be noted that there is significant uncertainty with the CBRs, as discussed in Appendix C.

Table 6.1
Results of Critical Body Residue Analysis

	Number of Tissue Samples Exceeding the CBR			
Metal	**Prickly Pear Creek**	**Upper Lake/Marsh**	**Wilson Ditch**	**Lower Lake**
Al	0 of 13	1 of 34	0 of 1	1 of 3
As	0 of 13	3 of 34 [a]	0 of 1	1 of 3
Be	0 of 13	0 of 34	0 of 1	0 of 3
Cd	0 of 13	3 of 34 [a]	0 of 1	1 of 3
Cr	0 of 13	0 of 34	0 of 1	0 of 3
Cu	0 of 13	0 of 34	0 of 1	0 of 3
Fe	0 of 13	0 of 34	0 of 1	1 of 3
Pb	0 of 13	1 of 34	0 of 1	1 of 3
Hg	0 of 13	1 of 34	0 of 1	0 of 3
Se	0 of 13	3 of 34 [a]	0 of 1	1 of 3
Tl	0 of 13	0 of 34	0 of 1	0 of 3
V	0 of 13	0 of 34	0 of 1	0 of 3
Zn	0 of 13	1 of 34	0 of 1	0 of 3

Note:

(a) some exceedances based on detection limit values.

Fillet tissue samples from game fish (*e.g.*, brown trout and rainbow trout) were collected from Prickly Pear Creek near and downstream of the Facility and Upper Lake and Upper Lake Marsh and compared statistically to reference sites in the same manner as other site media. While Hg and Se tissue concentrations in game fish were generally below CBRs (one exceedance of Hg and four exceedances of Se out of 51 samples), Hg and Se were the only two metals to have significantly higher concentrations in fish tissue than their respective reference sites (all other metals were lower than or not significantly different from reference sites) (Table 6.2). Thus, Hg and Se concentrations in fish at the site appear to be influenced by site activities. Tissue concentrations from Prickly Pear Creek and Wilson Ditch are not at levels that would present a risk to fish, while concentrations of some metals in a number of tissue samples collected from Upper Lake/Marsh and Lower Lake suggest a potential risk to fish.

Table 6.2
Comparison of Site and Reference Fish Tissue Samples

Result	Prickly Pear Creek	Upper Lake/Marsh
Significantly higher concentration	Hg	Hg, Se
Significantly lower concentration	Cd	Al, Cd
No significant difference	Al, Sb, As, Ba, Cu, Fe, Pb, Mn, Se, Ag, Tl, Zn	Sb, As, Ba, Cu, Fe, Pb, Mn, Ag, Tl, Zn

Note:

Sample locations shown in Table E-10 and Map 6a.

6.1.4 Dietary Assessment

Metal concentrations in fish prey items were examined by comparing the 95% UCL to a dietary LOAEL (Appendix E, Table E-11). The dietary assessment evaluated exposure to COPC metals from aquatic plants, aquatic invertebrates, forage fish, stomach contents, and sediment; a summary of the results is shown in Table 6.3. Dietary benchmarks were only available for As, Cd, Cu, Pb, Se, and Zn. No prey items had concentrations of these metals above the dietary benchmark in Prickly Pear Creek or Wilson Ditch. Selenium concentrations were elevated above the dietary benchmark in Lower Lake only. Lead from one stomach content sample exceeded the LOAEL in Upper Lake and Upper Lake Marsh. Sediment concentrations of Pb from Upper Lake and Upper Lake Marsh were above the dietary benchmark based on a 10% sediment ingestion rate. If alternative rates are applied (*e.g.*, 2% or 5%), As, Cd, and Pb would still exceed the benchmarks in Lower Lake. Sediment concentrations from Upper Lake and Upper Lake Marsh would exceed a benchmark at 5% but not at a 2% ingestion rate. Thus, some metals (*e.g.*, As, Cd, Cu, Pb) exceeded dietary benchmarks in several prey items from Lower Lake, and Pb minimally exceeded dietary benchmarks in Upper Lake and Upper Lake Marsh.

Table 6.3
Dietary Risk Characterization for Fish

CSM Unit	Metal (As, Cd, Cu, Pb, and Zn) Concentrations Exceeding the Dietary LOAEL					
	Benthic Invertebrates	Other Aquatic Invertebrates	Aquatic Plants	Forage Fish	Stomach Contents	Sediment
Prickly Pear Creek	None	None	None	None	Not measured	None
Upper Lake/Marsh	None	None	None	None	Pb	Pb
Wilson Ditch	None	None	None	None	Not measured	None
Lower Lake	Se	As, Pb, Se	As, Cd, Cu, Pb, Se	Se	Not measured	As, Cd, Pb, Se

6.1.5 Fish Health/Habitat

Habitat evaluations were conducted for each of the CSM units (Appendix A), and these included an assessment of shoreline features and fish cover. Prickly Pear Creek habitat was generally similar both upstream and onsite with abundant riparian vegetation and shoreline vegetation. Upper Lake and Upper Lake Marsh provides sparse or moderate to very heavy density fish cover in several forms: aquatic weeds, brush or woody debris, overhanging vegetation, and human structures. Lower Lake generally had sparse to moderate fish cover in the form of brush or woody debris, rock ledges or sharp drop-offs, boulders, and human structures. Wilson Ditch is generally shallow with abundant shoreline vegetation and is reported to have no flow during parts of the year. Thus, Wilson Ditch provides only seasonal habitat for fish or wildlife populations. Fish captured during the 2010 ecological investigation were visually examined for abnormalities at all CSM units and no abnormalities were reported (Appendix A).

6.2 Uncertainty Analysis

Exposure Estimates

The exposure estimates for fish relied on current and historical sediment, surface water, porewater, prey, and tissue data. To estimate exposure in the different CSM units, 95% UCL concentrations were estimated for all media and for each CSM unit. In most cases, sufficient data were available to estimate 95% UCLs ($n > 5$), although not all CSM units (*e.g.*, Wilson Ditch) had equal numbers of samples. In addition, for some metals (see Appendix B) insufficient data were available for the CSM unit to estimate a 95% UCL. As a substitute for the concentration for non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. As a result, some exposure estimates for CSM units with low sample sizes may be under- or overestimated.

As discussed in Section 5.2 (benthic invertebrates), exposure to some metals in surface water is dependent on hardness concentrations (*e.g.*, Cd, Cu, Pb, Zn). Mean hardness values for Prickly Pear Creek, Upper Lake and Upper Lake Marsh, and Wilson Ditch are similar across the months sampled, which is likely due to the input of Prickly Pear Creek to Upper Lake and Upper Lake Marsh at the diversion south of the Facility. Hardness concentrations are lowest in the spring and summer and increase through the fall and winter. Hardness concentrations at Lower Lake follow this trend; however, concentrations are generally higher at all times of the year compared to the other CSM units. The mean hardness varies by month and ranges between 51-122 mg/L $CaCO_3$ for Prickly Pear Creek, 76-127 mg/L $CaCO_3$ for Upper Lake and Upper Lake Marsh, 56-91 mg/L $CaCO_3$ for Wilson Ditch, and 104-282 mg/L $CaCO_3$ for Lower Lake (Table 5.8). The current data indicate that the summer months have the lowest hardness; therefore, the worst-case exposure concentrations are likely to have been incorporated into the risk assessment.

Porewater concentrations were compared to surface water benchmarks for fish in this analysis. Fish, unlike benthic invertebrates, are highly mobile and are not likely exposed to porewater concentrations as frequently as assumed in this risk assessment. For informational purposes, the results are presented in this section. However, any risks from porewater are likely overestimated and are not reliable indicators of risk to fish populations.

Metal concentrations were assumed to be 100% bioavailable in all media and, therefore, exposure is likely to be overestimated for some exposure pathways. For example, aquatic plant concentrations were only measured in Upper Lake and Upper Lake Marsh and estimated from sediment concentrations in all other CSM units. The uptake model for plants tends to overestimate tissue concentrations and does not incorporate bioavailability (see discussion in Section 11.2). Further, as discussed previously, metal bioavailability is known to be heavily influenced by hardness, organic carbon content, pH, temperature, and other factors. Current water quality criteria do not account for all of these parameters. US EPA has accounted for these factors in the acute Cu water quality criterion by employing the biotic ligand model (BLM). However, the data available for this site are incomplete with respect to the BLM and an analysis using the BLM could not be completed. Thus, bioavailability adjustments for Cu (and possibly other metals) may result in lower or higher estimates of exposure. Therefore, exposure estimates remain an uncertainty in this risk assessment. Finally, incidental sediment ingestion was evaluated for fish using a 10% ingestion rate and assuming 100% bioavailability. These assumptions likely overestimate potential dietary exposure and, consequently, dietary risks from sediments are conservative.

Toxicity Benchmarks

As discussed in Section 5.2, several surface water benchmarks (*e.g.*, Sb, Ag, and Tl) were obtained from US EPA's (2010b) GLI clearinghouse in the absence of finalized criteria from US EPA or the State of Montana. These benchmarks are secondary acute and/or chronic values and are derived using a US EPA methodology to develop criteria for the Great Lakes. This methodology allows for the derivation of aquatic benchmarks with fewer data than required for the derivation of AWQC. In this method, chronic water quality criteria for the protection of aquatic life are derived based on acute toxicity data and using a number of conservative safety factors. Therefore, any risks identified in surface waters from Sb, Ag, and Tl should be considered uncertain.

Critical Body Residues

The CBR approach is currently undergoing debate in the scientific community. The application of the tissue-residue approach to cationic metals is suggested to be problematic due to a number of factors, such as varying regulation/detoxification mechanisms, nutritional essentiality, and sequestration in tissues (Adams *et al*., 2010; Sappington *et al*., 2010; McElroy *et al*., 2010; US EPA, 2007) as well as a lack of standardization and limited datasets using this approach (Sappington *et al*., 2010). Due to the limited application of CBRs to metals and the lack of standardized approaches, minimal confidence is associated with this approach. It is important to note that while the CBRs evaluated herein suggested low risk from metals, sensitivity may differ between species and different lifestages. Only selected species and size classes were evaluated in the BERA due to limited toxicity data, and therefore risk results may not characterize all species or lifestages that could be encountered at the site.

Additional uncertainty with the CBR analysis for Se stems from the use of a draft tissue standard from US EPA (2004) that has not yet been adopted. The draft US EPA whole body CBR for Se is 7.91 mg/kg dwt (1.58 mg/kg ww assuming 80% moisture in fish tissue). This criterion is undergoing scientific debate and some issues have been identified (Skorupa *et al*., 2004; Lemly and Skorupa, 2007) including the appropriateness of the underlying toxicity database and species or tissues investigated. An alternative value of 5.85 mg/kg dw (1.17 mg/kg ww) has been proposed based on an alternative analysis (Lemly and Skorupa, 2007). Applying the lower CBR of 5.85 mg/kg dw results in one additional exceedance (2 exceedances total) from Lower Lake. Thus, Se concentrations from the limited data from Lower Lake would indicate a potential risk to fish, however, the results would not change for other CSM units.

Dietary Benchmarks

The dietary pathway is an important exposure route for fish species. Dietary TRVs (trout) were identified for As, Cd, Cu, Pb, Se, and Zn from the Clark Fork River (Montana) ERA (Appendix C). As discussed for the previous lines of evidence, not all species are alike, and thus the use of trout alone may not adequately address risks to all fish species. Organisms that were evaluated in the current study encompass a broad range of feeding habitats and niches and thus the relevance of each dietary benchmark differs from species to species. Additionally, these benchmarks do not account for bioaccumulation or assimilation efficiency. The use of dietary benchmarks is intended to provide a conservative estimate of toxicity; however, there is some uncertainty with its application to all possible fish species that could be encountered at the site.

6.3 Weight-of-Evidence Summary and Conclusions

The potential risks to fish populations posed by metal concentrations in surface water, porewater, fish tissue, and dietary items were evaluated using different lines of evidence. Table 6.4 presents the chemistry analysis results for each CSM unit and Table 6.5 presents a summary of all the lines of evidence evaluated. A summary of the key results for each CSM unit is provided below.

- **Prickly Pear Creek**: Surface water and porewater concentrations in Prickly Pear Creek exceeded acute or chronic benchmarks for some metals (Table 6.4). Surface water concentrations for Pb were significantly greater than concentrations at reference locations. Analysis of piezometer readings at two stations in Prickly Pear Creek suggest that As and Zn are elevated and possibly influenced by groundwater transport from Lower Lake. Mercury concentrations in fish tissue were found to be greater than those at reference locations but not above CBR values. Concentrations of prey items were not elevated. Overall, the potential risks to fish in Prickly Pear Creek are considered low. Arsenic, Cd, and Pb are the primary risk drivers.
- **Upper Lake and Upper Lake Marsh**: Surface water and porewater concentrations in Upper Lake and Upper Lake Marsh exceeded benchmarks for some metals (Table 6.4). Lead and Cd concentrations in surface water were significantly greater than water quality

benchmarks and concentrations measured at reference locations. Tissue concentrations of Hg and Se were significantly elevated in this CSM unit but did not exceed CBRs. Concentrations of Pb in prey items exceeded dietary benchmarks. Cadmium and Pb are the primary risk drivers in this CSM unit.

- **Wilson Ditch**: Only Cd and Pb exceeded surface water benchmarks in Wilson Ditch (Table 6.4). Tissue residues and prey item concentrations did not exceed respective toxicity benchmarks. The pattern of metal concentrations and benchmark exceedances were very similar to Upper Lake, which feeds into Wilson Ditch. Cadmium and Pb are the primary risk drivers in this CSM unit.
- **Lower Lake**: Several metals exceeded water quality benchmarks in surface waters and porewaters in Lower Lake (Table 6.5). Cadmium, Cu, and Pb surface water concentrations were also significantly higher compared to reference locations. Selenium tissue concentrations exceeded the CBR in one out of three samples. Concentrations of Al, As, Cd, Fe, and Pb also exceeded tissue benchmarks in one sample, however, confidence in these benchmarks is low. Concentrations of As, Cd, Cu, Se, and Pb in prey items exceeded dietary benchmarks. The primary risk drivers in Lower Lake are Sb, As, Cd, Cu, Pb, and Se.

In summary, the chemicals of primary concern (COCs) for fish are:

- Cd and Pb are COCs for all aquatic areas on or near the Facility;
- Sb, As, Cu, Hg, and Se are COCs for most aquatic areas on or near the Facility; and
- Al, Fe, Mn, Ag, Tl, and Zn are metals that are expected to pose negligible risks to fish (due to minimal or no predicted toxicity, no consistently significant differences from reference areas, or significant uncertainty associated with toxicity benchmarks) on or near the Facility.

Table 6.4
Risk Characterization for Fish

Metal	Prickly Pear Creek				Upper Lake/Marsh				Wilson Ditch			Lower Lake			
	SW	**PW**	**T**	**D**	**SW**	**PW**	**T**	**D**	**SW**	**T**	**D**	**SW**	**PW**	**T**	**D**
Al	x				x		x						x	x	
Sb												x	x		
As		x					x						x	x	x
Cd	x	x			xx		x		xx			xx	x	x	x
Cu					x							xx			x
Fe					x	x								x	
Hg	x		x				x								
Pb	xx				xx	x	x	x	xx			xx		x	x
Mn															
Se							x					x	x	x	x
Ag		x			x	x						x			
Tl												x			
Zn		x					x								

Notes:

Each column represents the results of chemistry evaluations and the results are defined as follows:

SW – an "x" indicates measured (dissolved, total or total recoverable) surface water concentrations (95% UCL) exceeded acute or chronic benchmarks, if available. In addition, an "xx" indicates that metal concentrations (dissolved or total) exceeded a benchmark and also were significantly greater than reference concentrations.

PW – an "x" indicates measured porewater concentrations exceeded acute or chronic benchmarks, if available. No porewater data were collected for Wilson Ditch.

T – an "x" indicates measured onsite fish tissue concentrations were significantly greater than reference area concentrations or the tissue concentrations exceed a CBR (i.e., Se for Lower Lake).

D - an "x" indicates metal concentration in prey items (95% UCL) exceeded dietary benchmarks, if available.

Table 6.5
Weight-of-Evidence Analysis for Fish

CSM Unit	Lines Of Evidence	Weight of Evidence[a] -	 0	 +	COCs[b]
Prickly Pear Creek	Surface Water/Porewater Benchmark Comparison			+	As, Cd, Hg, Pb
	Surface Water Reference Comparison			+	
	Critical Body Residues	-			
	Fish Tissue Reference Comparison			+	
	Dietary Assessment	-			
	Community/habitat data analysis		0		
Upper Lake/Marsh	Surface Water/Porewater Benchmark Comparison			+	Cd, Hg, Pb, Se
	Surface Water Reference Comparison			+	
	Critical Body Residues			+	
	Fish Tissue Reference Comparison			+	
	Dietary Assessment			+	
	Community/habitat data analysis		0		
Wilson Ditch	Surface Water Benchmark Comparison			+	Cd, Pb
	Surface Water Reference Comparison			+	
	Critical Body Residues	-			
	Fish Tissue Reference Comparison		na		
	Dietary Assessment	-			
	Community/habitat data analysis		0		
Lower Lake	Surface Water/Porewater Benchmark Comparison			+	Sb, As, Cd, Cu, Pb, Se
	Surface Water Reference Comparison			+	
	Critical Body Residues			+	
	Fish Tissue Reference Comparison		na		
	Dietary Assessment			+	
	Community/habitat data analysis		0		

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence.
na – reference comparison not available

7 Risk Characterization for Aquatic Plants

The refined SLERA for aquatic plants (Section 4.2.3) involved the assessment of a suite of potential exposure media, including surface water and porewater. The following metals exceeded one or more of the screening benchmarks and are evaluated further in the BERA for aquatic plants: Al, Sb, As, Cd, Cu, Fe, Pb, Mn, Hg, Se, Ag, Tl, and Zn. Six metals were found to pose negligible risks to aquatic plants and are not examined further in the BERA: Ba, Be, Cr, Co, Ni, and V. The BERA examined several lines of evidence to evaluate the potential for COPCs to adversely affect the survival, growth, or reproduction of aquatic plant populations. The BERA analysis and results are presented in the following sections and in detailed tables in Appendix E. Each line of evidence provides information to address the primary risk questions for aquatic plants (as defined previously in Section 3.6):

- Are the concentrations of metals in porewater, surface water, and soils from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas greater than benchmarks for survival, growth, or reproduction of plants? Are plant communities at the site exposed to metals concentrations in porewater, surface water, and soil that are significantly higher than concentrations at reference sites?

7.1 Lines of Evidence Evaluated

Surface, porewater, and tissue chemistry were used to evaluate the potential risks of COPCs to aquatic plants. The results presented here for surface water and porewater are the same as those reported for benthic invertebrates and fish, since the benchmarks and exposure concentrations were the same. Each of these tools were used in a weight-of-evidence analysis to identify the most likely risk drivers in each of the CSM units.

7.1.1 Surface Water

Surface water (dissolved, total, and total recoverable) chemistry was evaluated to address the associated risk to aquatic plants (Table 7.1). For each CSM unit, the 95% UCL of the water concentration for each metal was compared to water quality benchmarks (see Appendix E for detailed results tables). Hardness-based metals were also compared to 95% UCL concentrations based on minimum, mean, and maximum hardness concentrations. In addition, onsite surface water concentrations (dissolved and total recoverable concentrations) were statistically compared to reference site waters (as described in Section 4.3.3). Surface water results are summarized below by CSM unit.

- **Prickly Pear Creek**: Metal concentrations in surface water (total, total recoverable, or dissolved) from Prickly Pear Creek did not exceed acute water criteria except for Hg (HQ = 2) and Ag (HQ = 2 at mean hardness). Chronic criteria were exceeded for Al, Cd, Hg, Pb, and Ag. Exceedances for Hg and Ag were based on maximum detection limits, as the frequency of detection was low. However, the maximum detection limits are from historic data; recent data from 2010 used detection limits for these metals that would not indicate an exceedance of chronic criteria, except a slight exceedance for Ag based on dissolved concentrations (HQ = 2). Chronic exceedances for Al, Cd, and Pb were generally low (HQ = 2-5). Dissolved surface water concentrations of As, Fe, Pb, and Mn from Prickly Pear Creek were significantly greater than upstream stations, while Cu and Zn were not significantly different from upstream (see Appendix E, Table E-6). Total recoverable surface water concentrations of As, Pb, and Mn from Prickly Pear Creek were also significantly greater than upstream stations (see Appendix E, Table E-7).
- **Upper Lake and Upper Lake Marsh**: Concentrations of Cd, Cu, and Pb exceeded acute water criteria at all hardness levels (minimum, mean, and maximum). All other metals were below acute water criteria. Chronic criteria were exceeded for Al, Cd, Cu, Fe, Pb, Se, and Ag. Exceedances for Se were based on maximum detection limits, as the frequency of detection was low. Detection limits from the 2010 sampling event would not indicate an exceedance of the chronic criterion for Se. Chronic exceedances for Al, Cu, Fe, and Ag were generally low (HQ = 2-5). Cadmium and Pb chronic exceedances were generally high (HQs > 10) for total recoverable or total concentrations. However, dissolved concentrations of Cd and Pb did not exceed acute or chronic criteria (except for Pb at a minimum hardness, HQ = 2). Dissolved surface water concentrations of As, Pb, and Zn from Upper Lake and Upper Lake Marsh were significantly greater than the Walker Creek site, while Fe and Cu were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd, Pb, and Zn were also significantly greater than reference area concentrations (Appendix E, Table E-7).
- **Wilson Ditch**: No acute criteria were exceeded in samples collected from Wilson Ditch (excluding total Cd, in which two of the four the samples were below detection limits). Chronic criteria were exceeded for Cd and Pb. Chronic HQs ranged from 4-16 and 5-35 for Cd and Pb, respectively (Appendix E, Table E-5b). Dissolved surface water concentrations of As, Pb, and Zn, from Wilson Ditch were significantly greater than the Walker Creek site, while Fe and Cu were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd were also significantly greater than reference area concentrations (Appendix E, Table E-7).
- **Lower Lake**: Concentrations of Cd, Cu, and Se exceeded acute water criteria. All other metals were below acute water criteria. Chronic criteria were exceeded for Sb, Cd, Cu, Pb, Se, Ag, and Tl. Chronic exceedances for Cu, Ag, and Tl were generally low (HQ = 2-6) (Appendix E, Tables E-5a and E-5b). Chronic exceedances for Cd, Pb, and Se were generally high (HQs > 10) (Appendix E, Tables E-5a and E-5b). Dissolved surface water concentrations of As, Cu, and Pb from Lower Lake were significantly greater than the Walker Creek site, while Fe, Mn, and Zn were not significantly greater (Appendix E, Table E-6). Total recoverable concentrations of Cd and Pb were also significantly greater than reference area concentrations (Appendix E, Table E-7).

Table 7.1
Risk Characterization for Aquatic Plants Exposed to Metals COPCs in Site Surface Water and Porewater

	Prickly Pear Creek		Upper Lake/Marsh		Wilson Ditch	Lower Lake	
Metal	**SW**	**PW**	**SW**	**PW**	**SW**	**SW**	**PW**
Al	x		x				x
Sb						x	x
As		x					x
Cd	x	x	xx		xx	xx	x
Cu			x			xx	
Fe			x	x			
Hg							
Pb	xx		xx	x	xx	xx	
Mn							
Se						x	x
Ag		x	x	x		x	
Tl						x	
Zn		x					

Notes:

Each column represents the results of chemistry evaluations and the results are defined as follows:

SW – an "x" indicates measured (dissolved, total or total recoverable) surface water concentrations (95% UCL) exceeded acute or chronic benchmarks, if available. In addition, an "xx" indicates that metal concentrations (dissolved or total) exceeded a benchmark and also were significantly greater than reference concentrations.

PW – an "x" indicates measured porewater concentrations exceeded acute or chronic benchmarks, if available. No porewater data were collected for Wilson Ditch.

7.1.2 Porewater

Porewater chemistry was evaluated to determine if concentrations of metals were greater than acute and chronic benchmarks for aquatic plants (Table 7.1). Since porewater data were limited, maximum concentrations were evaluated when 95% UCLs could not be calculated. Due to low sample size, statistical analysis was not conducted on the porewater data. A majority of the metals analyzed in porewater have HQs < 1 when based on acute benchmarks. Some metals did exceed acute or chronic benchmarks, however, as described below.

- **Prickly Pear Creek**: Porewater concentrations did not exceed any acute water criteria. Chronic criteria were exceeded for Cd, Pb, Se, and Ag. Exceedances for Pb, Se, and Ag were based on maximum detection limits, as the frequency of detection was low. Chronic exceedances for Cd and Ag were generally low (HQ = 3-8) (Appendix E, Table E-5b). Piezometer samples were also collected in 2010 to investigate potential groundwater movement from Lower Lake to Prickly Pear Creek. Arsenic and Zn concentrations in these samples exceeded acute and chronic criteria (Appendix E, Tables E-5a and E-5b).

- **Upper Lake and Upper Lake Marsh**: Chronic criteria were exceeded for Cd, Fe, Pb, Se, and Ag (Appendix E, Tables E-5a and E-5b). Exceedances for Cd and Se were based on maximum detection limits, as the frequency of detection was low.
- **Lower Lake**: Arsenic in porewater from Lower Lake exceeded acute water criteria. Chronic criteria were exceeded by Al, Sb, As, Cd, Pb, Se, and Ag. Exceedances for Pb and Ag were based on maximum detection limits, as the frequency of detection was low. Chronic exceedances for As and Cd were generally high (HQ ≥ 8) (Appendix E, Tables E-5a and E-5b).

7.1.3 Tissue Chemistry

Aquatic plant tissues were collected in 2003 from Upper Lake and Upper Lake Marsh and Canyon Ferry Reservoir (reference area). Eight samples were collected from the Upper Lake and Upper Lake Marsh area and one sample from the reference area; a summary of metals concentrations are presented in Table 7.2. Although limited by sample size, the data suggest that plant tissue concentrations of As, Cd, Cu, Pb, and Zn are elevated in Upper Lake and Upper Lake Marsh. These metals have also been identified as exceeding reference concentrations in other media in one or more of the CSM units.

Table 7.2
Summary of Metal Concentrations in Aquatic Plant Tissues

Metal	Upper Lake/Marsh (mean concentration, mg/kg-ww)	Canyon Ferry Reservoir (mean concentration, mg/kg-ww)
As	8.3	<2
Cd	1.8	0.6
Cu	9	5.8
Pb	26	11.4
Se	<5	<5
Zn	52	18

7.2 Uncertainty Analysis

Key uncertainties with the exposure and toxicity assessment of aquatic plants are similar to those discussed for benthic invertebrates and fish. The primary sources of uncertainty include:

- **Exposure concentrations**: In some cases, insufficient data were available to estimate a 95% UCL. As a substitute for the concentration of non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. Therefore, some exposure estimates for areas with low sample sizes may be under- or overestimated.

- **Sample size**: For some media (*e.g.*, porewater and plant tissues) only a limited number of samples were collected. Therefore, all possible exposure conditions may not have been evaluated in this risk assessment.
- **Bioavailability**: Metal concentrations were assumed to be 100% bioavailable in all media and, therefore, exposure is likely to be overestimated for some exposure pathways.
- **Toxicity benchmarks**: Surface water benchmarks are typically based on toxicological data for invertebrate (primarily *Daphnia sp*.) and fish species. In general, fish or invertebrates are more sensitive to the effects of contaminants than plants (Kenaga and Moolenaar, 1979). However, limited plant and algal toxicity data are included in some of the metals criteria databases. Algal toxicity data are commonly used as a surrogate for aquatic plant data (*e.g.*, Suter and Tsao, 1996); however, the sensitivity of plants to toxicants may vary widely among species and chemicals so use of algal toxicity data to assess plant community risks is uncertain. Plant toxicity data in US EPA's Cd criterion indicate that effect concentrations for plants are less sensitive than those for fish and invertebrates. Similarly, the dissolved acute and chronic water quality criteria for Pb are 65 µg/L and 2.5 µg/L, respectively (based on a hardness of 100 mg/L $CaCO_3$), whereas data from the US EPA's Pb criterion indicate that freshwater algae are adversely affected at concentrations above 500 µg/L. Thus, risk estimates presented herein are likely overestimated for aquatic plants.

7.3 Weight-of-Evidence Summary and Conclusions

The potential risks to aquatic plant communities posed by metal COPCs were evaluated using surface water, porewater, and tissue chemistry. Table 7.3 presents a weight-of-evidence analysis for each CSM unit. Risk estimates for aquatic plants are likely overestimated since the aquatic benchmarks are derived primarily from data for invertebrates or fish, which are typically more sensitive to metals than aquatic plants. In summary, the COCs for aquatic plants are:

- Cd and Pb are COCs for all aquatic areas on or near the Facility;
- Sb, As, Cu, Hg, and Se are COCs for most aquatic areas on or near the Facility; and
- Al, Ba, Fe, Mn, Ag, Tl, and Zn are metals that pose negligible risks to aquatic plants (due to minimal or no predicted toxicity, no consistently significant differences from reference areas, or significant uncertainty associated with toxicity benchmarks) on or near the Facility.

Table 7.3
Weight-of-Evidence Analysis for Aquatic Plants

		Weight of Evidence[a]			
CSM Unit	**Line of Evidence**	**-**	**0**	**+**	**COCs[b]**
Prickly Pear Creek	Surface Water/Porewater Benchmark Comparison			+	As, Cd, Pb
	Surface Water Reference Comparison			+	
Upper Lake/Marsh	Surface Water/Porewater Benchmark Comparison			+	Cd, Pb
	Surface Water Reference Comparison			+	
	Aquatic Plant Tissue Residues		0		
Wilson Ditch	Surface Water Benchmark Comparison			+	Cd, Pb
	Surface Water Reference Comparison			+	
Lower Lake	Surface Water/Porewater Benchmark Comparison			+	Sb, As, Cd, Cu, Pb, Se
	Surface Water Reference Comparison			+	

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence.

8 Risk Characterization for Amphibians

The refined SLERA for amphibians (Section 4.2.4) identified several metals that required further evaluation in the BERA: Al, Sb, As, Be, Ba, Cd, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn. Amphibians have a unique a set of exposure routes that vary with lifestage (*i.e.*, egg, tadpole, and adult stages). To evaluate survival, growth, and reproduction of amphibians, surface water, porewater, sediment, soil, and tissue concentrations were evaluated. Based on an evaluation of amphibian toxicity data (Appendix C), toxicity benchmarks for other aquatic and terrestrial receptors were used to characterize potential risks to amphibians. The primary risk questions addressed in this analysis are (as defined previously in Section 3.6):

- Are the concentrations of metals in sediment, porewater, surface water, soil and biota from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas greater than benchmarks for survival, growth, or reproduction of amphibians?
- Are amphibians from the site exposed to metals concentrations in sediment, porewater, surface water, soil, or biota that are significantly higher than concentrations at reference sites?

8.1 Lines of Evidence Evaluated

Metal concentrations were evaluated in various environmental media by comparing the 95% UCL concentration to the appropriate toxicity benchmark. In addition, metal concentrations in site media are compared to concentrations at reference locations. Details on each of the lines of evidence evaluated are described below.

8.1.1. Sediment

Sediment Quality Guidelines

No consensus-based SQGs exist for amphibians; therefore, SQGs for benthic invertebrates were used as a surrogate. Analysis of limited available sediment data for amphibians suggested that these benchmarks would be protective of species tested (see Appendix C). Thus, sediment concentrations (95% UCLs) were compared to sediment benchmarks (TECs and PECs) for each of the aquatic CSM units (Table 8.1). Metals that exceeded TECs or PECs were similar across most CSM units, including As, Sb, Cd, Cu, Hg, Pd, Ag, and Zn. Metals that did not exceed or infrequently exceeded TECs or PECs included Al, Fe, Mn, and Ni. There were no sediment benchmarks for Be, Ba, Se, Tl, or V. Results of the sediment comparison are presented in Appendix E (Table E-12).

Table 8.1
Risk Characterization for Amphibians Exposed to Metals in Sediment

	Risk Estimates (TEC)			**Risk Estimates (PEC)**		
CSM Unit	**HQ ≤ 1**	**HQ > 1 to < 10**	**HQ ≥ 10**	**HQ ≤ 1**	**HQ > 1 to < 10**	**HQ ≥ 10**
Prickly Pear Creek	Al, Sb, Fe, Ni, Ag	Cu	As, Cd, Hg, Mn, Pb, Zn	Al, Sb, Fe, Ni, Ag	As, Cd, Cu, Mn, Pb, Zn	Hg
Upper Lake/Marsh	Al, Fe	Mn	Sb, As, Cd, Cu, Hg, Pb, Zn	Al, Sb, Fe, Mn, Ni	Cu, Zn	Cd, Hg, Pb, Ag
Wilson Ditch	Al, Fe, Ni	Sb, As, Cu, Mn, Ag, Zn	Cd, Hg, Pb	Al, Sb, Cu, Fe, Mn, Ni	As, Cd, Ag, Zn	Hg, Pb
Lower Lake	Al, Fe, Ni	Mn	Sb, As, Cd, Cu, Hg, Pb, Ag, Zn	Al, Fe, Mn, Ni	-	Sb, As, Cd, Cu, Hg, Pb, Ag, Zn

Reference Comparison

Statistical analysis with sediments was described previously in Section 5 (Table 5.4; see also Appendix E, Table E-3) and the results are summarized here. In Prickly Pear Creek sediments, no metal concentrations were significantly higher than reference sediment concentrations, although Mn was significantly lower. Concentrations of Sb, As, Cd, Cu, Pb, Hg, Mg, Ni, Se, Ag, Tl, and Zn in Lower Lake were all significantly higher when compared to Walker Creek sediments. In Upper Lake and Upper Lake Marsh sediments, Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Se, Ag, and Zn were all significantly higher than reference sediments. Sediment concentrations of Cd, Hg, Pb, Ag, and Mn from Wilson Ditch were all significantly higher than reference area concentrations.

8.1.2 Surface Water and Porewater

Surface water (dissolved, total, and total recoverable) and porewater chemistry were evaluated for amphibians in the same manner as for other benthic invertebrates, fish, and aquatic plants. Results for surface water and porewater have been described in sections 5, 6, and 7; detailed data tables are provided in Appendix E (Tables E-4 through E-7). Table 8.2 provides a summary of the surface water and porewater chemistry risk analyses for amphibians. Cadmium and Pb consistently exceeded aquatic toxicity benchmarks and/or reference area concentrations. Concentrations of most metals in either surface water or porewater from Lower Lake were found to exceed acute or chronic surface water criteria. Some criteria exceedances were based solely on elevated detection limits (*e.g.*, Hg, Ag, and Se); however, recent analyses with lower detection limits suggest that concentrations are below benchmarks. Risk results for Sb, Ag, and Tl are highly uncertain due to the lack of data used to derive the toxicity benchmarks (see Section 8.2).

Table 8.2
Risk Characterization for Amphibians Exposed to Metal COPCs in Site Surface Water and Porewater

	Prickly Pear Creek		Upper Lake/Marsh		Wilson Ditch	Lower Lake	
Metal	**SW**	**PW**	**SW**	**PW**	**SW**	**SW**	**PW**
Al	x		x				x
Sb						x	x
As		x					x
Cd	x	x	xx		xx	xx	x
Cu			x			xx	
Fe			x	x			
Hg							
Pb	xx		xx	x	xx	xx	
Mn							
Ni							
Se						x	x
Ag		x	x	x		x	
Tl						x	
Zn		x					

Notes:

Each column represents the results of chemistry evaluations and the results are defined as follows:
SW – an "x" indicates measured (dissolved, total or total recoverable) surface water concentrations (95% UCL) exceeded acute or chronic benchmarks, if available. In addition, an "xx" indicates that metal concentrations (dissolved or total) exceeded a benchmark and also were significantly greater than reference concentrations.
PW – an "x" indicates measured porewater concentrations exceeded acute or chronic benchmarks, if available. No porewater data were collected for Wilson Ditch.

8.1.3 Soil

Benchmark Comparisons

Because no soil benchmarks exist for amphibian species, wildlife EcoSSLs were used as surrogate screening levels. Amphibian toxicity data for soil exposures (Appendix C) suggest that US

EPA's EcoSSLs are protective of amphibian species for which data are available. Soil concentrations (95% UCLs) were compared to soil benchmarks for wildlife for each of the upland CSM units (Table 8.3). Most metals in each of the CSM units were found to exceed the wildlife soil benchmarks, except Ba, Be, Mn, and Ni. Potential risks from As, Ag, and V were generally low (HQ < 10), while potential risks from other metals were generally high (HQ > 10) in all CSM units (Table 8.3). Detailed results for soil comparisons are presented in Appendix E (Table E-13).

Table 8.3
Risk Characterization for Amphibians Exposed to Metal COPCs in Site Soils

CSM Unit	HQ ≤ 1	HQ > 1 to < 10	HQ ≥ 10
Prickly Pear Creek (Riparian Zone)	Ba, Be, Mn, Ni, Tl	As, V	Sb, Cd, Cu, Hg, Pb, Se, Ag, Tl, Zn
Upper Lake/Upper Lake Marsh (Bank Soils)	Ba, Be, Mn, Ni	As, V	Sb, Cd, Cu, Hg, Pb, Se, Ag, Tl, Zn
Tito Park	Ba, Be, Mn, Ni	Ag, V	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, Zn
Lower Lake (Bank Soils)	Ba, Be, Mn, Ni	V	Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, Zn
Site Perimeter (East)	Ba, Be, Mn, Ni	Se, Ag, V	Sb, As, Cd, Cu, Hg, Pb, Tl, Zn
Site Perimeter (West)	Ba, Be, Mn, Ni	As, V	Sb, Cd, Cu, Hg, Pb, Se, Ag, Tl, Zn

Reference Area Comparison

Metal concentrations in site soils were compared to concentrations in soils collected from the Walker Creek reference area (Appendix E). In most cases, statistical differences between site and reference soils were not identified. Concentrations of Sb, As, Cd, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn were generally enriched in site soils as compared to the Walker Creek soils (*i.e.*, mean concentrations are 5 to > 100 times greater than reference area concentrations). Concentrations of Ba, Be, Cr, Co, Fe, Mn, and V were consistent with reference soil concentrations and are likely reflective of natural conditions within the Helena Valley (Appendix E, Table E-14). Soil investigations at the site in the 1980s also noted that Cr and Mn were similar to background concentrations, while other elements (Ag, As, Cd, Cu, Hg, Pb, Sb, Se, Tl, and Zn) were enriched compared to background (CH2M Hill, 1987a; Hydrometrics, 1990).

8.1.4 Dietary Benchmark Comparisons

Limited dietary benchmarks are available for amphibian species (Appendix C). Generally, only one or two species have been tested *via* oral exposure for the metals Cd, Hg, MeHg, Pb, Se, and V. Metal concentrations in prey items (*i.e.*, aquatic plants, aquatic invertebrates, forage fish, terrestrial plants, earthworms, and terrestrial invertebrates) were compared to these dietary benchmarks; details are presented in Appendix E (Table E-15). Concentrations of Cd and Hg (total and methyl) in aquatic and terrestrial invertebrates and forage fish exceeded dietary benchmarks (NOAELs and LOAELs) in one or more CSM units. These risk estimates were all based on measured concentrations (95% UCLs, or maximum concentrations if data were insufficient to derive a 95% UCL). When measured data were not available, tissue concentrations for aquatic plants, terrestrial plants, and earthworms were modeled using metal uptake models (see Section 4). Concentrations of Hg, MeHg, and Pb exceeded dietary NOAELs or LOAELs for these media; however, the risk estimates are likely largely overestimated because the models do not account for bioavailability or homeostatic regulation. Risks associated with Se and V dietary exposures were negligible for most prey items and CSM units.

8.1.4 Tissue Residue Comparisons

Four Columbia Spotted frog samples were collected from the site and one from Walker Creek. No statistics were conducted with these data due to low sample size. Comparison of mean concentrations from onsite samples to the reference sample identified Al, Cd, Cu, Pb, Mn, Hg, Se, and Ag as having concentrations 2 or more times greater than reference tissues (Figure 8.1). The other metals (Sb, As, Ba, Be, Cr, Co, Fe, Ni, Tl, V, and Zn) had concentrations similar to or less than Walker Creek.

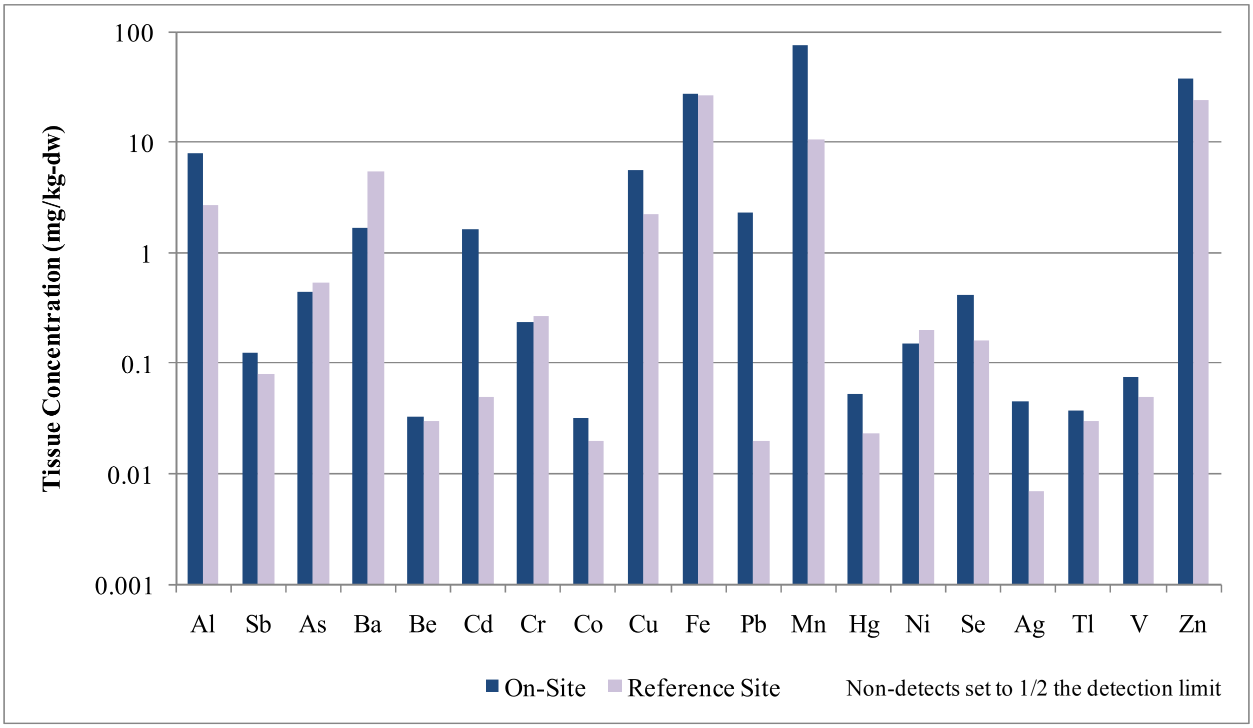

Figure 8.1 **Mean Metals Concentrations in Columbia Spotted Frog Tissue Samples**

8.2 Uncertainty Analysis

Key uncertainties with the exposure and toxicity assessment for amphibians are similar to those discussed for other aquatic and terrestrial organisms. The primary sources of uncertainty include:

- **Exposure concentrations**: In some cases, insufficient data were available to estimate a 95% UCL. As a substitute for the concentration of non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. Therefore, some exposure estimates for areas with low sample sizes may be under- or overestimated.
- **Sample size**: For some media (*e.g.*, porewater, prey tissues, amphibian tissues) only a limited number of samples were collected. Therefore all possible exposure conditions may not have been evaluated in this risk assessment.
- **Bioavailability**: Metal concentrations were assumed to be 100% bioavailable in all media and, therefore, exposure is likely to be overestimated for some exposure pathways.
- **Sediment Toxicity Benchmarks**: Few sediment toxicity bioassays were identified in the literature for amphibian species (Appendix C). A comparison of the available data for Cd, Cu, Pb, Hg, and Zn to sediment benchmarks for benthic invertebrates suggested that sediment TECs and PECs would serve as a useful screening tool for the risk assessment. However, the risk characterization for amphibian sediment exposures at the site are considered highly uncertain due to the limited number of available benchmarks for this route of exposure.
- **Surface Water Toxicity Benchmarks**: As for sediments, AWQC typically derived from aquatic invertebrate and fish toxicity data were used to evaluate potential risks to amphibians from exposures to surface water and porewater. In some cases, these criteria include amphibian toxicity data. Furthermore, available toxicity data for amphibians (Appendix C) suggest that these criteria are sufficiently protective of most amphibian species. However, surface water criteria for several metal COPCs were based on a much more limited number of species (*e.g.*, Sb, Ag, and Tl). As noted in previous sections, these benchmarks were based on limited toxicity datasets and employ the use of several safety factors. Therefore, the risks identified for surface waters from Sb, Ag, and Tl should be considered uncertain.
- **Soil Benchmarks**: Toxicity data for soil exposures is very limited for amphibian species. Data for only three metals were identified (Cd, Cu, and Pb). On the basis of amphibian toxicity data and wildlife EcoSSLs for these metals, amphibians appear to be less sensitive than avian and mammalian receptors. However, due to the lack of toxicity data, the risk characterization for amphibian soil exposures at the site are considered uncertain.
- **Dietary Toxicity Benchmarks**: Dietary benchmarks are available for a limited number of amphibian species and a limited number of metals and exposure conditions. The data applied here are of limited reliability since the state-of-the-science for the dietary exposure pathway for amphibian toxicology is actively evolving. The risk estimates identified in this assessment should be considered highly uncertain.

8.3 Weight-of-Evidence Summary and Conclusions

The potential risk to amphibian populations posed by metal COPCs were evaluated using several lines of evidence (Table 8.4). Based on the information collected from the site, survival, growth, and reproduction of the amphibian species may be adversely affected by the presence of metals in both aquatic and terrestrial media. Due to the lack of amphibian-specific toxicity data and standardized protocols for assessment, the risk characterization for amphibians is considered highly uncertain. As a result, the magnitude of risks predicted using the various lines of evidence should not be extrapolated to amphibian populations due to these data limitations. The risk characterization for amphibians is therefore limited to identifying: (1) those metals that are likely contributors to overall risks; and (2) those metals that appear to be no different from reference conditions or are expected to pose negligible risks. The metals of primary concern (*i.e.*, COCs) for amphibians include Sb, As, Cd, Cu, Hg, Mn, Pb, Se, Ag, Tl, and Zn. The metals expected to pose negligible risks to amphibians include Al, Ba, Be, Fe, Ni, and V.

Table 8.4
Weight-of-Evidence Analysis for Amphibians

CSM Unit	Line of Evidence	Weight of Evidence[a] -	 0	 +	COCs[b]
Prickly Pear Creek and Riparian Soils	Sediment Benchmark Comparison – PECs			+	Sb, As, Cd, Cu, Hg, Mn, Pb, Se, Ag,Tl, Zn
	Sediment – Reference Comparison	-			
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Soil Benchmark Comparison			+	
	Soil Reference Comparison			+	
	Dietary Assessment			+	
	Amphibian Tissue Concentrations (body burdens)			+	
Upper Lake/Marsh and Banks	Sediment Benchmark Comparison – PECs			+	Sb, As, Cd, Cu, Hg, Mn, Pb, Se, Ag, Tl, Zn
	Sediment – Reference Comparison			+	
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Soil Benchmark Comparison			+	
	Soil Reference Comparison			+	
	Dietary Assessment			+	
	Amphibian Tissue Concentrations (body burdens)			+	
Wilson Ditch	Sediment Benchmark Comparison – PECs			+	Sb, As, Cd, Cu, Hg, Mn, Pb, Se, Ag, Zn
	Sediment – Reference Comparison			+	
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Dietary Assessment			+	
Lower Lake and Banks	Sediment Benchmark Comparison – PECs			+	Sb, As, Cd, Cu, Hg, Mn, Pb, Se, Ag, Tl, Zn
	Sediment – Reference Comparison			+	
	Surface Water/Porewater Benchmark Comparison			+	
	Surface Water Reference Comparison			+	
	Soil Benchmark Comparison			+	
	Soil Reference Comparison			+	
	Dietary Assessment			+	
Tito Park	Soil Benchmark Comparison			+	Sb, As, Cd, Cu, Pb, Se, Tl, Zn
	Soil Reference Comparison			+	
	Dietary Assessment			+	
Site Perimeter (East)	Soil Benchmark Comparison			+	Sb, As, Cd, Cu, Pb, Tl, Zn
	Soil Reference Comparison			+	
	Dietary Assessment			+	
Site Perimeter (West)	Soil Benchmark Comparison			+	Sb, Cd, Cu, Pb, Se, Ag, Tl, Zn
	Soil Reference Comparison			+	
	Dietary Assessment			+	

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence.

9 Risk Characterization for Terrestrial Plants

The results of the refined SLERA for terrestrial plants (Section 4.2.5) identified several COPCs that required further evaluation in the BERA: Sb, As, Ba, Cd, Cr, Cu, Co, Fe, Pb, Mn, Hg, Ni, Se, Tl, V, and Zn. To evaluate the potential for COPCs to adversely affect the survival, growth, and propagation of terrestrial plant communities, several lines of evidence were evaluated in the BERA as described below. Each line of evidence provides information to address the primary risk questions (as defined previously in Section 3.6):

- Are the concentrations of metals in porewater, surface water, and soils from Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas greater than benchmarks for survival, growth, or reproduction of plants?
- Are plant communities at the site exposed to metals concentrations in porewater, surface water, and soil that are significantly higher than concentrations at reference sites?

9.1 Lines of Evidence Evaluated

Benchmark Comparison

Terrestrial plants are primarily exposed *via* contact with soils. Therefore, soil exposure estimates were compared to soil-based toxicological benchmarks. In the SLERA, maximum concentrations were used; however, in the BERA, more realistic estimates of exposure were investigated (*i.e.*, the 95% UCL). For each CSM unit, the 95% UCL surface soil concentration for each metal was compared to the soil-plant toxicity benchmark (see Appendix E, Table E-13). Table 9.1 presents a summary of the potential risks predicted from exposure to metals in soils at each CSM unit. Several metals (Sb, As, Cd, Cr, Cu, Hg, Mn, Pb, Se, Tl, V, and Zn) were consistently elevated above toxicity benchmarks in all areas of the site. Concentrations of Ba, Co, and Ni were either not elevated (HQ < 1) or slightly elevated (HQ < 10) in site soils, depending on the CSM unit. There was no toxicological benchmark for Fe; however, Fe has been recognized as a commonly occurring element in soils (20,000 to 550,000 mg/kg) which is essential for plant growth. Iron is unlikely to be toxic in well-aerated soils with pH between 5 and 8 (US EPA, 2003b).

Table 9.1
Risk Characterization for Terrestrial Plants Exposed to Metal COPCs in Site Soils

	Risk Estimates		
CSM Unit	**HQ ≤ 1**	**HQ > 1 to < 10**	**HQ ≥ 10**
Prickly Pear Creek (Riparian Zone)	Ni, Co	Sb, Ba, Cd, Mn, Tl	As, Cr, Cu, Hg, Pb, Se, V, Zn
Upper Lake/Upper Lake Marsh (Bank Soils)	Ba, Co, Ni	Cd, Cu, Mn, Tl	Sb, As, Cr, Hg, Pb, Se, V, Zn
Tito Park	Ba, Co, Ni	Mn, Tl	Sb, As, Cd, Cr, Cu, Hg, Pb, Se, V, Zn
Lower Lake (Bank Soils)	Ba, Ni	Co, Mn	Sb, As, Cd, Cr, Cu, Hg, Pb, Se, Tl, V, Zn
Site Perimeter (East)	Ba, Co, Ni	Sb, Cd, Mn, Se, Tl	As, Cr, Cu, Hg, Pb, V, Zn
Site Perimeter (West)	-	Ba, Cd, Co, Ni, Tl	Sb, As, Cr, Cu, Hg, Mn, Pb, Se, V, Zn

Reference Area Comparison

Metal concentrations in site soils were compared to concentrations in soils collected from the Walker Creek reference area (Appendix E, Table E-14). In most cases, statistical differences between site reference soils were not identified. However, low sample sizes and high variability in the soil chemistry results likely contributed to the reduced power of the statistical tests employed. Concentrations of Sb, As, Cd, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn were generally enriched (*i.e.*, mean concentrations are 5 to > 100 times greater than reference area concentrations) in site soils as compared to the Walker Creek soils. Concentrations of Ba, Cr, Co, Fe, Mn, and V were consistent with reference soil concentrations and are likely reflective of natural conditions within the Helena Valley. Soil investigations at the site in the 1980s also noted that Cr and Mn were similar to background concentrations, while other elements (Ag, As, Cd, Cu, Hg, Pb, Sb, Se, Tl, and Zn) were enriched compared to background (CH2M Hill, 1987a; Hydrometrics, 1990).

Soil Characteristics

Exposure of plants to soil COPCs at the site may be affected by the characteristics of the soil in each CSM units. For instance, metal bioavailability is influenced by soil characteristics (US EPA, 2007). Generally, the bioavailability of cationic metals (Ag, Ba, Cr^{III}, Cu, Fe, Hg, Mn, Pb, Tl, Zn) to plants is low in soils with pH between 7 and 8.5 and a low to medium (< 6%) organic matter content (US EPA, 2007). The bioavailability of anionic metals (As, Cr^{VI}, V, Se) to plants is typically high in these pH and organic matter ranges (US EPA, 2007). Thus, conditions in Facility surface soils (Table 9.2) may limit the bioavailability of some cationic metals while favoring the bioavailability of some anionic metals. For example, while concentrations of Cu, Pb, and Zn indicated elevated risks to plants (Table 9.1), these risk estimates are likely overestimated based on the soil conditions (*i.e.*, neutral pH and low TOC) at the site that suggests lower bioavailability of these metals.

Table 9.2
Summary of Surface Soil Characteristics Collected in 2010

					Grain Size Fraction (%)			
CSM Unit	**Measure**	**Field pH (s.u.)**	**TOC (%)**	**Moisture (%)**	**Sand**	**Silt**	**Clay**	**Fine Sand**
Prickly Pear Creek (Riparian)	Mean	7.1	2.4	23.3	58.2	24.7	9.3	9.4
	Range	6.8-7.5	0.7-4.6	3.3-32.8	22-88	8-44	4-14	1-20
Upper Lake/Upper Lake Marsh (Bank soils)	Mean	8.1	1.9	9.9	45.2	25.2	22.8	6.8
	Range	7.4-8.8	0.3-3.8	2.0-28.8	30-66	20-32	8-34	6-8
Lower Lake (Bank soils)	Mean	8.1	1.8	9.8	52.0	19.5	22.0	8.7
	Range	7.8-8.3	0.2-3.7	5.0-21.4	36-72	2-32	12-36	4-14
Tito Park	Mean	8.3	0.5	11.5	31.8	34.7	25.0	8.5
	Range	8.0-8.5	0.5-0.5	9.4-16.3	25-39	32-40	20-28	7-9
Site Perimeter (East)	Mean	8.0	1.1	3.7	69.0	18.0	9.0	4.0
	Range	7.9-8.1	0.9-1.3	2.5-4.9	57-81	12-24	4-14	3-5
Site Perimeter (West)	Mean	8.2	3.0	5.1	50.8	23.5	15.0	10.8
	Range	8.1-8.3	0.8-5.8	3.0-6.7	32-58	18-28	10-22	4-28
Walker Creek (Reference)	Mean	6.1	2.4	22.1	65.3	18.5	10.5	5.7
	Range	5.0-6.6	0.9-4.9	12.4-35.3	53-71	15-25	9-13	3-9

9.2 Uncertainty Analysis

Potential sources of uncertainty with the risk characterization for terrestrial plant communities include inaccurate estimates of exposure and effects. Further details on this uncertainty and the effects on interpretation of the risk characterization are provided below.

Exposure Estimates

In some cases, insufficient data were available to estimate a 95% UCL. As a substitute for the concentration of non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. Therefore, some exposure estimates for areas with low sample sizes may be under- or overestimated.

Soil exposure estimates were also developed assuming 100% metal bioavailability. A number of factors affect metals bioavailability in soils, such as pH, organic matter content, aging, temperature, humidity, and chemical form (US EPA, 2007). As discussed in section 9.1, site conditions may favor the bioavailability of anionic metals in surface soils, while cationic metals may be less bioavailable. Historic data collected at the site evaluated the extractability of metals using a single extraction procedure (CH2MHill, 1987a). Sequential chemical extractions are used to characterize the fraction of metals that tend to be the most bioavailable or readily soluble (US EPA, 2007). A summary of total and extractable metals from Facility surface soils collected in the 1980s is shown in Table 9.3. These data indicate that, historically, metal bioavailbilty in site soils is well below 100%. While several remedial activities have been conducted at the Facility since these data were collected, it is reasonable to assume that they are representative of metal bioavailability in site soils. Thus, the use of total metal concentrations for estimating terrestrial plant exposure, as was conservatively conducted herein, likely overestimates actual exposure and potential risk.

Table 9.3
Total and Extractable Metals Concentrations in Site Surface Soils (0-4 inches)

Metal	**Extraction**	**Total Concentration[a] (mg/kg$_{dw}$)**		**Extractable Concentration[b] (mg/kg$_{dw}$)**		**% of Total**	
		Mean	Range	Mean	Range	Mean	Range
As	HCL [c]	48.70	15.5-163.5	26.89	4.7-84	62%	17-117%
Ba	DTPA [d]	129.15	69-219	3.39	1.14-6.36	3%	1-6%
Cd	DTPA	7.91	0.25-48	4.13	0.14-18.32	56%	14-87%
Cr	DTPA	16.37	9-44	0.01	0.01-0.05	0.1%	0-0.4%
Co	DTPA	9.08	4.8-14	1.39	0.07-3.26	16%	1-30%
Cu	DTPA	40.36	12-158	8.89	1.26-50.4	19%	5-34%
Fe	DTPA	16120	7,700-25,800	38.76	2.34-242	0.2%	0-1%
Pb	DTPA	248.40	19-1317	126.10	3.85-713.85	44%	11-105%
Mn	DTPA	451.70	204-710	152.24	11.26-314	35%	4-78%
Ag	DTPA	0.87	0.09-4.55	0.01	0.01-0.01	4%	0-11%
V	DTPA	33.07	1.4-60	0.28	0.28-0.28	1%	0-20%
Zn	DTPA	134	42-379	19.27	0.01-123.48	11%	0-33%

Notes:

Source: Data includes information for 47 soil samples reported by CH2M Hill (1987a).

(a) Total metals digested in nitric acid, hydrogen peroxide and either nitric or hydrochloric acid.

(b) Extractable metals concentration refers to the fraction available for uptake.

(c) HCL Extractable metals extracted with concentrated hydrochloric acid (HCl).

(d) DTPA Extractable metals extracted with DTPA (diethylenetriaminepentaacetic acid)/TEA (triethanolamine)/$CaCl_2$ solution at pH 7.3.

Toxicity Benchmarks

The toxicity benchmarks used for evaluating potential risks to terrestrial plants relied primarily on data compiled for the US EPA EcoSSLs and Efroymson *et al*. (1997a). The EcoSSLs are generally derived using plant toxicity data obtained from standard test species (*e.g.*, lettuce, alfalfa, wheat, rice, ryegrass) and using standard test soils under stringent test conditions (*e.g.*, neutral pH and regular hydration). The available toxicity data is limited for some COPCs and may not be representative of all plant species and environmental conditions potentially present at the site. For example, the US EPA EcoSSL for Cu was developed on the basis of four plant species exposed to Cu in soils with pH ranging from 4.4-6.4. These conditions are slightly acidic, while the soils at the Facility are slightly alkaline (*i.e.*, pH 7.1-8.3). Further, none of the plant species represented in the Cu toxicity database and used to derive the Cu EcoSSL (alfalfa, black bindweed, citrus cultivar, or perennial ryegrass) are native to Montana. Thus, risk estimates may be over- or underestimated due to limited toxicity data and differences in sensitivity between standard plant test species and plant species potentially present at the site.

9.3 Weight-of-Evidence Summary and Conclusions

The potential risks to terrestrial plant communities from exposure to COPCs in site soils were examined using two lines of evidence (Table 9.4). Comparisons of soil COPC concentrations to plant toxicity benchmarks indicated that several COPCs exceeded benchmarks in each of the CSM units. COPCs that were consistently elevated above toxicity benchmarks were Sb, As, Cd, Cr, Cu, Hg, Mn, Pb, Se, Tl, V, and Zn. In some areas, concentrations of Ba, Cr, Co, Fe, Mn, and V exceeded toxicity benchmarks; however, levels were not significantly different from those in reference locations. The terrestrial plant risk characterization may be overestimated due to the use of conservative exposure metrics and assuming 100% metal bioavailability. Based on the results of the BERA, survival, growth, and reproduction of the terrestrial plant community may be adversely affected by the presence of metals in site surface soils. Metals of primary concern (*i.e.*, COCs) for terrestrial plant communities at the site are:

- Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn are COCs in soils for all upland areas on or near the Facility; and
- Ba, Co, Cr, Fe, Mn, Ni, and V are metals in soils that are expected to pose negligible risks (due to minimal or no predicted toxicity or no significant differences from reference areas) on or near the Facility.

Table 9.4
Weight-of-Evidence Analysis for Terrestrial Plants

		Weight-of-Evidence Evaluation[a]			
CSM Unit	**Lines of Evidence**	**-**	**0**	**+**	**COC(s)[b]**
Prickly Pear Creek (Riparian Zone)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn
	Soil Chemistry *vs*. Reference	-[c]		+	
Upper Lake and Marsh (Bank Soils)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn
	Soil Chemistry *vs*. Reference	-[c]		+	
Tito Park	Soil Chemistry *vs*. Toxicity Benchmarks			+	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn
	Soil Chemistry *vs*. Reference	-[c]		+	
Lower Lake (Bank Soils)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn
	Soil Chemistry *vs*. Reference	-[c]		+	
Site Perimeter (East)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn
	Soil Chemistry *vs*. Reference	-[c]		+	
Site Perimeter (West)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn
	Soil Chemistry *vs*. Reference	-[c]		+	

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence.
(c) Concentrations of Ba, Cr, Fe, Co, Mn, and V were not significantly elevated compared to reference soils.

10 Risk Characterization for Terrestrial Invertebrates

The results of the refined SLERA for soil invertebrates (Section 4.3.6) identified several COPCs that required further evaluation: Sb, As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Se, Ag, Tl, V, and Zn. To evaluate the potential for COPCs to adversely affect survival, growth, and reproduction of terrestrial invertebrate communities, several lines of evidence were evaluated in the BERA as described below. Each line of evidence provides information to address the primary risk questions (as defined previously in Section 3.6):

- Are the concentrations of metals in soils from upland areas greater than benchmarks for survival, growth, or reproduction of soil invertebrates?
- Are terrestrial invertebrates at the site exposed to metals concentrations in soil that are significantly higher than concentrations at reference sites?

10.1 Lines of Evidence Evaluated

Benchmark comparison

Terrestrial invertebrates are primarily exposed *via* contact with soils. Therefore, soil exposure estimates were compared to soil-based toxicological benchmarks. In the SLERA, maximum concentrations were used; however, more realistic estimates of exposure were used in the BERA (*i.e.*, the 95% UCL). For each CSM unit, the 95% UCL surface soil concentration for each metal was compared to the soil invertebrate benchmark (see Appendix E, Table E-13). Table 10.1 presents the risk characterization for terrestrial invertebrates from exposure to COPCs in soils for each CSM unit. Chromium, Cu, Hg, and Zn were consistently elevated ($HQ > 10$) above toxicity benchmarks in all areas of the site. Several metals (As, Cd, Mn, Pb, Se, Tl, and V) were either slightly elevated ($HQ < 10$) or moderately elevated ($HQ \geq 10$) above toxicity benchmarks in certain CSM unit. Antimony, Ba, and Ag were either not elevated ($HQ < 1$) or slightly elevated ($HQ < 10$) in site soils. Soil invertebrate toxicity data are lacking for Fe, so it was not evaluated in this line of evidence. However, Fe concentrations in site soils were comparable to reference sites (Table 10.2).

Table 10.1
Risk Characterization for Soil Invertebrates Exposed to Metals in Site Soils

	Risk Estimates		
CSM Unit	**HQ ≤ 1**	**HQ > 1 to < 10**	**HQ ≥ 10**
Prickly Pear Creek (Riparian Zone)	Sb, Cd	As, Ba, Mn, Pb, Se, Tl, V	Cr, Cu, Hg, Zn
Upper Lake/Upper Lake Marsh (Bank Soils)	Sb, Ba	As, Cd , Mn, Pb, Tl, V	Cr, Cu, Hg, Se, Zn
Tito Park	Sb, Ba, Mn	Se, Tl, V	As, Cd, Cr, Cu, Hg, Pb, Zn
Lower Lake (Bank Soils)	--	Sb, Ba, Cd, Mn, Pb, Se, V	As, Cr, Cu, Hg, Tl, Zn
Site Perimeter (East)	Sb, Ba, Cd, Se	Mn, Pb, Tl, V	As, Cr, Cu, Hg, Zn
Site Perimeter (West)	--	Sb, As, Ba, Cd, Mn, Pb, Se, Tl, V	Cr, Cu, Hg, Zn

Reference Area Comparisons

Soil Chemistry

Metal concentrations in site soils were compared to concentrations in soils collected from the Walker Creek reference area (Appendix E, Table E-14). In most cases, statistical differences between site soils and reference soils were not identified. However, low sample sizes and high variability in the soil chemistry results likely contributed to the reduced power of the statistical tests used. Concentrations of Sb, As, Cd, Cu, Pb, Hg, Se, Ag, Tl, and Zn are generally enriched (*i.e.*, mean concentrations are 10-100 times greater than reference areas) in site soils as compared to the Walker Creek soils. Concentrations of Ba, Cr, Fe, Mn, and V were consistent with reference soil concentrations and are likely reflective of natural conditions within Helena Valley (Appendix E). Soil investigations at the site in the 1980s also noted that Cr and Mn were similar to background concentrations, while other elements (Ag, As, Cd, Cu, Hg, Pb, Sb, Se, Tl, and Zn) were enriched compared to background (CH2M Hill, 1987a; Hydrometrics, 1990).

Earthworm Tissue Chemistry

Earthworm tissues were collected from the Prickly Pear Creek riparian zone and in the Upper Lake and Upper Lake Marsh near the Prickly Pear Creek diversion at the southern end of the site (Map 7). Metal concentrations in earthworm tissues were compared to reference area tissues (*i.e.*, Walker Creek area) to assess the influence of the site. Statistical differences were analyzed and results are presented in Appendix E (Table E-16). Concentrations of several metals (Sb, As, Cd, Cu, Pb, Hg, Ag, Tl, and Zn) in earthworm tissues collected from the site were found to be significantly higher than reference areas (Appendix E, Table E-16). Concentrations of Cr, Mn, Se, and V were not significantly different from reference areas. Mean Se concentrations (5-20 mg/kg) were elevated compared to reference areas (mean = 0.25 mg/kg) but not significantly different in all areas of the site. Barium and Fe concentrations were significantly lower in earthworm tissues from the site compared to reference tissues. Thus, earthworm tissue concentrations show a similar pattern as soil concentrations for several elements (*i.e.*, Sb, As, Cd, Cu, Pb, Hg, Se, Ag, Tl, and Zn), indicating significant enrichment at the site.

Soil Characteristics

Exposure of terrestrial invertebrates to soil COPCs at the site may be influenced by the physical characteristics of the soil present in the CSM units. Soil characteristics measured in the 2010 ecological field investigation are summarized in Table 9.2 and these data were used to qualitatively evaluate factors that influence habitat, exposure, and metal bioavailability. For example, it was noted in the 2010 ecological field investigation (Appendix A) that earthworms were difficult to sample in Facility soils and absent in most CSM units, despite a significant sampling effort. The soil characteristics in Table 9.2 provide evidence that soils in several CSM units likely do not provide optimal habitat for earthworm species. For instance, soils sampled from Upper Lake, Lower Lake, Tito Park, the Site Perimeter and unpaved Facility areas were generally dry (mean moisture content typically < 12%). Conversely, areas where earthworms were collected (riparian areas of Prickly Pear Creek and Walker Creek) had moisture contents exceeding 20%. Optimum moisture for earthworms under laboratory conditions range from 20-30% (Berry and Jordan, 2001). Therefore, site soils that are not located in riparian areas appear to be sub-optimal for soft bodied, burrowing soil invertebrates such as earthworms. Since hard-bodied insects and arthropods (*e.g.*, ants, spiders, beetles, grasshoppers) were found in these areas, the presence of earthworms at the site appears to be driven to a significant extent by physical soil characteristics rather than the presence of COPCs.

The bioavailability of metals is also affected by soil characteristics (US EPA, 2007). Generally, the bioavailability of cationic metals (Ag, Ba, Cr^{III}, Cu, Fe, Hg, Mn, Pb, Tl, Zn) to soil invertebrates is low in soils with pH between 7-8.5 and low to medium organic matter content (< 6%) (US EPA, 2007). The bioavailability of anionic metals (As, Cr^{VI}, V, Se) to soil invertebrates is typically high in these pH and organic matter ranges (US EPA, 2007). Conditions (*e.g.*, neutral pH and low TOC) in Facility surface soils (Table 9.2) may limit the bioavailability of some cationic metals while favoring the bioavailability of some anionic metals. Thus, risk estimates for cationic metals are likely overestimated if soil conditions are considered.

10.2 Uncertainty Analysis

Potential sources of uncertainty with the risk characterization for terrestrial invertebrates include inaccurate estimates of exposure and effects. Further details on this uncertainty and its effects on interpretation of the risk characterization are provided below.

Exposure Estimates

In some cases, insufficient data were available to estimate a 95% UCL. As a substitute for the concentration of non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. Therefore, some exposure estimates for areas with low sample sizes may be under or over-estimated.

Soil exposure estimates were also developed assuming 100% metal bioavailability. A number of factors affect metals bioavailability in soils, such as pH, organic matter content, aging, temperature, humidity, and chemical form (US EPA, 2007). As discussed in section 9.1, site conditions may favor the bioavailability of anionic metals in surface soils, while cationic metals may be less bioavailable. Historic data collected at the site evaluated the extractability of metals using a single extraction procedure (CH2MHill, 1987a). A summary of total and extractable metals from Facility surface soils collected in the 1980s is shown in Table 9.3. This data indicate that, historically, metal bioavailability in site soils is well below 100%. Thus, the use of total metal concentrations for estimating terrestrial invertebrate exposure, as was conservatively conducted herein, is likely to overestimate actual exposure and potential risk.

Toxicity Benchmarks

The toxicity benchmarks used for evaluating potential risks to terrestrial invertebrates relied primarily on data compiled for the US EPA EcoSSLs and Efroymson *et al*. (1997b). The EcoSSLs are generally derived using terrestrial invertebrate toxicity data obtained from standard test species (*e.g.*, earthworms, potworms, springtails) and using standard test soils under stringent test conditions (*e.g.*, neutral pH, 5-10% organic matter, and 20-30% moisture). The available toxicity data is limited for some COPCs and may not be representative of all terrestrial invertebrate taxa species or environmental conditions potentially present at the site. For example, the Cu EcoSSL for invertebrates was developed on the basis of 10 studies in which soil pH ranged from 4.0-5.6. These conditions are slightly acidic, while the soils at the Facility are slightly alkaline (pH 7.1-8.3). Further, nine of the 10 data points for the Cu EcoSSL were obtained using soft-bodied invertebrates (earthworms and nematodes) and one using hard-bodied invertebrates (springtails). Therefore, the EcoSSL may not be representative of the soil taxa typically present in most CSM units, where earthworms were not present. Mercury concentrations in soil resulted in the highest risk estimates for soil invertebrates among all the COPCs examined. However, the Hg toxicity benchmark is based on one study for earthworms that included safety factors for extrapolating from a lowest effect concentration (Efroymson *et al.*, 1997b). The authors indicated that confidence in this benchmark was low (Efroymson *et al.*, 1997b). Thus, risk estimates for Hg and other COPCs may be over- or underestimated due limited toxicity data and the relevance of the toxicity benchmarks for the site.

10.3 Weight-of-Evidence Summary and Conclusions

The potential risks to terrestrial invertebrate communities posed by COPCs in site soils were evaluated using several lines of evidence (Table 10.2). Comparison of soil COPC concentrations to terrestrial invertebrate toxicity benchmarks indicated that several COPCs exceeded benchmarks in each of the CSM units. COPCs that were consistently elevated above toxicity benchmarks are: As, Cd, Cr, Cu, Hg, Pb, Se, Tl, and Zn. In some areas, concentrations of Ba, Cr, Fe, Mn, and V exceeded toxicity benchmarks; however, the levels of these metals were not significantly different from those in reference locations. The risk estimates obtained in this analysis may be overestimated due to the use of conservative exposure metrics and assuming 100% metal bioavailability. Based on the results of the BERA, survival, growth, and reproduction of the terrestrial invertebrate communities may be adversely affected by the presence of metals in surface soils. The primary COCs for terrestrial invertebrates are:

- As, Cu, Hg, Pb, Tl, and Zn are COCs in soils for all upland areas on or near the Facility;
- Cd and Se are COCs in soils for some upland CSM units; and
- Ag, Ba, Cr, Mn, Fe, Sb, and V are metals in soils that are expected to pose negligible risks (due to minimal or no predicted toxicity or no significant differences from reference areas) on or near the Facility.

Table 10.2
Weight-of-Evidence Analysis for Terrestrial Invertebrates

		Weight-of-Evidence Evaluation[a]			
CSM Unit	**Line of Evidence**	**-**	**0**	**+**	**COCs[b]**
Prickly Pear Creek (Riparian Zone)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Cu, Hg, Zn
	Soil Chemistry *vs*. Reference	- [c]		+	
	Earthworm Tissue Chemistry *vs*. Reference	- [c]		+	
Upper Lake and Marsh (Bank Soils)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Hg, Se, Zn
	Soil Chemistry *vs*. Reference	- [c]		+	
	Earthworm Tissue Chemistry *vs*. Reference	- [c]		+	
Tito Park	Soil Chemistry *vs*. Toxicity Benchmarks			+	As, Cd, Cu, Hg, Pb, Zn
	Soil Chemistry *vs*. Reference	- [c]		+	
Lower Lake (Bank Soils)	Soil Chemistry *vs*. Toxicity Benchmarks			+	As, Cu, Hg, Tl, Zn
	Soil Chemistry *vs*. Reference	- [c]		+	
Site Perimeter (East)	Soil Chemistry *vs*. Toxicity Benchmarks			+	As, Cu, Hg, Zn
	Soil Chemistry *vs*. Reference	- [c]		+	
Site Perimeter (West)	Soil Chemistry *vs*. Toxicity Benchmarks			+	Cu, Hg, Zn
	Soil Chemistry *vs*. Reference	- [c]		+	

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence.
(c) Concentrations of Ba, Cr, Fe, Co, Mn, and V were not significantly elevated compared to reference concentrations.

11 Risk Characterization for Birds and Mammals

The results of the refined SLERA for birds and mammals (Section 4.2.6) identified several COPCs that required further evaluation in the BERA: Al, Sb, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg (and MeHg), Se, Ag, Tl, V, and Zn. To evaluate the potential for COPCs to adversely affect survival, growth, and reproduction of wildlife receptors, several lines of evidence were evaluated. Each line of evidence provides information to address the primary risk questions (as described previously in Section 3.6):

- Are daily dietary COPC doses for birds and mammals that inhabit Prickly Pear Creek, Lower Lake, Upper Lake, Upper Lake Marsh, Wilson Ditch, and upland areas at the site greater than TRVs for survival, growth, or reproduction?
- Are COPC concentrations in site prey items greater than concentrations from reference sites?

To evaluate both aquatic and terrestrial areas of the site, a number of representative wildlife receptors with varying feeding preferences were examined quantitatively:

- Aquatic omnivorous birds (*i.e.*, mallard);
- Piscivorous birds (*i.e.*, belted kingfisher);
- Sediment-probing birds (*i.e.*, sandpiper);
- Terrestrial omnivorous birds (*i.e.*, American robin);
- Terrestrial insectivorous birds (*i.e.*, tree swallow);
- Piscivorous mammals (*i.e.*, mink);
- Terrestrial invertivorous mammals (*i.e.*, shrew); and
- Terrestrial herbivorous mammals (*i.e.*, vole).

The following sections described the results of the BERA for wildlife receptors; Appendix E provides detailed tables of results for each receptor.

11.1 Dietary Assessment

The BERA for wildlife receptors is organized into receptors that feed primarily in aquatic or wetland areas and those that feed primarily in terrestrial environments. Section 4.3.1 describes the exposure pathways and exposure assumptions used to construct hypothetical diets for each of the wildlife receptors evaluated in the BERA. Exposures were evaluated for a range of environmental media (*e.g.*, surface water, sediment, soil) and food web items (*e.g.*, aquatic and terrestrial invertebrates, aquatic and terrestrial plants, fish, and amphibians). Exposure concentrations were estimated using a 95% UCL on the mean when data were sufficient ($N > 5$). When less than five samples were available, maximum concentrations were used to estimate exposure. Dietary exposure was quantified on a mg/kg-day wet weight basis and compared to TRVs (mg/kg-day wet weight) for birds and mammals (Appendix C). Exposure estimates were compared to both NOAEL- and LOAEL-based TRVs for each wildlife receptor. Exposure assessment and risk results for aquatic wildlife were based on the mallard, kingfisher, sandpiper, and mink. These receptors were evaluated in four CSM Units: Prickly Pear Creek, Upper Lake and Upper Lake Marsh, Wilson Ditch, and Lower Lake. Terrestrial exposure and risk estimates were based on the robin, swallow, shrew, and vole. Exposure assessment and risk results for terrestrial wildlife were based on the robin, swallow, shrew, and vole. Terrestrial CSM Units included the riparian or bank areas and upland areas of Prickly Pear Creek, Upper Lake and Upper Lake Marsh, Lower Lake, Tito Park, and the East and West Site Perimeter.

Aquatic Wildlife Receptors

A summary of the risk estimates for aquatic wildlife are presented in Table 11.1 and details for each receptor are presented in Appendix E (Tables E-17 through E-22). Results for each receptor and CSM unit are described below.

Mallard (aquatic omnivorous bird): The dietary assessment for mallards was based on exposure estimates using the 95% UCL and dietary items including benthic invertebrates, other aquatic invertebrates, aquatic plants, surface water, and sediment (incidental). Generally, ingestion of aquatic plants and incidental sediment ingestion were the largest contributors to the overall dietary dose (Appendix E, Table E-27). The risk results identified that Cr and Ag did not exceed a HQ of 1.0 in any of the CSM units. Mn (HQ_{NOAEL}=2, HQ_{LOAEL}=1) slightly exceeded a HQ of 1.0 in Prickly Pear Creek. Methylmercury (HQ_{NOAEL}=24, HQ_{LOAEL}=2) and Pb (HQ_{NOAEL}=4, HQ_{LOAEL}=2) exceeded a HQ of 1.0 in Upper Lake and Marsh. Methylmercury (HQ_{NOAEL}=32, HQ_{LOAEL}=2), and Pb (HQ_{NOAEL}=2, HQ_{LOAEL}=<1) exceeded a HQ of 1.0 in Wilson Ditch. Multiple COPCs exceeded either a NOAEL or LOAEL in Lower Lake, including As, Cd, Cu, MeHg, Pb, Se, and Tl. Only Cu, Pb, and Se exceeded LOAEL-based TRVs in Lower Lake: Cu (HQ_{LOAEL}=2); Pb (HQ_{LOAEL}=7); and Se (HQ_{LOAEL}=10). There were no avian TRVs available for Sb, Be, or Fe; potential risks from these COPCs could not be quantified.

Belted Kingfisher (aquatic avian piscivore): The dietary assessment for the belted kingfisher was based on exposure estimates using the 95% UCL and dietary items including benthic invertebrates, other aquatic invertebrates, forage fish, piscivorous fish, amphibians, surface water, and sediment (incidental). Generally, incidental sediment ingestion was the largest contributor to the overall dietary dose, followed by fish and invertebrates (Appendix E, Table E-27). Chromium and Ag did not exceed a HQ of 1.0 in any of the CSM units. None of the COPCs exceeded a HQ of 1.0 for NOAEL- or LOAEL-based TRVs at a 95% UCL exposure level for Prickly Pear Creek. Methylmercury (HQ_{NOAEL} = 10) and Pb (HQ_{NOAEL} = 5) doses exceeded NOAEL-based TRVs, but only Pb exceeded a LOAEL-based TRV (HQ = 2) in the Upper Lake and Upper Lake Marsh. Methylmercury (HQ_{NOAEL} = 13) exposure exceeded a NOAEL-based TRV, but not a LOAEL-based TRV, in Wilson Ditch. Several COPC doses exceeded NOAEL-based TRVs in Lower Lake (Table 11.1). However, LOAEL-based TRVs were exceeded for only two metals: Pb (HQ_{LOAEL} = 5) and Se (HQ_{LOAEL} = 5). There were no avian TRVs available for Sb, Be, or Fe; potential risks from these COPCs could not be quantified.

Sandpiper (aquatic avian benthivore): The dietary assessment for the sandpiper was based on exposure estimates using the 95% UCL and dietary items including benthic invertebrates, other aquatic invertebrates, surface water, and sediment (incidental). Due to its feeding behavior (sediment probing), the incidental sediment ingestion is much higher for the sandpiper (18%) than for other aquatic receptors (1-9.4%). Consequently, incidental sediment ingestion was the largest contributor to the overall dietary dose (Appendix E, Table E-27). Several COPCs exceeded a NOAEL-based HQ of 1.0 in Prickly Pear Creek, and Cu (HQ_{LOAEL} = 3), Mn (HQ_{LOAEL} = 14), and Pb (HQ_{LOAEL} = 4) exceeded a LOAEL-based HQ of 1.0. Similar results were apparent for Upper Lake and Upper Lake Marsh, Wilson Ditch, and Lower Lake based on NOAEL-based TRV comparisons (Table 11.1). LOAEL-based TRV exceedances for Upper Lake and Marsh included: Cu (HQ_{LOAEL} = 6), Hg (HQ_{LOAEL} = 4), MeHg (HQ_{LOAEL} = 12), Mn (HQ_{LOAEL} = 2), Pb (HQ_{LOAEL} = 25), and Se (HQ_{LOAEL} = 2). LOAEL-based TRV exceedances for Wilson Ditch included: Hg (HQ_{LOAEL} = 6), MeHg (HQ_{LOAEL} = 17), Mn (HQ_{LOAEL} = 3), and Pb (HQ_{LOAEL} = 7). All metals exceeded both NOAEL- and LOAEL-based TRVs in Lower Lake except Cr, Ag, and V. There were no avian TRVs available for Sb, Be, or Fe; potential risks from these COPCs could not be quantified.

Table 11.1
Risk Characterization for Aquatic-dependent Wildlife Receptors

CSM Unit	Receptor	Risk Characterization					
		NOAEL			LOAEL		
		HQ ≤ 1	HQ > 1 to < 10	HQ ≥ 10	HQ ≤ 1	HQ > 1 to < 10	HQ ≥ 10
Prickly Pear Creek	Mallard	All other	Mn	None	All	None	None
	Kingfisher	All	None	None	All	None	None
	Sandpiper	As, Cd, Cr, Hg, Se, Ag, Tl, V, Zn	Al, Cu, MeHg	Mn, Pb	All other	Cu, Pb	Mn
	Mink	All other	As, V	Al	All other	Al	None
Upper Lake and Marsh	Mallard	All other	Pb	MeHg	All other	MeHg, Pb	None
	Kingfisher	All other	MeHg, Pb	None	All other	Pb	None
	Sandpiper	Cr, Ag, Tl, V, Zn	Al, As, Cd, Hg, Mn, Se	Cu, MeHg, Pb	As, Cr, Ag, V	Cu, Hg, Mn, Se	MeHg, Pb
	Mink	Be, Cd, Cr, Cu, Hg, Se, Ag, Tl , Zn	Sb, As, Pb, V	Al, MeHg	All other	Al, MeHg	None
Wilson Ditch	Mallard	All other	Pb	MeHg	All other	MeHg	None
	Kingfisher	All other	None	MeHg	All	None	None
	Sandpiper	As, Cd, Cr, Se, Ag, Tl, V, Zn	Al, Cu, Mn	Hg, MeHg, Pb	All other	Hg, Mn, Pb	MeHg
	Mink	All other	None	Al, MeHg	All other	Al, MeHg	None
Lower Lake	Mallard	Al, Cr, Hg, Mn, Ag, V, Zn	As, Cu	Cd, MeHg, Pb, Se, Tl	All other	Cu, Pb, Se	None
	Kingfisher	Al, Cr, Hg, Mn, Ag, V, Zn	As, Cd, Cu, MeHg	Pb, Se, Tl	All other	Pb, Se	None
	Sandpiper	Ag, V	Al, Cr, Hg, Mn, Zn	As, Cd, Cu, MeHg, Pb, Se, Tl	Cr, Ag	As, Hg, MeHg, Mn, Tl	Cd, Cu, Pb, Se
	Mink	Be, Cr, Hg, Mn, Ag, Zn	Cu, V	Al, Sb, As, Cd, MeHg, Pb, Se, Tl	Cr, Cu, Hg, Mn, Pb, Ag, V, Zn	Al, Cd, MeHg	Sb, As, Se, Tl

Mink (aquatic mammalian piscivore): The dietary assessment for the mink was based on exposure estimates using the 95% UCL and dietary items including other aquatic invertebrates, forage fish, piscivorous fish, amphibians, surface water, and sediment (incidental). Generally, incidental sediment ingestion was the largest contributor to the overall dietary dose, followed by fish and aquatic invertebrates (Appendix E, Table E-27). Chromium and Ag did not exceed a HQ of 1.0 in any of the CSM units. Aluminum, As, and V exceeded NOAEL-based TRVs, but only Al exceeded LOAEL-based TRVs (HQ_{LOAEL} = 4) in Prickly Pear Creek. Several metals exceeded NOAEL-based TRVs in Upper

Lake and Upper Lake Marsh (Table 11.1), but only Al (HQ_{LOAEL} = 6) and MeHg (HQ_{LOAEL} = 6) exceeded LOAEL-based TRVs. Similar results were apparent for Wilson Ditch (Table 11.1), where Al (HQ_{LOAEL} = 4) and MeHg (HQ_{LOAEL} = 8) exceeded LOAEL-based TRVs. Several COPCs (Al, Sb, As, Cd, Cu, MeHg, Pb, Se, and Tl) exceeded both NOAEL- and LOAEL-based TRVs in Lower Lake, while other COPCs (Be, Cr, Hg, Mn, Ag, V and Zn) did not exceed the LOAEL-based TRV. There was no mammalian TRV available for Fe; potential risks for Fe could not be quantified.

Terrestrial Wildlife Receptors

A summary of the risk characterization for terrestrial wildlife receptors are presented in Table 11.2 and details for each receptor are presented in Appendix E (Tables E-23 through E-26). Results for each receptor and CSM unit are described below.

Robin (terrestrial avian omnivore): The dietary assessment for robins was based on exposure estimates using the 95% UCL and dietary items including terrestrial plants, earthworms, terrestrial invertebrates (*e.g.*, ants, spiders, beetles), aerial/foliar invertebrates (*e.g.*, grasshoppers), surface water, and soil (incidental). Generally, incidental soil ingestion was the largest contributor to the overall dietary dose, followed by earthworms and terrestrial plants (Appendix E, Table E-27). Several COPCs exceeded NOAEL- or LOAEL-based TRVs in each of the CSM units (Table 11.2). LOAEL-based TRV exceedances included:

- **Prickly Pear Creek**: Cu (HQ_{LOAEL} = 4), Mn (HQ_{LOAEL} = 2), Pb (HQ_{LOAEL} = 12), and Se (HQ_{LOAEL} = 5).
- **Upper Lake and Upper Lake Marsh**: Cu (HQ_{LOAEL} = 3), Hg (HQ_{LOAEL} = 3), MeHg (HQ_{LOAEL} = 6), Pb (HQ_{LOAEL} = 25) and Se (HQ_{LOAEL} = 10).
- **Lower Lake**: Cd (HQ_{LOAEL} = 2), Cu (HQ_{LOAEL} = 12), Hg (HQ_{LOAEL} = 2), MeHg (HQ_{LOAEL} = 5), Mn (HQ_{LOAEL} = 2), Pb (HQ_{LOAEL} = 34), and Se (HQ_{LOAEL} = 5).
- **Tito Park**: As (HQ_{LOAEL} = 3), Cd (HQ_{LOAEL} = 19), Cu (HQ_{LOAEL} = 29), MeHg (HQ_{LOAEL} = 2), Pb (HQ_{LOAEL} = 109), and Se (HQ_{LOAEL} = 3).
- **Site Perimeter (East)**: As (HQ_{LOAEL} = 3), Cu (HQ_{LOAEL} = 60), MeHg (HQ_{LOAEL} = 2), Mn (HQ_{LOAEL} = 2), and Pb (HQ_{LOAEL} = 13).
- **Site Perimeter (West)**: Cu (HQ_{LOAEL} = 24), Mn (HQ_{LOAEL} = 5), Pb (HQ_{LOAEL} = 21) and Se (HQ_{LOAEL} = 5).

There were no avian TRVs available for Sb, Be, or Fe; potential risks from these COPCs could not be quantified.

Table 11.2
Risk Characterization for Terrestrial Wildlife Receptors

		Risk Estimates					
		NOAEL			LOAEL		
CSM Unit	**Receptor**	**HQ ≤ 1**	**HQ > 1 to < 10**	**HQ ≥ 10**	**HQ ≤ 1**	**HQ > 1 to < 10**	**HQ ≥ 10**
Prickly Pear Creek (Riparian Zone)	Robin	As, Cr, Hg, Ag, Tl, V	Al, Cd, Cu, Mn	MeHg, Pb, Se	As, Cd, Cr, Hg, MeHg, Ag, Tl	Cu, Mn, Se	Pb
	Swallow	As, Cd, Cr, Hg, Mn, Ag, Tl, V, Zn	Al, Cu, MeHg, Pb, Se	None	All others	Se	None
	Shrew	Be, Cr, Hg, Mn, Ag, Zn	Cd, Cu, Se, Tl, V	Al, Sb, As, MeHg, Pb	Cd, Cr, Hg, Mn, Pb, Ag, Tl, V, Zn	Sb, As, Cu, MeHg, Se	Al
	Vole	Be, Cr, Mn, Ag, Zn	As, Cd, Cu, Hg, Pb, Tl, V	Al, Sb, MeHg, Se	Cd, Cr, Cu, Hg, Mn, Pb, Ag, Tl, V, Zn	Sb, As	Al, MeHg, Se
Upper Lake and Marsh (Banks)	Robin	Cr, Mn, Ag, V, Zn	Al, As, Cu, Hg, Tl	Cd, MeHg, Pb, Se	As, Cd, Cr, Mn, Ag, Tl	Cu, Hg, MeHg	Pb, Se
	Swallow	As, Cd, Cr, Mn, Ag, Tl, V, Zn	Al, Cu, Hg, Pb, Se	MeHg	All others	MeHg, Se	None
	Shrew	Be, Mn, Ag, Zn	Cr, Cu, Hg, Tl	Al, Sb, As, Cd, MeHg, Pb, Se, V	Cr, Hg, Mn, Ag, Tl, V, Zn	Sb, As, Cd, Cu, Pb	Al, MeHg, Se
	Vole	Be, Cr, Cu, Mn, Ag, Zn	As, Cd, Hg, Pb, V	Al, Sb, MeHg, Se, Tl	Cd, Cr, Cu, Mn, Ag, Tl, V, Zn	Sb, As, Pb	Al, MeHg, Se
Lower Lake (Banks)	Robin	Cr, Ag, V	Al, As, Hg, Mn, Zn	Cu, MeHg, Pb, Se, Tl	As, Cr, Ag, Tl	Cd, Hg, MeHg, Mn, Se	Cu, Pb
	Swallow	As, Cr, Hg, Mn, Ag, V, Zn	Al, Cd, Cu, Pb, Se, Tl	MeHg	As, Cd, Cr, Cu, Hg, Mn, Ag, Tl	MeHg, Pb, Se	None
	Shrew	Be, Mn, Ag	Cr, Hg, Zn	Al, Sb, As, Cd, Cu, MeHg, Pb, Se, Tl, V	Cr, Hg, Mn, Ag, V, Zn	Cd, Pb, Se, Tl	Al, Sb, As, Cu, MeHg
	Vole	Be, Cr, Mn, Ag, Zn	Cd, Cu, Hg, V	Al, Sb, As, MeHg, Pb, Se, Tl	Cd, Cr, Hg, Mn, Ag, V, Zn	Sb, As, Cu, Pb, Se, Tl	Al, MeHg
Tito Park	Robin	Cr, Mn, Ag, V	Al, Se, Tl, Zn	As, Cd, Cu, MeHg, Pb	Cr, Hg, Mn, Ag, Tl	As, MeHg, Se	Cd, Cu, Pb
	Swallow	As, Cr, Cu, Hg, Mn, Ag, Tl, V, Zn	Al, Cd, MeHg, Pb, Se	None	All others	Se	None

		Risk Estimates					
		NOAEL			LOAEL		
CSM Unit	Receptor	HQ ≤ 1	HQ > 1 to < 10	HQ ≥ 10	HQ ≤ 1	HQ > 1 to < 10	HQ ≥ 10
	Shrew	Be, Hg, Mn, Ag	Cr, Se, Tl, V, Zn	Al, Sb, As, Cd, Cu, MeHg, Pb	Cr, Hg, Mn, Ag, Tl, V	Sb, MeHg, Se, Zn	Al, As, Cd, Cu, Pb
	Vole	Be, Cr, Mn, Ag	Cu, Hg, Se, V, Zn	Al, Sb, As, Cd, MeHg, Pb, Tl	Cr, Hg, Mn, Ag, V, Zn	Sb, Cd, Cu, MeHg, Pb, Se, Tl	Al, As
Site Perimeter (East)	Robin	Cr, Hg, Ag, V, Zn	Al, Cd, Mn, Se, Tl	As, Cu, MeHg, Pb	Cd, Cr, Hg, Se, Ag, Tl	As, MeHg, Mn	Cu, Pb
	Swallow	As, Cr, Hg, Mn, Ag, Tl, V, Zn	Al, Cd, Cu, MeHg, Se	Pb	All others	Cu, Pb	None
	Shrew	Be, Hg, Mn, Ag, Zn	Cr, Se, Tl	Al, Sb, As, Cd, Cu, MeHg, Pb, V	Cr, Hg, Mn, Ag, Tl, V, Zn	Sb, Cd, MeHg, Pb, Se	Al, As, Cu
	Vole	Be, Cr, Mn, Ag, Zn	Cd, Hg, Pb, Se, Tl, V	Al, Sb, As, Cu, MeHg	Cd, Cr, Cu, Hg, Mn, Pb, Se, Ag, Tl, V, Zn	None	Al, As, Cu, MeHg
Site Perimeter (West)	Robin	Hg, V	Al, As, Cr, Mn, Se, Ag, Tl, Zn	Cd, Cu, MeHg, Pb	As, Cd, Cr, Hg, MeHg, Ag, Tl	Mn, Se	Cu, Pb
	Swallow	As, Cd, Cr, Cu, Hg, Mn, Ag, Tl, V, Zn	Al, MeHg, Pb, Se	None	All others	Se	None
	Shrew	Be, Hg, Ag	Cr, Mn, Se, Tl, Zn	Al, Sb, As, Cd, Cu, MeHg, Pb, V	Cr, Hg, Mn, Ag, Tl, V, Zn	As, Cd, MeHg, Pb, Se	Al, Sb, Cu
	Vole	Be, Cr, Hg, Mn, Ag, Zn	Cd, Cu, Pb, V	Al, Sb, As, MeHg, Se, Tl	Cd, Cr, Hg, Mn, Pb, Ag, Tl, V, Zn	Sb, As, Cu, MeHg, Se	Al

Note:

HQ = Dietary exposure based on 95% UCL concentrations/NOAEL- or LOAEL-based TRV.

Swallow (terrestrial avian insectivore): The dietary assessment for swallows was based on exposure estimates using the 95% UCL and dietary items including terrestrial plants, benthic invertebrates, terrestrial invertebrates (*e.g.*, ants, spiders, beetles), aerial/foliar invertebrates (*e.g.*, grasshoppers), and surface water. Since swallows feed primarily on flying insects, incidental soil and sediment ingestion is not considered a relevant exposure pathway for this receptor. Consequently, ingestion of plants and terrestrial invertebrates are the largest contributors to the overall dietary dose (Appendix E, Table E-27). Several COPCs exceeded NOAEL- or LOAEL-based TRVs in each of the CSM units (Table 11.2). LOAEL-based TRV exceedances included:

- **Prickly Pear Creek**: Se (HQ_{LOAEL} = 2).
- **Upper Lake and Upper Lake Marsh**: MeHg (HQ_{LOAEL} = 3) and Se (HQ_{LOAEL} = 4).
- **Lower Lake**: MeHg (HQ_{LOAEL} = 2), Pb (HQ_{LOAEL} = 2), and Se (HQ_{LOAEL} = 4).
- **Tito Park**: Se (HQ_{LOAEL} = 2).
- **Site Perimeter (East)**: Cu (HQ_{LOAEL} = 2) and Pb (HQ_{LOAEL} = 6).
- **Site Perimeter (West)**: Se (HQ_{LOAEL} = 2).

There were no avian TRVs available for Sb, Be, or Fe; potential risks from these COPCs could not be quantified.

Shrew (terrestrial mammalian insectivore): The dietary assessment for shrews was based on exposure estimates using the 95% UCL and dietary items including terrestrial plants, earthworms, terrestrial invertebrates (*e.g.*, ants, spiders, beetles), aerial/foliar invertebrates (*e.g.*, grasshoppers), and soil (incidental). Incidental soil ingestion is the largest contributor to the overall dietary dose, followed by earthworms and terrestrial soil invertebrates (Appendix E, Table E-27). Most metals exceeded NOAEL- or LOAEL-based TRVs in each of the CSM units (Table 11.2). LOAEL-based TRV exceedances included:

- **Prickly Pear Creek**: Al (HQ_{LOAEL} = 17), Sb (HQ_{LOAEL} = 3), As (HQ_{LOAEL} = 4), Cu (HQ_{LOAEL} = 3), MeHg (HQ_{LOAEL} = 3), and Se (HQ_{LOAEL} = 5).
- **Upper Lake and Upper Lake Marsh**: Al (HQ_{LOAEL} = 57), Sb (HQ_{LOAEL} = 6), As (HQ_{LOAEL} = 5), Cd (HQ_{LOAEL} = 4), Cu (HQ_{LOAEL} = 3), MeHg (HQ_{LOAEL} = 13), Pb (HQ_{LOAEL} = 3), and Se (HQ_{LOAEL} = 10).
- **Lower Lake**: Al (HQ_{LOAEL} = 60), Sb (HQ_{LOAEL} = 13), As (HQ_{LOAEL} = 17), Cd (HQ_{LOAEL} = 5), Cu (HQ_{LOAEL} = 10), MeHg (HQ_{LOAEL} = 14), Pb (HQ_{LOAEL} = 4), Se (HQ_{LOAEL} = 7), and Tl (HQ_{LOAEL} = 3).

- **Tito Park**: Al (HQ_{LOAEL} = 53), Sb (HQ_{LOAEL} = 7), As (HQ_{LOAEL} = 37), Cd (HQ_{LOAEL} = 49), Cu (HQ_{LOAEL} = 23), MeHg (HQ_{LOAEL} = 5), Pb (HQ_{LOAEL} = 14), Se (HQ_{LOAEL} = 4), and Zn (HQ_{LOAEL} = 2).
- **Site Perimeter (East)**: Al (HQ_{LOAEL} = 39), Sb (HQ_{LOAEL} = 6), As (HQ_{LOAEL} = 34), Cd (HQ_{LOAEL} = 2), Cu (HQ_{LOAEL} = 49), MeHg (HQ_{LOAEL} = 6), Pb (HQ_{LOAEL} = 2), and Se (HQ_{LOAEL} = 2).
- **Site Perimeter (West)**: Al (HQ_{LOAEL} = 52), Sb (HQ_{LOAEL} = 10), As (HQ_{LOAEL} = 12), Cd (HQ_{LOAEL} = 4), Cu (HQ_{LOAEL} = 19), MeHg (HQ_{LOAEL} = 4), Pb (HQ_{LOAEL} = 3), and Se (HQ_{LOAEL} = 5).

There were no mammalian TRVs available for Fe; potential risks from Fe could not be quantified.

Vole (terrestrial mammalian herbivore): The dietary assessment for voles was based on exposure estimates using the 95% UCL and dietary items including terrestrial plants, terrestrial invertebrates (*e.g.*, ants, spiders, beetles), surface water, and soil (incidental). Incidental soil ingestion and terrestrial plants are the largest contributors to the overall dietary dose for the vole (Appendix E, Table E-27). Most COPCs exceeded NOAEL- or LOAEL-based TRVs in each of the CSM units (Table 11.2). LOAEL-based exceedances included:

- **Prickly Pear Creek**: Al (HQ_{LOAEL} = 58), Sb (HQ_{LOAEL} = 2), As (HQ_{LOAEL} = 2), MeHg (HQ_{LOAEL} = 10), and Se (HQ_{LOAEL} = 11).
- **Upper Lake and Upper Lake Marsh**: Al (HQ_{LOAEL} = 101), Sb (HQ_{LOAEL} = 2), As (HQ_{LOAEL} = 2), MeHg (HQ_{LOAEL} = 43), and Se (HQ_{LOAEL} = 19).
- **Lower Lake**: Al (HQ_{LOAEL} = 95), Sb (HQ_{LOAEL} = 3), As (HQ_{LOAEL} = 8), Cu (HQ_{LOAEL} = 3), MeHg (HQ_{LOAEL} = 25), Pb (HQ_{LOAEL} = 2), Se (HQ_{LOAEL} = 8), and Tl (HQ_{LOAEL} = 6).
- **Tito Park**: Al (HQ_{LOAEL} = 95), Sb (HQ_{LOAEL} = 2), As (HQ_{LOAEL} = 19), Cd (HQ_{LOAEL} = 9), Cu (HQ_{LOAEL} = 7), MeHg (HQ_{LOAEL} = 9), Pb (HQ_{LOAEL} = 5), Se (HQ_{LOAEL} = 3), and Tl (HQ_{LOAEL} = 2).
- **Site Perimeter (East)**: Al (HQ_{LOAEL} = 53), As (HQ_{LOAEL} = 16), Cu (HQ_{LOAEL} = 14), and MeHg (HQ_{LOAEL} = 10).
- **Site Perimeter (West)**: Al (HQ_{LOAEL} = 90), Sb (HQ_{LOAEL} = 3), As (HQ_{LOAEL} = 3), Ba (HQ_{LOAEL} = 3), Cu (HQ_{LOAEL} = 6), MeHg (HQ_{LOAEL} = 8), and Se (HQ_{LOAEL} = 9).

Reference Comparisons

Statistical analyses were performed for several of the primary exposure media that contribute to the overall dietary dose of the wildlife receptors evaluated in the BERA. COPC concentrations in site sediments, surface water (total), soils, benthic invertebrates, game fish, amphibians, and earthworms were compared to reference site concentrations following the procedures described in Section 4.3.3. Detailed tables with statistical results are provided in Appendix E and a summary of those results is presented below for each environmental medium:

- **Sediments**: COPC concentrations in Prickly Pear Creek sediment locations near the Facility were not significantly different from those in upstream reference locations (Table 5.4). Manganese concentrations were significantly lower near the Facility (mean = 338 mg/kg) than at upstream locations (mean = 509 mg/kg). Upper Lake and Upper Lake Marsh sediments had significantly elevated concentrations of Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Se, Ag, and Zn compared to the reference locations (Walker Creek Pond and Marsh). Concentrations of Al, Ba, Be, Co, Fe, Tl, and V in Upper Lake and Upper Lake Marsh were not significantly different from reference locations. Wilson Ditch sediments had significantly elevated concentrations of Cd, Pb, Mn, Hg, and Ag compared to reference locations (Walker Creek Pond and Marsh). Concentrations of Al, Sb, As, Ba, Cu, Fe, Se, Tl, and Zn in Wilson Ditch were not significantly elevated compared to reference locations. Except for Al, Ba, Be, Cr, Co, and Fe, all metals were significantly elevated in Lower Lake sediments as compared to Walker Creek sediments.
- **Surface water (total recoverable)**: Most of the surface water data collected on and near the Facility, as well as data collected in reference locations, included a large number of non-detected values for the targeted COPCs. Therefore, statistical comparisons were only conducted for those COPCs with frequent detections. Surface water in Prickly Pear Creek had significantly elevated concentrations of As, Pb, and Mn compared to upstream. Cadmium, Pb, and Zn were significantly elevated in Upper Lake and Upper Lake Marsh surface waters compared to Walker Creek. Cadmium was the only metal significantly elevated in Wilson Ditch compared to Walker Creek. Arsenic, Cd, and Pb were significantly elevated in Lower Lake surface waters compared to Walker Creek.
- **Soil**: Concentrations of Sb, As, Cd, Cu, Pb, Hg, Se, Ag, Tl, and Zn are generally enriched (*i.e.*, mean concentrations are 10-100 times greater than reference areas) in Facility soils as compared to the Walker Creek soils. Onsite concentrations of Ba, Cr, Fe, Mn, and V were consistently not significantly different from reference soils and, therefore, site concentrations of these COPCs may be reflective of natural conditions within Helena Valley (Appendix E, Table E-14).
- **Benthic invertebrates**: Concentrations of several COPCs (Sb, Pb, Hg, Ag, and V) were significantly elevated in benthic invertebrate tissues collected from Prickly Pear Creek compared to upstream locations (Table 5.5). Several COPCs (As, Cd, Pb, Se, Ag, and Zn) were elevated and significantly different in Upper Lake and Upper Lake Marsh invertebrate tissues compared to Walker Creek. Only one sample was collected from Wilson Ditch, which had elevated concentrations of Sb, As, Cd, Cu, Pb, Mn, Hg, Se, Ag, and Zn compared to Walker Creek. Benthic invertebrate tissues from Lower Lake contained elevated concentrations of Sb, As, Cd, Pb, Hg, Se, Ag, Tl, and Zn compared to Walker Creek.
- **Game fish**: Game fish fillets were collected from both onsite locations and reference areas. Mercury was the only metal that was significantly elevated in onsite fish tissues from Prickly Pear Creek compared to upstream (Appendix E, Table E-9). Mercury and Se concentrations were significantly elevated in fish collected from Upper Lake and Upper Lake Marsh compared to Walker Creek (Pond and Marsh). Mean Ba, Cr, and Pb

concentrations were 2-3 times greater than in fish from Upper Lake and Upper Lake Marsh but not significantly different from Walker Creek fish.

- **Amphibians**: Four Columbia spotted frogs were collected from the site and one from Walker Creek. No statistics were conducted with these data due to low sample size. Comparison of mean concentrations from onsite samples to the reference sample identified Al, Cd, Cu, Pb, Mn, Hg, Se, and Ag as having concentrations 2 or more times greater than reference tissues (Figure 8.1).
- **Earthworms**: Earthworm tissues were collected from riparian areas near Prickly Pear Creek, the Upper Lake Marsh near the Prickly Pear Creek diversion at the southern end of the site (see Map 7), and Walker Creek. Concentrations of COPCs (Sb, As, Cd, Cu, Pb, Hg, Ag, Tl, and Zn) in earthworm tissues collected from the site were found to be significantly higher than reference areas (Appendix E, Table E-16). Concentrations of Cr, Mn, Se, and V were not significantly different from reference areas. Mean Se concentrations (5-20 mg/kg) were elevated compared to reference areas (mean = 0.25 mg/kg), but the difference was not significant for all sampled areas of the site. Barium and Fe concentrations were significantly lower in earthworm tissues from the site compared to reference tissues. Thus, earthworm tissue concentrations show a similar pattern as soil concentrations for several elements (*i.e.*, Sb, As, Cd, Cu, Pb, Hg, Se, Ag, Tl, and Zn), indicating significant enrichment at the site.

In summary, concentrations of Sb, As, Cd, Cu, Pb, Hg, Se, Ag, Tl, and Zn are consistently significantly elevated (*i.e.*, in a majority of CSM units and media) in environmental media on and near the Facility compared to reference locations. Al, Ba, Be, Cr, Co, Fe, Mn, Ni, and V concentrations are consistently not significantly different (*i.e.*, in a majority of CSM units and media) from reference sites and are likely representative of typical conditions in the Helena Valley.

Egg Tissue Concentrations

Embryo or egg tissue concentrations provide a useful tool to evaluate exposure and potential reproductive effects on sensitive lifestages. Egg tissue concentrations have been used to monitor the exposure of avian species to bioaccumulative substances (*e.g.*, polychlorinated biphenyls, dioxins, Hg, and Se [Beyer *et al.*, 1996; Heinz *et al.*, 2010a]). In the summer of 2010, US FWS placed nest boxes in several locations along Upper Lake, Upper Lake Marsh, and Tito Park to monitor metal concentrations in eggs of birds nesting near the Facility (Map 9). Six eggs were collected; metal concentrations are presented in Appendix B (Table B-20). Bird species included tree swallow (1 egg), violet-green swallow (3 eggs), yellow-headed blackbird (1 egg), and red-winged blackbird (1 egg). These species feed primarily on flying insects and seeds/grains in terrestrial or semi-aquatic habitats.

Avian egg TECs have been proposed for a limited number of metals, primarily Hg and Se (Heinz and Hoffman, 2003; Heinz *et al*., 2010a,b; Albers *et al*., 2007; Beyer *et al*., 1996; Ohlendorf, 2003; Adams *et al*., 2003). Egg thresholds for other metals are not readily available and/or are not relevant since some metals do not appreciably accumulate into egg tissue (Beyer *et al*., 1996). USGS (Seiler *et al*., 2004) and Ohlendorf (1993) compiled background egg concentrations for several priority metals for comparison to eggs collected from potentially contaminated sites. Egg TECs and background levels are presented in Table 11.3, along with a summary of egg metal concentrations measured at the Facility. Metal concentrations in eggs collected at the Facility are generally similar to background or lower than reported effect threshold concentration (*i.e.*, for Se and Hg as discussed further below). Lead and Zn concentrations in eggs collected at the Facility are elevated above background and appear to confirm elevated concentrations of these COPCs in several environmental media at the site (*e.g.*, sediment, soils, invertebrates). Since effects thresholds for eggs are not available for Pb and Zn, potential risks could not be evaluated for these metals.

Several studies have described Hg concentrations in bird eggs associated with reproductive effects (Heinz and Hoffman, 2003; Heinz *et al*., 2010a,b; Albers *et al*., 2007). Concentrations in the range of 0.5-1.0 mg Hg/kg wet weight have been identified as the LOAEL for reproductive effects (*e.g.*, hatchability, viability) in several species (*e.g.*, mallards, kestrels, pheasants, and egrets) (Heinz *et al*., 2010a). Mean and maximum measured Hg concentrations in eggs collected from the Facility were 0.05 and 0.08 mg/kg wet weight, respectively (Table 11.3). Therefore, measured Hg concentrations in eggs collected at the Facility are an order of magnitude lower than reported effect concentrations and do not indicate potential risks to avian receptors.

Table 11.3
Risk Characterization for Avian Eggs Collected from the Facility in 2010

			Facility Egg Concentrations (n = 6)	
Metal	**Avian Egg Background Level (mg/kg dry weight)[a]**	**Avian Egg TECs (LOAEL Reproduction) (mg/kg dry weight)[a]**	**Mean Concentration (mg/kg dry weight)[b]**	**Max Concentration (mg/kg dry weight)**
As (Inorganic)	0.25	3.6	0.15	0.28
Cd	0.15	-	0.03	0.09
Cu	5.5	-	2.92	4.33
Pb	<0.5	-	2.48	5.54
Hg	0.1 (dw)	-	0.27 (dw)	0.44 (dw)
	-	0.5-1.0 (ww)	0.05 (ww)	0.08 (ww)
Se	1.9 (dw)	6-16 (dw)	4.76 (dw)	5.66 (dw)
		3-5 (ww)	0.88 (ww)	1.09 (ww)
Zn	50	-	97.78	127.00

Notes:

(a) Sources: Heinz and Hoffman, 2003; Heinz et al., 2010a,b; Albers et al., 2007; Beyer et al., 1996; Ohlendorf et al., 2003; Adams et al., 2003; Seiler et al., 2004; Ohlendorf, 1993.

(b) For non-detected values, one-half the detection limit used to calculate the mean concentration.

Concentration thresholds in bird eggs have been used to evaluate Se toxicity in the field (Beyer *et al*., 1996; Ohlendorf, 2003; Adams *et al*., 2003). A range of Se concentrations in eggs (6-16 mg Se/kg dry weight or 3-5 mg/kg wet weight) were shown to be associated with avian embryotoxicity (Beyer *et al*., 1996; Adams *et al*., 2003; Ohlendorf, 2003). As shown in Table 11.13, Se concentrations measured in eggs collected at the Facility are below reported effect concentrations and do not indicate potential risks to avian receptors.

The species from which eggs were collected at the Facility share feeding preferences with the tree swallow, a representative avian receptor that was evaluated in the BERA (Table 11.2). The risk characterization for the tree swallow predicted low risks from exposure to most COPCs (*i.e.*, Pb, Se, MeHg, and Cu were found to be COCs for tree swallows) and the egg chemistry results support this conclusion. To conclude, site-specific egg chemistry data do not indicate unacceptable risks to insectivorous/granivorous avian species; however, evidence of elevated exposure to some COPCs in this avian receptor group is apparent. The collected egg chemistry data does not provide information regarding piscivorous/benthivorous birds (*e.g.*, belted kingfisher, sandpiper), which have potentially greater exposure to COPCs at the Facility due to their feeding preferences.

Community/Habitat Analysis

Qualitative evaluation of the habitat and presence/absence of birds and mammals was conducted in 1989 (Western Technology and Engineering, Inc., 1989) and 2010 (GEI and Gradient, 2010, see Appendix A). These studies provide information based on opportunistic sightings, which do not provide quantitative data on the abundance of any of the terrestrial receptors of concern at this site compared to reference sites. However, this information is useful for understanding the ecological habitats present and available for use by wildlife. Field investigations have noted a diversity of habitats (*e.g.*, wetland, riparian, and upland habitats), identified over 50 species of birds and 20 species of mammals, and recorded the presence of amphibians and reptiles (Western Technology and Engineering, Inc., 1989; GEI and Gradient, 2010). Generally, wetland and riparian habitats (*e.g.*, Prickly Pear Creek, Upper Lake and Upper Lake Marsh, and Wilson Ditch) were characterized by a variety of vegetation types. The Lower Lake and surrounding upland areas generally have minimal to no vegetative cover and are adjacent to Facility buildings and roads. Similarly, the Facility perimeter and unpaved Facility areas have minimal vegetative cover. Thus, the quality of habitats available for wildlife species are generally poor in the northern part of the Facility but improve with distance from the Facility, particularly in Prickly Pear Creek and the Upper Lake and Upper Lake Marsh areas at the southern end of the Facility.

11.2 Uncertainty Analysis

Potential sources of uncertainty with the risk characterization for wildlife may include assumptions used to estimate exposure and effects and those used to characterize risks from individual-level endpoints to population-level effects. Further details on these uncertainties and the effects on interpretation of the risk characterization are provided below.

Sampling Density

The wildlife dietary assessment is dependent on the availability of representative samples for each of the prey items, exposure conditions, and CSM units under investigation. The dataset used in the BERA typically provided several data points (5 or more for most environmental media) for each CSM unit. However, some sets of environmental data were more limited in size. For example, earthworms, amphibians, and terrestrial invertebrates were collected or composited from a limited number of locations throughout the site. Thus, dietary exposure to these items may not be representative of all conditions potentially encountered at the site. In addition, biota were sampled in the fall of 2003 and the summer of 2010. Thus, the current dataset may not be representative of metal concentrations that would be encountered during other seasons.

Exposure Estimates

Estimates of exposure were developed by pooling data from each of the CSM units in order to calculate 95% UCL concentrations for each environmental medium. In most cases, sufficient data were available to estimate 95% UCLs (n > 5); however, not all exposure areas had equal numbers of samples in the datasets. For some metals in some areas (see Appendix B), insufficient data were available to estimate a 95% UCL. As a substitute for the concentration of non-detected samples, mean and maximum measured values and one-half the detection limit were used to estimate exposure. Since US EPA's ProUCL software accounts for non-detects, it was not necessary to use a non-detect substitution method for datasets with sufficient sample size to estimate a 95% UCL. As a result, some exposure estimates for areas with low sample sizes may be under- or overestimated.

Modeled Exposure Estimates

As described in Section 4, uptake models were used to estimate the concentrations of metals in aquatic and terrestrial plant tissues and earthworms for CSM units that lacked empirical data. These uptake models have been developed (in some cases) with relatively few data points and under conditions that may not be representative of conditions at the site. To evaluate the reliability of the uptake models employed in the BERA, site-specific tissue data were compared to modeled tissue estimates. For aquatic plants, a bioaccumulation model based on Jackson (1998) was used to estimate plant tissue concentrations on the basis of sediment concentrations. Sediment and aquatic plant/algal tissue concentrations collected from the Upper Lake and Upper Lake Marsh area in 2003 (US EPA, 2005a) were compared to the uptake model regression line in Figure 11.1. Modeled concentrations are represented by the regression line in Figure 11.1. The data in this figure illustrate that modeled As, Cd, Pb, and Zn concentrations are equal to or up to 100 times greater than measured concentrations. Thus, for wildlife receptors consuming aquatic plants (*e.g.*, mallard), exposure concentrations based on this uptake model are likely overestimated, resulting in HQs that are also likely overestimated.

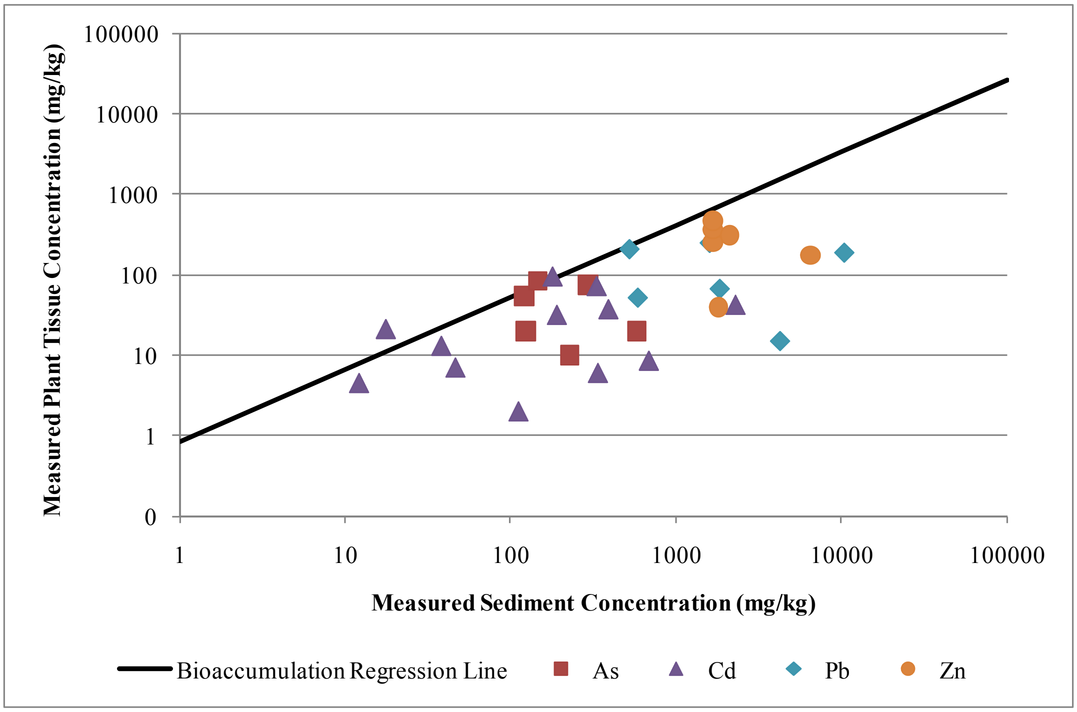

Figure 11.1 Comparison of Measured *vs.* Modeled Aquatic Plant Tissues

Uptake models were also used for estimating terrestrial plant concentrations from site soil concentrations (see Section 4 for models). No recent terrestrial plant data have been collected at the Facility to evaluate the modeled concentration used in the BERA. However, plant concentrations were collected in the 1980s and reported by CH2M Hill (1987a). For comparison, concentrations in plant tissues collected in the 1980s are compared to plant tissue concentrations estimated using the plant uptake models employed in the BERA (Table 11.4). The data in Table 11.4 indicate that modeled plant tissue concentrations for As, Cd, Fe, Hg, and Zn are generally higher than maximum measured tissue concentrations collected from the Facility. Thus, modeled tissue concentrations for these metal COPCs are likely overestimated, resulting in overly conservative risk estimates for wildlife consuming terrestrial plants (*e.g.*, robin, swallow, vole). The remaining metal COPCs (Ba, Cr, Co, Cu, Pb, Mn, Ag, V) share similar ranges of modeled *vs.* measured concentrations and, therefore, the uptake models provide concentration estimates that are comparable to site conditions.

Table 11.4
Modeled *vs.* Measured Plant Metals Concentrations for the East Helena Study Area

Metal[a]	**Measured Plant Tissue Concentrations**[a] **(mg/kg-dw)**		**Modeled Plant Tissue Concentrations**[b] **(mg/kg-dw)**	
	Minimum	**Maximum**	**Range of Means**	**Range of Maximums**
As	0.07	5.4	3-81	9-811
Ba	1.0	59	12-48	17-142
Cd	0.35	2.4	3-36	6-117
Cr	0.7	4.0	0.5-0.7	0.6-1.1
Co	0.7	0.7	0.05-0.12	0.06-0.35
Cu	1	52	18-57	28-121
Fe	27	972	14,230-26,086	20,100-57,500
Pb	0.07	62	13-63	26-140
Mn	8	100	25-92	39-309
Hg	0.014	0.22	3-21	8-58
Ag	0.35	1.3	0.02–0.10	0.03–0.33
V	0.7	2	0.16-0.20	0.22-0.26
Zn	8	85	201-1022	378-2594

Notes:

(a) Data obtained for Alfalfa, Needle and Thread grass, Winter Wheat, and Barley samples from Table 4.1 in CH2M Hill (1987a).

(b) Data summarized for from Appendix E (concentrations in dry weight assuming 80% moisture).

Earthworm tissue concentrations were collected from only two locations near the Prickly Pear Creek riparian zone, so earthworm concentrations for other CSM units were modeled. The reliability of the uptake models employed in the BERA was assessed and the results are presented in Table 11.5. Modeled concentrations for most COPCs appear to be overestimated from measured concentrations by a factor of 2-144 (Table 11.5). Modeled concentrations for As, Mn, and V appear to be similar to or slightly below measured concentrations. Thus, the exposure assessment and resulting risk estimates for robins and shrews is likely overestimated for most metals. Differences in measured *vs.* modeled tissue concentrations may be due to the inability of these models to incorporate site-specific soil conditions, metal bioavailability, and biological regulatory mechanisms for metals.

Table 11.5
Modeled *vs.* Measured Earthworm Metal Concentrations for Prickly Pear Creek

Metal	Mean Soil Concentration from Prickly Pear Creek (mg/kg_{dw})	Measured Earthworm Tissue Concentrations from Prickly Pear Creek (mg/kg_{ww})	Modeled Earthworm Tissue Concentrations from Prickly Pear Creek (mg/kg_{ww})[a]	Ratio of Modeled *vs.* Measured Tissue Concentrations
Al	6326.67	72.58	1265.33	17
Sb	14.68	0.08	2.94	35
As	91.05	3.23	1.17	0.4
Ba	248.33	0.95	4.52	5
Be	5.00	0.03	0.05	2
Cd	19.03	2.13	17.23	8
Cr	14.33	0.09	0.88	9
Co	8.17	0.05	0.20	4
Cu	340.50	1.49	35.07	23
Fe	22100.00	132.56	4420.00	33
Hg	2.70	0.02	0.54	30
Mn	872.00	11.34	9.02	0.8
Ni	8.33	0.06	1.67	28
Pb	1053.50	3.28	44.22	13
Se	6.25	0.20	0.71	4
Ag	14.00	0.04	5.73	144
Tl	0.98	0.013	0.20	15
V	39.67	0.45	0.33	0.7
Zn	1206.33	25.59	175.36	7

Note:

(a) Modeled using the bioaccumulation equations from Section 4 and assuming 80% moisture.

Metal Bioavailability

All dietary exposure estimates assumed 100% metal bioavailability from the environmental media. A number of factors affect metals bioavailability in soils and sediments, such as pH, organic matter content, aging, temperature, humidity, and chemical form (US EPA, 2007). As discussed in previous sections, historic data collected at the site evaluated the extractability of metals using a single extraction procedure (CH2MHill, 1987a). A summary of total and extractable metals from Facility surface soils collected in the 1980s is shown in Table 9.3. This data indicate that, historically, bioavailability of metals in soils within the study area is well below 100%. Thus, the use of total metal concentrations for estimating exposure and uptake, as was conservatively conducted herein, is likely to overestimate exposure to abiotic and biotic media and, as a result, overestimate risks from metal exposure at the site.

An uncertainty analysis was conducted to provide additional context regarding the uncertainty associated with metal bioavailability assumptions in the BERA (Table 11.6). In this analysis, risks associated with the primary metal COCs in soils or sediments (*i.e.*, those metals which exceeded LOAELs) were quantified using varying bioavailability assumptions. Risks were calculated by reducing the active (bioavailable) metal fraction in soils and sediments while keeping all other parameters constant. This analysis focused on the aquatic and terrestrial receptors with the highest sediment/soil ingestion rates (*i.e.*, sandpiper, mink, robin, and shrew), as these receptors would be most affected by changes in metal bioavailability. As shown in Table 11.6, LOAEL-based HQs (using the 95% UCL) are ≥ 1 for all metal COCs, even when bioavailability is assumed to equal 25% in sediments or soils. Results for Tito Park and the Eastern site perimeter (not shown in Table 11.6) would be similar as soil concentrations are generally equal to or higher than those from Lower Lake. In addition, it was originally assumed that 100% of mercury in soils and sediments was present as methylmercury. If it is assumed that MeHg is present at 50% of the total mercury concentration, than the LOAEL-based HQs remain elevated. For example, if MeHg comprised 50% of the total mercury concentration and is assumed to be 50% bioavailable in soils, LOAEL-based HQs (using the 95% UCL) for a shrew would be 1 (Prickly Pear Creek), 4 (Upper Lake/Marsh), 9 (Lower Lake), 3 (Tito Park), 4 (East Perimeter), and 3 (West Perimeter). Thus, while bioavailability introduces additional uncertainty into the BERA, metal COC concentrations are such that risks would still be considered unacceptable even when assuming low metal bioavailablility. As such, additional data collection to define metal bioavilability in soils and sediments are not expected to change the conclusions of the BERA for wildlife receptors (*i.e.*, while the magnitude of risks would change, the same COCs would be identified).

Table 11.6
Uncertainty Analysis for Metal Bioavailabiltiy Assumptions

			Hazard Quotient (based on 95% UCL and LOAEL) for Varying Bioavailbility Fractions			
CSM Unit	**Receptor**	**Metal**	25%	50%	75%	100%
Prickly Pear Creek	Sandpiper	Cu	1	2	2	3
		Mn	4	8	11	14
		Pb	1	2	3	4
	Mink	Al	1	2	3	4
	Robin	Cu	1	2	3	4
		Mn	1	2	2	2
		Pb	3	6	9	12
		Se	2	3	4	5
	Shrew	Al	7	11	14	17
		Sb	1	2	3	3
		As	1	2	3	4
		Cu	1	2	2	3
		MeHg	1	2	2	3
		Se	2	3	4	5
Upper Lake/Marsh	Sandpiper	Cu	3	4	5	6
		Hg	1	2	3	4
		MeHg	3	6	9	12
		Mn	1	1	2	2
		Pb	8	13	19	25
		Se	1	1	2	2
	Mink	Al	2	3	4	6
		MeHg	1	3	4	6
	Robin	Cu	2	2	3	3
		Hg	2	2	2	3
		MeHg	3	4	5	6
		Pb	8	14	19	25
		Se	5	7	8	10
	Shrew	Al	38	44	51	57
		Sb	4	5	5	6
		As	2	3	4	5
		Cd	3	3	3	4
		Cu	2	2	2	3
		MeHg	4	7	10	13
		Pb	1	2	3	3
		Se	6	7	9	10
Wilson Ditch and West Site Perimeter	Sandpiper	Hg	2	3	4	6
		MeHg	4	9	13	17
		Mn	1	2	2	3
		Pb	2	3	5	7
	Mink	Al	1	2	3	4
		MeHg	2	4	6	8
	Robin	Cu	10	14	19	24
		Mn	2	3	4	5
		Pb	7	11	16	21
		Se	3	3	4	5
	Shrew	Al	34	40	46	52
		Sb	6	8	9	10
		As	2	3	4	6

CSM Unit	Receptor	Metal	Hazard Quotient (based on 95% UCL and LOAEL) for Varying Bioavailbility Fractions 25%	50%	75%	100%
		Cd	3	3	3	4
		Cu	9	13	16	19
		MeHg	3	3	4	4
		Pb	1	2	2	3
		Se	3	4	5	5
Lower Lake	Sandpiper	As	2	4	5	7
		Cd	3	6	9	11
		Cu	5	7	10	13
		Hg	1	1	2	2
		MeHg	2	3	5	6
		Mn	4	4	5	6
		Pb	21	37	53	70
		Se	25	47	70	92
		Tl	2	4	5	7
	Mink	Al	2	4	5	7
		Sb	4	7	11	14
		As	4	7	10	13
		Cd	1	2	3	3
		MeHg	1	2	2	3
		Se	4	8	12	16
		Tl	8	17	25	33
	Robin	Cd	1	1	2	2
		Cu	6	8	10	12
		Hg	1	1	1	2
		MeHg	3	4	4	5
		Mn	1	1	2	2
		Pb	11	19	26	34
		Se	4	4	5	5
	Shrew	Al	41	48	54	60
		Sb	8	10	11	13
		As	5	9	13	17
		Cd	4	4	4	5
		Cu	5	7	8	10
		MeHg	9	11	12	14
		Pb	2	3	3	4
		Se	5	6	6	7
		Tl	2	3	3	3

Arsenic Exposure Estimates

Arsenic speciation is an important factor to consider when interpreting exposure and risk to wildlife species. Arsenic species were measured in game fish at the site to primarily address human health issues (Table 11.5). However, As speciation is also relevant to the BERA due to the differences between total As concentrations and total inorganic As concentrations. Wildlife TRVs as well as TRVs for other ecological receptors are typically developed from literature studies that use inorganic As salts in the exposure medium, as is the case in this BERA. Risk assessments typically conservatively assume that the total As (inorganic and organic) concentration is equivalent to the inorganic As fraction. Data collected from the site in 2010 show that fish tissue concentrations contain < 10% inorganic As compared to total As (Table 11.7). This relationship is potentially similar across other environmental media. Therefore, exposure estimates using total As (as conducted herein) and compared to TRVs for inorganic As are expected to overestimate ecological risks.

Table 11.7
Total and Inorganic Arsenic in Fillet Tissues from Game Fish Collected in 2010

Location	Mean Total As Concentration (mg/kg dw)	Mean Inorganic As Concentration (mg/kg dw)
Prickly Pear Creek (Upstream)	0.43	0.009
Prickly Pear Creek (On-Site)	0.28	0.023
Upper Lake and Marsh	0.13	0.008
Walker Creek (Pond and Marsh)	0.33	0.021

Note:

See Appendix B, Table B-12, for raw data.

Methylmercury Exposure Estimates

Methylmercury was assumed to be 100% of the measured total Hg concentration for most media (*e.g.*, soil, sediment, plants, and fish). However, direct measurements of MeHg were obtained from several samples of benthic invertebrates, other aquatic invertebrates, earthworms, and other terrestrial invertebrates. The fraction of MeHg as a percent of total Hg ranged from 1-57% and 1-20% in aquatic and terrestrial invertebrates, respectively (see Appendix B). Clearly, the assumption that 100% of the total Hg is MeHg is overly conservative. Therefore, risk estimates based on total Hg concentrations (*i.e.*, sediments, soils, plants, and fish) are likely overestimated.

Exposure Factors

The intake of metals from site media was based on generalized literature information (US EPA, 1993; Nagy *et al*., 2001). These exposure assumptions are uncertain because they do not account for site and species-specific intake rates. Therefore, the amount of environmental media consumed by the representative wildlife receptors evaluated in the BERA may not be accurate. In addition, it was assumed that a hypothetical receptor feeds only on prey items from each of the CSM units and does not obtain food from other CSM units or outside of the study area (*e.g.*, area use factor of 1.0). While this assumption may be relevant for some species, it is not likely accurate for all species. In general, the exposure assumptions are intended to be conservative; however, the accuracy of the exposure assumptions remains uncertain.

Toxicity Benchmarks

An important source of uncertainty in the risk estimates for terrestrial wildlife receptors are the NOAEL- and LOAEL-based TRVs. This uncertainty is due to the availability of toxicological data and the representativeness of the species investigated in the toxicity studies. For some metals investigated in this BERA, available toxicity data is limited to a few studies and a few toxicological endpoints. Therefore, the toxicity values may not be representative of all species. While developing TRVs for use in this BERA (Appendix C), it was necessary to make assumptions regarding the doses eliciting adverse effects and assumptions in the intake of the test organisms. For some metals (*e.g.*, Ba, Co, Ag, Tl), uncertainty factors were applied to extrapolate from LOAELs to NOAELs. Finally, the test compounds are typically soluble metal salts, which may not be entirely representative of metal forms found at the site. For these reasons, interpretation of the TRVs and the resulting risk estimates should be carefully considered.

Aluminum was found to exceed NOAELs/LOAELs for several receptors, however, these toxicity benchmarks were derived from soluble ionic Al salts (see Appendix C) and likely not similar to forms present in the environment. Further, Al concentrations were generally not significantly different between the Facility and reference areas (see Appendix E). Therefore, although risk estimates for Al were elevated for some receptors, these estimates are expected to be overestimates and not reflective of historical Facility activities.

Organism *versus* Population Risks

In the BERA, effects (*i.e.*, survival growth, or reproduction) on individual organisms were conservatively used to represent population-level effects (Suter *et al*., 2005). This approach is conservative and a conventional practice in ecological risk assessment; however, extrapolation from organism-level effects to population-level effects is a source of uncertainty. When individual-level endpoints are not identified through the risk assessment process, it is assumed that populations are protected. However, when individual-level risk estimates are identified, one cannot assume a proportional risk at the population level. Because of compensatory or depensatory mechanisms, and multiple feed-back loops, populations can balance the loss of individual organisms (Suter *et al*., 2005). Generally, the likelihood that a chemical with a limited spatial distribution of toxicological benchmark exceedances poses risks to populations is considered low. Chemicals with broad distributions and elevated magnitudes of toxicological benchmark exceedances have a greater potential for posing population-level risks. The risk estimates provided in this BERA are predictive of individual-level effects and, therefore, direct extrapolation to populations should be considered uncertain.

11.3 Weight-of-Evidence Summary and Conclusions

The potential risks to birds and mammals posed by metal COPCs in environmental media were examined using several lines of evidence (Table 11.8). A dietary assessment was conducted for several aquatic and terrestrial wildlife receptors and daily COPCs doses were compared to NOAEL- and LOAEL-based TRVs. A summary of the risk characterization is provided by CSM unit:

- **Prickly Pear Creek**: Risk estimates for most aquatic and terrestrial receptors were generally low (HQ < 10) based on a total dietary assessment. The primary risk drivers included Sb, As, Cu, Hg, MeHg, Pb, and Se. However, most risk estimates are driven by incidental ingestion of sediments or soils that were assumed to be 100% bioavailable. The habitats surrounding Prickly Pear Creek contain a diversity of vegetation and terrain and a number of birds and mammals were observed in this area. Generally, the current data suggest that risks are considered low to moderate in the Prickly Pear Creek CSM unit.
- **Upper Lake and Upper Lake Marsh**: Risk estimates for Upper Lake and Upper Lake Marsh were typically higher than in the Prickly Pear Creek CSM unit, and risk drivers included Sb, As, Cd, Cu, Hg, MeHg, Pb, Se, Tl, and Zn. In addition, risks from Hg and MeHg were generally higher than other CSM units, owing to higher total Hg concentrations identified in various environmental media. Potential risks in Upper Lake and Upper Lake Marsh are considered moderate and metal concentrations are elevated in the area next to the Facility (north side of the Lake).

- **Wilson Ditch/Site Perimeter (west)**: Metal concentrations in Wilson Ditch are typically lower than Upper Lake Marsh, and the risk drivers include Sb, As, Cd, Cu, Hg, MeHg, Pb, and Se. Soil concentrations are elevated in western portion of the site perimeter, resulting in elevated risk estimates for terrestrial receptors based on the assumption of 100% metal bioavailability. Habitat in this area is limited as the land use is primarily pasture land and industrial uses. Wildlife risks in this area are considered low to moderate and primarily from terrestrial upland media exposure routes.
- **Lower Lake/Tito Park**: Metal concentrations tend to be elevated over other CSM units in Lower Lake and Tito Park and, accordingly, risk estimates are elevated. Most metals have HQs greater than 1.0 and some greater than 10, depending on the metal and receptor evaluated. Risk drivers include Sb, As, Cd, Cu, Pb, Hg, MeHg, Se, Tl, and Zn. As is the case for other CSM units, sediment and soil ingestion comprise a large portion of the overall risk, which is likely overestimated due to the varying assumptions applied in the dietary assessment. Risks to wildlife in this area are considered moderate to high; however, habitat quality in this area is poor and likely not attractive for most wildlife species.
- **Site Perimeter (east)**: The site perimeter on the eastern side of the Facility contains elevated metal concentrations commensurate with the prevailing wind direction. Risk drivers in this CSM unit are Sb, As, Cd, Cu, MeHg, Pb, and Se. Soil ingestion and the assumption of 100% metal bioavailability are the predominant factors that drive estimated wildlife risks. Habitat quality is poor in some parts of this area; however, Prickly Pear Creek is adjacent to this area providing cover for wildlife foraging in this area.

Potential risk results for wildlife (birds and mammals) can be summarized as follows:

- Sb, As, Cu, Hg, MeHg, Pb, and Se are COCs in all CSM units;
- Cd, Tl, and Zn are COCs in some CSM units; and
- Al, Ba, Be, Cr, Co, Fe, Mn, Ni, Ag, and V are metals that pose negligible risks (due to minimal or no predicted toxicity or no significant differences from reference areas) in the CSM units.

Table 11.8
Weight-of-Evidence Analysis for Aquatic and Terrestrial Birds and Mammals

		Weight-of-Evidence Evaluation[a]			
CSM Unit	**Lines of Evidence**	**-**	**0**	**+**	**COC(s)[b]**
Prickly Pear Creek (Riparian Zone)	Aquatic Wildlife Risk Determination			+	Cu, Hg, MeHg, Pb
	Terrestrial Wildlife Risk Determination			+	Sb, As, Cu, Hg, MeHg, Pb, Se
	Site Environmental Media *vs.* Reference	-[c]		+	
Upper Lake and Marsh (Bank Soils)	Aquatic Wildlife Risk Determination			+	Cu, Hg, MeHg, Pb, Se
	Terrestrial Wildlife Risk Determination			+	Sb, As, Cd, Cu, Hg, MeHg, Pb, Se
	Bird Egg Concentrations	-			
	Site Environmental Media *vs.* Reference	-[c]		+	
Tito Park and Lower Lake	Aquatic Wildlife Risk Determination			+	As, Cd, Cu, Hg, MeHg, Pb, Se, Tl
	Terrestrial Wildlife Risk Determination			+	Sb, As, Cd, Cu, Hg, MeHg, Pb, Se, Tl, Zn
	Bird Egg Concentrations	-			
	Site Environmental Media *vs.* Reference	-[c]		+	
Site Perimeter (East)	Aquatic Wildlife Risk Determination			+	Sb, As, Cd, Cu, Hg, MeHg, Pb, Se
	Terrestrial Wildlife Risk Determination			+	
	Site Environmental Media *vs.* Reference	-[c]		+	
Wilson Ditch and Site Perimeter (West)	Aquatic Wildlife Risk Determination			+	Hg, MeHg, Pb
	Terrestrial Wildlife Risk Determination			+	Sb, As, Cd, Cu, Hg, MeHg, Pb, Se
	Site Environmental Media *vs.* Reference	-[c]		+	

Notes:

(a) Weight of evidence:
"-" data indicate that metals are not expected to pose unacceptable risk.
"0" – data do not support a conclusion regarding potential risk.
"+" – data indicate that metals are expected to pose an unacceptable risk.
(b) COCs – the primary metals contributing to risk are noted based on multiple lines of evidence (i.e., $HQ_{LOAEL}>1$ and greater than reference area).
(c) Concentrations of Al, Ba, Be, Cr, Co, Fe, Mn, Ni, and V were not significantly elevated compared to reference areas.

12 Baseline Ecological Risk Assessment Summary and Conclusions

12.1 Overview

The Facility is located in East Helena, Montana. The Facility operated from 1888 to 2001 and produced Pb bullion from smelting of a variety of foreign and domestic concentrates, ores, fluxes, and other non-ferrous metal-bearing materials. For more than twenty years, extensive site clean-up activities have been undertaken at the Facility, including the demolition of numerous structures. This BERA was conducted as part of the Phase II RFI and was prepared in general accordance with US EPA guidance documents (US EPA, 1997, 1998, 1999a, 2007) and site investigation work plans (Gradient, 2010; Hydrometrics, 2010). The BERA follows the eight-step risk assessment process set forth by US EPA (1997). The objectives of the BERA were to:

1. Evaluate the likelihood for potential risks (if any) posed by metals to aquatic and terrestrial ecological receptors within the study area; and
2. Provide risk managers with information that will aid in remediation or cleanup efforts to protect ecological resources present or likely to be present at the site.

The BERA provides a baseline analysis of current conditions and current potential risks. Future land use has not been determined but is likely to include one or more of the following: industrial uses, commercial uses, recreational or open spaces, or agricultural uses. Elevated metal concentrations have been identified in surface water, sediment, surface soil, and groundwater at the site, primarily as a result of deposition from historical stack and fugitive emissions, slag, and process water. The primary COPCs are metals/metalloids, including: Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn.

The study area evaluated in the BERA is comprised of several distinct ecological units (developed as part of the CSM and termed "CSM Units") that are on or adjacent to the Facility: Prickly Pear Creek, Upper Lake and Marsh, Wilson Ditch, Lower Lake, Tito Park, Eastern Perimeter and Western Perimeter (Map 2). Prickly Pear Creek lies to the east and northeast of the Facility and has been a source of water for agriculture, mining, and industrial uses for more than a century. Upper Lake (at the extreme southern end of the Facility) is fed through diversion of flow from Prickly Pear Creek. Upper Lake discharges *via* return flow to Prickly Pear Creek, seasonal discharge to Wilson Ditch, and subsurface leakage to the local groundwater system. Wilson Ditch is a seasonal agricultural irrigation ditch extending from Upper Lake northwestward towards the Helena Valley. The Eastern and Western Perimeter surrounding the Facility consists primarily of agricultural and rangeland. The area on the Facility between Upper and Lower Lake is called Tito Park. The soil in this area is very compacted, sparsely vegetated and has been covered with a soil cap. The BERA examined potential risks to ecological receptors expected to inhabit each of the aforementioned CSM units.

12.2 Weight-of-Evidence Approach

A number of ecological investigations have been conducted at the Facility which provided a substantial amount of information to support the ERA process. These data include evaluations of metal concentrations in sediment, soil, surface water, porewater, and biotic tissues (*e.g.*, fish, invertebrates, amphibians, and bird eggs). In addition, habitat evaluations and/or toxicity bioassays have been performed within each of the CSM units. In order to provide a robust risk analysis, each of these datasets were evaluated using a weight-of-evidence approach. The primary elements of this approach include: predictive risk estimates using a HQ approach, site-specific toxicity studies, direct observations of ecological receptor habitat and presence, and comparisons to reference areas outside the influence of the Facility. Each line of evidence has distinct advantages and limitations. The results from each of the lines of evidence were considered, the strengths and weaknesses of each method examined, and subsequently combined to provide reliable risk conclusions. For example, if several lines of evidence yield concordant results, then conclusions can be determined with greater confidence. Further, if conflicting results are identified then the lines of evidence are reviewed and discrepancies or uncertainties are examined to identify which line of evidence provides the most reliable conclusion. The results of the weight-of-evidence analysis are described below for the aquatic and terrestrial communities with a focus on those metals that are the primary risk drivers. Primary risk drivers or COCs are those metals/metalloids with multiple lines of evidence consistently indicating a potential risk to the ecological receptor groups evaluated in the BERA.

12.3 Aquatic Community

The survival, growth, and reproduction of several aquatic ecological receptor groups were examined, including: benthic invertebrates, fish, amphibians, aquatic plants, and aquatic-dependent wildlife. For each receptor group, several lines of evidence were investigated to characterize potential risks in the aquatic units on and near the Facility (*i.e.*, Prickly Pear Creek, Upper Lake and Marsh, Wilson

Ditch, and Lower Lake). The BERA process for aquatic communities was initiated with a refined screening level risk assessment to remove COPCs that are unlikely to pose ecological risks and therefore can be safely removed from further consideration in the BERA. Next, the BERA used a weight-of-evidence approach to characterize risks to each aquatic ecological receptor group and for each CSM unit. A summary of this is presented in Table 12.1.

Prickly Pear Creek

Benthic invertebrate communities were examined in Prickly Pear Creek using several lines of evidence. Comparison of sediment concentrations to SQGs indicated potential risks for As, Hg, Mn, Pb, and Zn. Evaluation of metal bioavailability (*i.e.*, SEM/AVS) in sediments indicated low risks from exposure to SEM metals in Prickly Pear Creek. In addition, sediment toxicity test results (using *Hyalella azteca* and *Chironomus dilutus*) only found sediment toxicity at one location and only in one of the two test species. Further, none of the onsite sediment concentrations were significantly greater than at upstream reference locations. Comparison of surface water and porewater concentrations to water quality criteria indicated potential risks for Cd, Hg, Pb, and Ag. Evidence of groundwater inputs from Lower Lake to Prickly Pear Creek were identified from piezometer readings showing elevated concentrations of As and Zn. However, Prickly Pear Creek surface water concentrations of As and Zn did not exceed surface water criteria. Concentrations of As, Mn, and Pb in Prickly Pear Creek surface water were significantly elevated above reference concentrations. Benthic invertebrate tissue concentrations of some metals (Sb, Hg, Pb, Ag, and V) were also elevated above reference. Overall, predicted risk estimates for Prickly Pear Creek indicated a low potential for risk to benthic invertebrates and concentrations of most metals were consistent with concentrations at reference locations. Cadmium, Hg and Pb are the primary COCs for benthic invertebrates in Prickly Pear Creek.

The risk characterization for other aquatic receptors (fish, aquatic plants, and amphibians) in Prickly Pear Creek concluded that Cd, Hg, Pb, and Ag exceed water quality criteria. Fish tissue and fish prey item concentrations did not indicate exceedances of adverse effect thresholds. However, Hg and Pb concentrations in fish and amphibian tissues were elevated above reference area concentrations. Several metals were found to exceed toxicity benchmarks for amphibian species and Hg was consistently identified as a COC. Risks to aquatic-dependent wildlife (*e.g.*, mallard, belted kingfisher, sandpiper, and mink) were generally low and potential risks were indicated for Cu, Mn, and Pb, primarily through incidental sediment ingestion.

Potential risks to aquatic receptors from exposure to metals in Prickly Pear Creek are considered low to moderate. While several metals had minor benchmark exceedances for at least one line of evidence, Cd, Hg, and Pb consistently indicated a potential risk to aquatic receptors. Groundwater transport from Lower Lake provides a source of metals to Prickly Pear Creek, particularly As. Concentrations of Hg in Prickly Pear Creek are elevated in some aquatic biota and surface water. Thus, the primary COCs for most aquatic receptors in Prickly Pear Creek are Cd, Hg and Pb. Other metals that may pose a low risk to one or more aquatic receptors are As, Cu, Mn, Ag, and Zn.

Table 12.1
Summary of the BERA for Aquatic-Dependent Ecological Receptors

CSM Unit	**Potential Risks**			**COCs[a]**	**Primary Exposure Medium[b]**
	Negligible	**Low/Moderate**	**High**		
Prickly Pear Creek	Al, Sb, Ba, Be, Co, Cr, Fe, Mn, Ni, Ag, Tl, V	As, Cd, Cu, Mn, Hg, MeHg, Pb, Ag, Zn	None	Cd, Pb, Hg	Sediment, Surface Water
Upper Lake and Upper Lake Marsh	Al, Ba, Be, Co, Cr, Fe, Ni, Tl, V	Sb, As, Cd, Cu, Mn, Se, Ag, Zn	Hg, Pb	As, Cd, Cu, Hg, Pb, Ag, Zn	Sediment
Wilson Ditch	Al, Sb, Ba, Be, Co, Cr, Cu, Fe, Mn, Ni, Se, Tl, V	As, Cd, Ag, Zn	Hg, Pb	Cd, Hg, Pb	Sediment, Surface Water
Lower Lake	Al, Ba, Be, Co, Cr, Fe, Mn, Ni, V	Ag, Tl, Zn	Sb, As, Cd, Cu, Hg, Pb, Se	Sb, As, Cd, Cu, Hg, Pb, Se	Sediment

Notes:

(a) COCs that consistently indicate potential risks for multiple receptors and multiple lines of evidence.
(b) The exposure medium that provides the most significant contribution to the overall predicted risks.

Upper Lake and Upper Lake Marsh

Benthic invertebrate communities were examined in Upper Lake and Upper Lake Marsh using several lines of evidence. Comparison of sediment concentrations to SQGs indicated potential risks for Sb, As, Cd, Cu, Hg, Pb, Ag, and Zn. Evaluation of metal bioavailability (*i.e.*, SEM/AVS) in sediments confirmed that Cd, Cu, Pb, and Zn may pose risks to benthic invertebrates at several locations (particularly the northern edge adjacent to Lower Lake; see Map 8). Concentrations of several metals in Upper Lake and Upper Lake Marsh were significantly elevated above reference concentrations, including metals for which potential risks were predicted. Limited toxicity testing was conducted in Upper Lake and Upper Lake Marsh and results of these tests did not provide evidence of sediment toxicity to benthic invertebrates.

Surface water and porewater evaluations indicated that Cd, Pb, and Ag pose a potential risk to aquatic receptors (*i.e.*, aquatic plants, fish, amphibians, and invertebrates) and concentrations of As, Cd, Pb, and Zn were elevated above reference concentrations. Fish tissue concentrations of Hg were below toxicity thresholds but greater than reference concentrations. Lead concentrations in sediments are at a level that may pose risks to fish *via* the dietary pathway (*i.e.*, incidental ingestion). Several metals, particularly Cd, Hg, and Pb, in sediments, dietary items, and tissues of amphibians indicated a potential risk to amphibian species inhabiting Upper Lake and Upper Lake Marsh. Risks to aquatic-dependent wildlife (*e.g.*, mallard, belted kingfisher, sandpiper, and mink) were generally low and potential risks were indicated from exposure to Cu, Hg, Mn, Pb, and Se and primarily through incidental sediment ingestion.

Potential risks to aquatic receptors from exposure to metals in Upper Lake and Upper Lake Marsh are considered low to moderate. While several metals had minor toxicological benchmark exceedances for at least one line of evidence, As, Cd, Cu, Hg, Pb, Ag, and Zn consistently indicated a potential risk to aquatic receptors. Concentrations of Se in sediment and tissues were greater than reference concentrations but below toxicity thresholds. Consequently, these metals are considered COCs in the Upper Lake and Marsh CSM Unit.

Wilson Ditch

The risk characterization for Wilson Ditch was generally similar to that of Upper Lake and Upper Lake Marsh due to the hydrologic connection between these two CSM Units. Comparison of sediment concentrations to SQGs indicated potential risks to benthic invertebrates for As, Cd, Hg, Pb, Ag, and Zn. Evaluation of metal bioavailability (*i.e.*, SEM/AVS) indicated potential risks to benthic invertebrates from exposure to Cd, Pb, and Zn at several locations. Concentrations of As, Cd, Hg, Mn, Pb, Ag, and Zn in either sediment or surface water were significantly greater than reference concentrations. No toxicity bioassays have been conducted in Wilson Ditch.

Cadmium and Pb were the only metals to exceed surface water quality criteria for aquatic receptors in Wilson Ditch. Limited tissue residue samples were collected from Wilson Ditch, however, these data did not indicate a risk to fish. As, Cd, Hg, Pb, Ag, and Zn in sediment and Hg in prey items were found to pose a potential risk to amphibian species. Mercury was also consistently identified as a risk driver for aquatic-dependent wildlife (*e.g.*, mallard, belted kingfisher, sandpiper, and mink) along with Mn (Sandpiper only) and Pb through incidental sediment ingestion.

Potential risks to aquatic receptors from exposure to metals in Wilson Ditch are considered low to moderate. Additionally, Wilson Ditch provides seasonal habitat for aquatic receptors since water flows only during the irrigation season (approximately April-September). The primary COCs for most aquatic receptors in Wilson Ditch are Cd, Hg and Pb. Other metals that may pose a low risk to one or more aquatic receptors are As, Mn, Ag, and Zn.

Lower Lake

Metal concentrations in abiotic and biotic media of Lower Lake are considerably greater than metal concentrations in other CSM units or reference areas and, therefore, elevated risks were identified based on several lines of evidence. Comparison of sediment concentrations to SQGs indicated potential risks to benthic invertebrates from exposure to Sb, As, Cd, Cu, Hg, Pb, Ag, and Zn. Evaluation of metal bioavailability (*i.e.*, AVS/SEM) in sediments confirmed potential risks to benthic invertebrates from exposure to Cd, Cu, Pb, and Zn. Based on limited toxicity test data (using *Hyalella azteca*) borderline sediment toxicity was observed in Lower Lake. Metals indicating potential risks to benthic invertebrates were also present at significantly greater concentrations than those in reference areas. Comparison of surface water and porewater concentrations to water quality criteria indicated potential risks from Sb, As, Cd, Pb, Ag, Se, and Tl. Concentrations of As, Cd, and Pb were significantly greater in Lower Lake than reference concentrations. Benthic invertebrate tissue concentrations of several metals (Sb, As, Cd, Hg, Pb, Ag, Se, Tl and Zn) were also elevated in Lower Lake compared to reference tissue concentrations. Overall, sediment, surface water and tissue metal concentrations indicate a moderate to high potential for risk to benthic invertebrates in Lower Lake.

The risk characterization for other aquatic receptors (fish, aquatic plants, and amphibians) concluded that Sb, As, Cd, Pb, Ag, Se, and Tl in surface waters exceeded water quality criteria. Fish tissue and fish prey item concentrations indicated potential risks to fish from exposure to Se (tissue) and As, Cd, and Pb (prey items). Several metals were found to exceed toxicity thresholds for amphibian species and Cd, Hg, and Pb were consistently identified as risk drivers. Risks to aquatic-dependent wildlife (*e.g.*, mallard, belted kingfisher, sandpiper, and mink) were generally moderate (HQs > 5) to high (HQs > 10) for Sb, As, Cd, Cu, Hg, Pb, Se, and Tl primarily through incidental sediment ingestion. The primary COCs for most aquatic receptors in Lower Lake are Sb As, Cd, Cu, Hg, Pb, and Se. Other metals that may pose a low to moderate risk to one or more aquatic receptors are Ag, Tl, and Zn.

12.4 Terrestrial Community

The survival, growth, and reproduction of terrestrial ecological receptor groups were examined for terrestrial plants, soil invertebrates, amphibians, and terrestrial birds and mammals. For each receptor group, several lines of evidence were investigated to characterize potential risks in riparian and terrestrial CSM units (*e.g.*, Prickly Pear Creek, Upper Lake and Marsh, Lower Lake, Tito Park, and East Site Perimeter and West Site Perimeter). The BERA process for terrestrial communities was initiated with a refined screening level risk assessment to remove COPCs that are unlikely to pose ecological risks and therefore can be safely removed from further consideration in the BERA. Next, the BERA used a weight-of-evidence approach to characterize risks to each aquatic ecological group and for each CSM unit. A summary of this is presented in Table 12.2.

Prickly Pear Creek Riparian Areas

The riparian areas of Prickly Pear Creek were characterized based on soil and tissue chemistry data. Soil chemistry evaluations for terrestrial receptors (*e.g.*, plants, invertebrates, and wildlife) consistently indicated elevated risks from exposure to Sb, As, Cu, Hg, Pb, and Se. Concentrations of Sb, As, Cd, Cu, Hg, Pb, Ag, Tl, and Zn in soils and earthworm tissues were significantly greater than reference area concentrations. Dietary exposure analyses for amphibians and terrestrial birds and mammals consistently identified Sb, As, Hg, and Se as risk drivers and incidental soil ingestion was the primary contributor to estimated total risks.

Relative to other CSM units, the potential risks from metal exposure to terrestrial receptors near Prickly Pear Creek are considered low. Concentrations of most metals result in low predicted risks (HQs < 5), although concentrations of some metals (*e.g.*, Hg, Pb, Se) for some receptors result in moderate to high predicted risks (HQs > 10). It should be noted that metals in soils were assumed to be 100% bioavailable in the exposure assessment which is expected to result in overly conservative risk estimates. Based on the available evidence, the primary COCs for most terrestrial receptors in the Prickly Pear

Creek riparian zone are Sb, As, Cu, Hg, Pb, and Se. Other metals that may pose a low risk to one or more terrestrial receptors are Cd, Ag, Tl, and Zn.

Table 12.2
Summary of the BERA for Terrestrial Ecological Receptors

	BERA (Potential Risks)				
CSM Unit	**Negligible**	**Low/Moderate**	**High**	**COCs**[a]	**Primary Exposure Medium**[b]
Prickly Pear Creek	Al, Ba, Be, Co, Cr, Fe, Mn, Ni, V	Sb, As, Cd, Cu, Ag, Tl, Zn	Hg, Pb, Se	Sb, As, Cu, Hg, Pb, Se	Soil
Upper Lake and Upper Lake Marsh	Al, Ba, Be, Co, Cr, Fe, Mn, Ni, V	Sb, As, Cd, Cu, Ag, Tl, Zn	Hg, Pb, Se	Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, Zn	Soil
Lower Lake/ Tito Park	Al, Ba, Be, Co, Cr, Fe, Mn, Ni, V	Ag, Tl	Sb, As, Cd, Cu, Hg, Pb, Se, Zn	Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, Zn	Soil
Site Perimeter (East and West)	Al, Ba, Be, Co, Cr, Fe, Mn, Ni, V	Ag, Tl, Zn	Sb, As, Cd, Cu, Hg, Pb, Se	Sb, As, Cd, Cu, Hg, Pb, Se	Soil

Notes:

(a) COCs that consistently indicate potential risks for multiple receptors and multiple lines of evidence.
(b) The exposure medium that provides the most significant contribution to the overall predicted risks.

Upper Lake and Upper Lake Marsh Bank Soils

The banks of Upper Lake and Upper Lake Marsh were characterized based on soil and tissue chemistry data. In addition, several bird eggs were collected in the area between Upper Lake, Tito Park, and Lower Lake. Soil chemistry evaluations for terrestrial receptors (*e.g.*, plants, invertebrates, and wildlife) consistently indicated elevated risks from exposure to Sb, As, Cd, Cu, Hg, Pb, Se, Tl, and Zn. Concentrations of Sb, As, Cd, Cu, Hg, Pb, Ag, Tl, and Zn in soils and earthworm tissues were significantly greater than reference area concentrations. Dietary exposure to Cd, Hg, Pb, and Se indicated potential risks to amphibians and terrestrial birds and mammals. Metal concentrations in avian eggs were below available toxicity thresholds. Concentrations of Pb and Zn appear to be elevated in avian egg tissues, suggesting potential elevated exposure to these metals in the sampled area.

Potential risks of metals to the terrestrial community of Upper Lake and Upper Lake Marsh are considered moderate. Most metal concentrations result in low to moderate risks (HQs < 10), although some metal concentrations (*e.g.*, Hg, Pb, Se) for some receptors result in high predicted risks (HQs > 10). Risk estimates are likely overestimated due to the assumption of 100% metal bioavailability. Based on the available evidence, the primary COCs for most terrestrial receptors exposed to soils surrounding Upper Lake and Upper Lake Marsh are Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, and Zn.

Lower Lake Bank Soils and Tito Park Soils

Metal concentrations in soils and predicted risks for terrestrial receptors are generally similar for the Tito Park and Lower Lake CSM units. Soil chemistry evaluations for terrestrial receptors (*e.g.*, plants, invertebrates, and wildlife) consistently indicated elevated risks in both of these CSM units from exposure to Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, and Zn. Concentrations of these metals in soils were also significantly greater than reference area concentrations. Earthworm samples were unobtainable from Tito Park and Lower Lake, which is excepted to be due to the dry, compacted clay capped soils found in these areas. Thus, a reference comparison was not possible for soil invertebrate tissues. Risk predictions for wildlife from modeled dietary exposure consistently identified Sb, As, Cd, Cu, Hg, Pb, and Se as risk drivers. These risk estimates are largely driven by the incidental soil ingestion pathway and assumptions of 100% soil metal bioavailability. Metal concentrations in avian eggs collected in this area were below toxicity thresholds for Se and Hg, but Pb and Zn appeared to be elevated, suggesting potential elevated exposure to these metals.

Compared to the other CSM units, Tito Park and Lower Lake had the highest predicted risks for terrestrial receptors. HQs were consistently high (HQs > 10) for soil exposure pathways and for multiple terrestrial receptor groups. Risk estimates are likely overestimated due to the assumption of 100% metal bioavailability; however, some estimates would still be high even if significantly reduced metal bioavailability were assumed. Based on the available evidence, the primary COCs for most terrestrial receptors exposed to soils surrounding Tito Park and Lower Lake are Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, and Zn.

Site Perimeter Soils

The pattern of elevated metal concentrations in soils surrounding the Facility is generally similar to that observed for Lower Lake and Tito Park. Concentrations of Sb, As, Cd, Cu, Hg, Pb, Se, Ag, Tl, and Zn consistently exceeded soil toxicity benchmarks and reference area concentrations. Antimony, As, Cu, Hg, Pb, and Se generally have the highest risk predictions. Risk predictions for wildlife from modeled dietary exposure consistently identified Sb, As, Cd, Cu, Hg, Pb, and Se as risk drivers. These risk estimates are largely driven by the incidental soil ingestion pathway and assumptions of 100% bioavailability of metals in soils. Thus, risk estimates for terrestrial communities are moderate to high around the site perimeter. The primary COCs for most terrestrial receptors exposed to soils surrounding Tito Park and Lower Lake are Sb, As, Cd, Cu, Hg, Pb, and Se. Other metals/metalloids that may pose a low to moderate risk to one or more terrestrial receptors include: Ag, Tl, and Zn.

12.5 Uncertainties

An extensive dataset was available to evaluate the potential risks to aquatic and terrestrial ecological receptors. However, there were areas within the risk assessment that required conservative generic assumptions that could be examined further to refine the risk estimates. The following list provides a brief summary of these uncertainties:

- The nature and extent of contamination was adequately described for most environmental media examined in each of the CSM units assessed in this BERA. Limited data existed for aquatic and terrestrial plants and earthworms. Therefore, in some CSM units tissue concentrations were estimated using bioaccumulation models which were found to overestimate tissue concentrations. Plant tissues are not expected to be a primary source of metals for the ecological receptors under consideration. The results presented herein provide an overestimate of risks for CSM units where plant and earthworm tissue concentrations were estimated using bioaccumulation models.
- The exposure assessment relied on assumptions that tend to overestimate exposure and risk. The primary source of uncertainty in the exposure analysis lies in the assumption of 100% bioavailability of metals from environmental media such as sediments and soils. Bioavailability considerations are critical for metals risk assessment since large proportions of metals may be bound to the soil/sediment matrix and unavailable to the receptor or target organ (US EPA, 2007). The available data (*i.e.*, SEM/AVS, toxicity bioassays, tissue concentrations, and soil extractions) suggest that a portion of metals found at the site are unavailable. Therefore, risk estimates based on sediment and soil contact or ingestion pathways are overestimated. Additional bioavailability analyses on sediments and soils would aid in the description of current conditions at the site.
- A number of lines of evidence for exposure to MeHg and Se were investigated in the risk assessment. These include sediment, soils, invertebrate tissues, fish tissues, amphibian tissues, and avian egg tissues. Risk estimates for MeHg and Se were often identified based on soil and sediment contact and ingestion pathways (assuming 100% bioavailability), however, tissue concentrations of these metals generally identified low concentrations and low risk predictions. Bioavailability estimates for MeHg and Se could aid in the interpretation of the risk estimates. Further, the avian eggs collected from the site did not include samples from piscivorus or aquatic-dependent species, thus accumulation of MeHg and/or Se in top-level predators foraging in aquatic environs at the site remains uncertain.

- The toxicity benchmarks used to characterize adverse effects to ecological receptors for some metals were based on limited data and may not reflect site-specific conditions. For example, some water quality benchmarks were based on methods that relied on small datasets and conservative safety factor adjustments. Thus, risk estimates for these metals in surface waters (*e.g.*, Ag, Tl, and V) are uncertain. CBRs and dietary toxicity benchmarks were also compiled to characterize risks to fish populations. These benchmarks are also uncertain due to limited datasets and difficulties with extrapolating effects from the toxicity literature. Finally, a review of amphibian toxicological literature was conducted to identify relevant toxicity benchmarks to evaluate this receptor group. While a large and growing body of toxicological literature is available for amphibians, standardized assessment methods are lacking and limited chronic toxicological data are available for most of the metals examined herein. Therefore, the risk results for amphibians are uncertain.
- Finally, the BERA examined effects on individual organisms which are conservatively used to represent population-level effects in the risk assessment process (Suter *et al.*, 2005). However, extrapolation from organism-level effects to population-level effects is a source of uncertainty. When individual-level endpoints are not identified through the risk assessment process, it is assumed that populations are protected. However, when individual-level risk estimates are identified, one cannot assume a proportional risk at the population level. Chemicals with broad distributions and elevated magnitudes of toxicological benchmark exceedances generally have a greater potential for posing population-level risks.

12.6 Conclusions

The BERA provided evidence that both the aquatic and terrestrial environments on and near the Facility are contaminated by mining-related wastes. Concentrations of several metals in sediments and soils are elevated to an extent that could pose a risk to ecological receptors. Specific conclusions regarding the impact of these elevated exposures are summarized below:

- Prickly Pear Creek provides a range of habitats for aquatic and terrestrial receptors and is relatively undisturbed, except near the Facility. The current concentrations of metals in Prickly Pear Creek and associated riparian areas appear to pose a low/moderate risk to the aquatic and terrestrial community. Further, metal concentrations in Prickly Pear Creek near the Facility are generally within the range of concentrations found outside of the influence of the Facility.
- The Upper Lake and Upper Lake Marsh area supports a diverse mix of habitats and ecological receptors. Metal concentrations are elevated in portions of this unit particularly at the north side, adjacent to Tito Park. Overall risk estimates for this area are low to moderate.
- Risks to ecological receptors from metal exposures in Wilson Ditch are low to moderate. Metal contamination is evident in this channel and concentrations are similar to those of its primary water source, Upper Lake. However, Wilson Ditch provides limited habitat

for aquatic receptors since water flows only during the irrigation season (approximately April-September).

- Lower Lake and Tito Park are man-made structures with very minimal vegetation or habitat available for ecological receptors. Lower Lake and Tito Park have significantly elevated concentrations of metals in aquatic and terrestrial environments. Metal concentrations in these areas pose a risk to most of the ecological receptors examined in this BERA. In addition, Lower Lake provides a source of metals to adjacent CSM units (*i.e.*, Upper Lake and Prickly Pear Creek). This area of the Facility may need to be prioritized for further remedial investigations and cleanup activities to reduce the transport of metals to surrounding ecological habitats.
- The East and West Perimeter of the Facility is characterized by elevated metal concentrations indicative of impacts from historic smelting activities. COPC concentrations are elevated above reference areas and are expected to pose a risk to terrestrial receptors. Overall ecological risks from soil exposure are high in this CSM unit and additional remedial activities may need to be undertaken to reduce exposure.
- The primary COCs for ecological receptors throughout most CSM units are As, Cd, Cu, Hg (and MeHg), Pb, and Se.
- Metals that could pose ecological risks in some CSM units of the Facility, particularly those closest to the Facility, are Sb, Mn, Ag, Tl, and Zn.
- Metals that generally pose negligible risks to ecological receptors and are not significantly elevated above reference areas are Al, Ba, Be, Cr, Co, Fe, Ni, and V.

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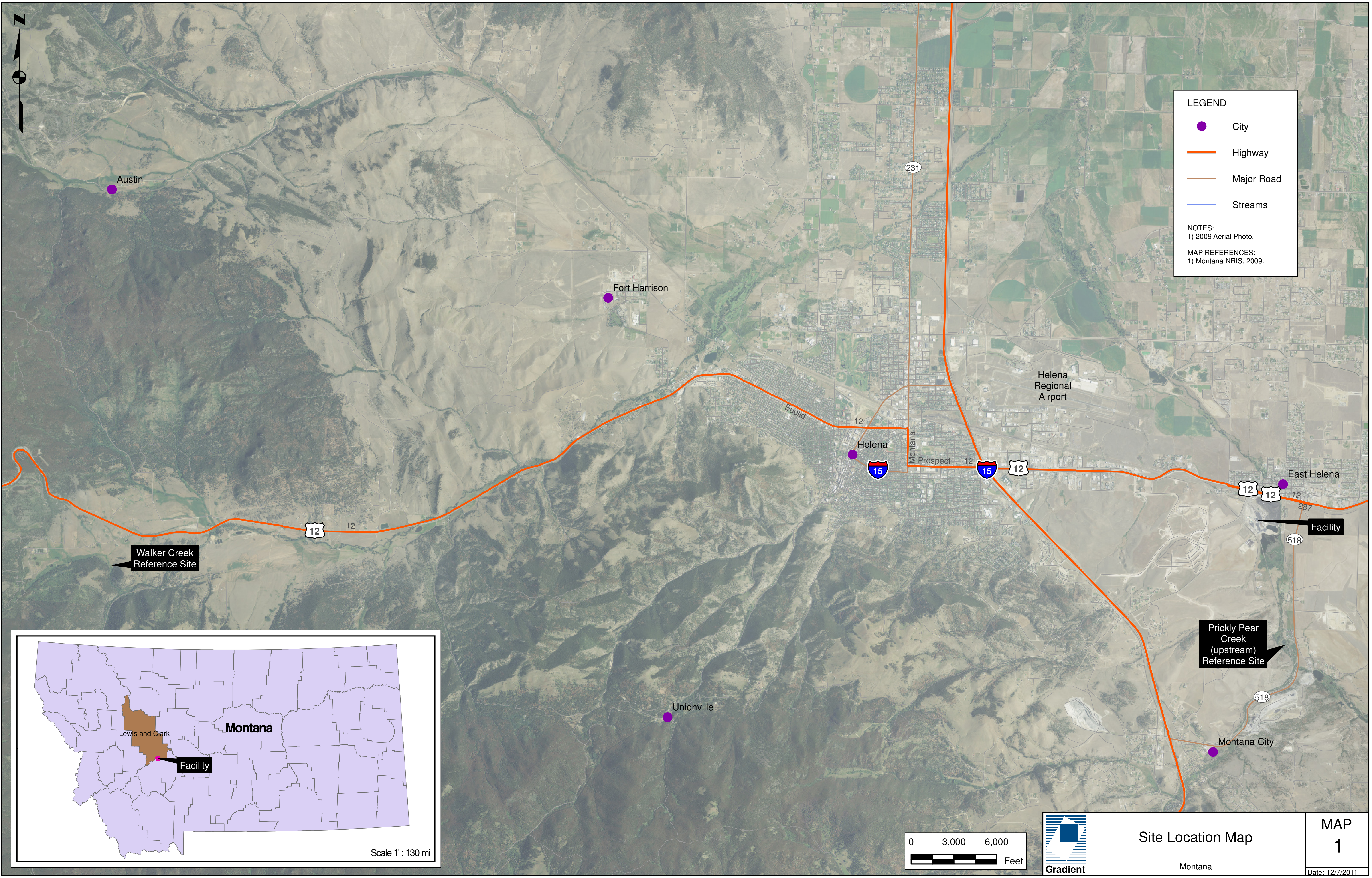
Maps



Site Location Map

Montana

MAP 1

Date: 12/7/2011

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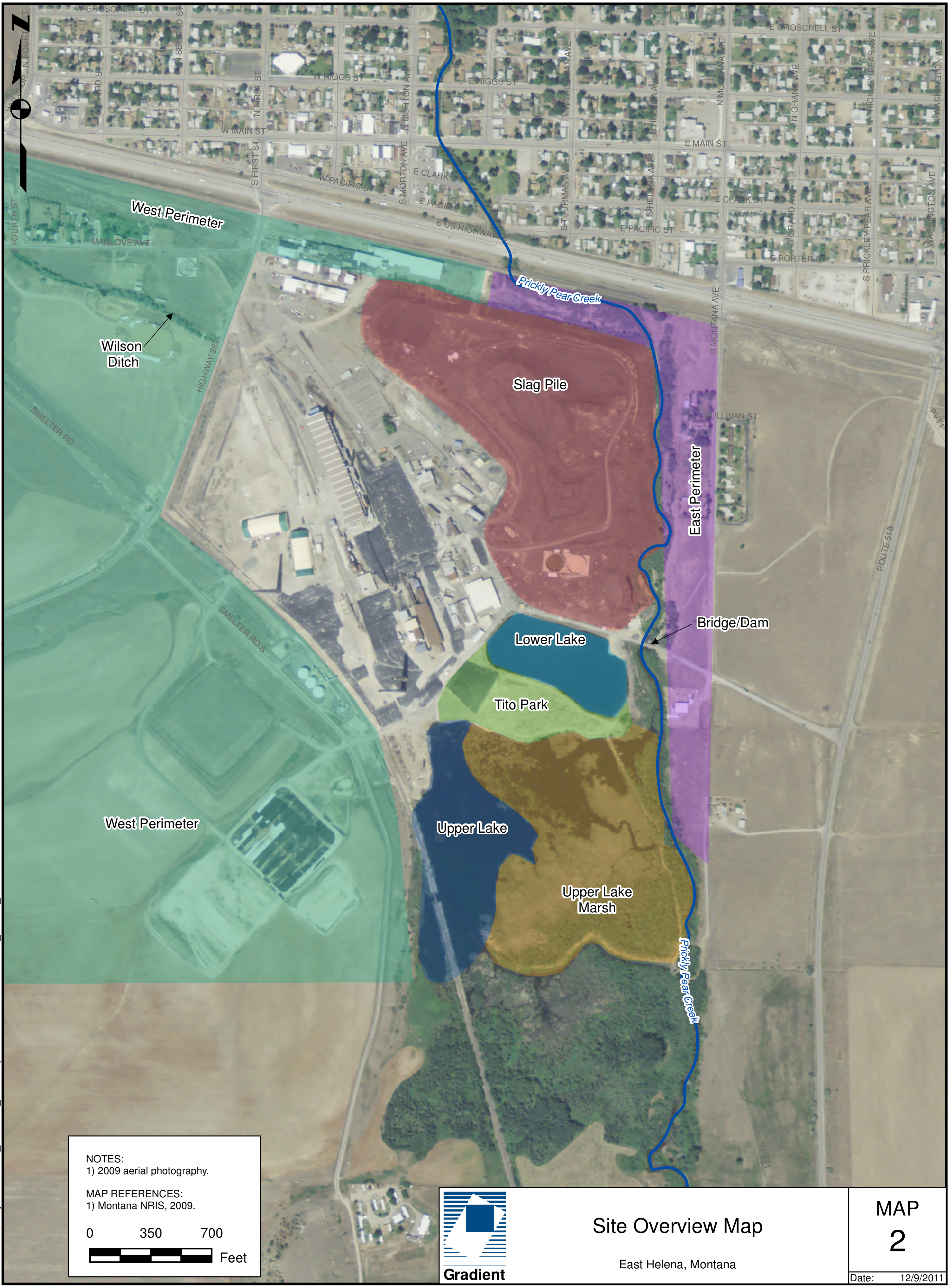


NOTES:
1) 2009 aerial photography.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

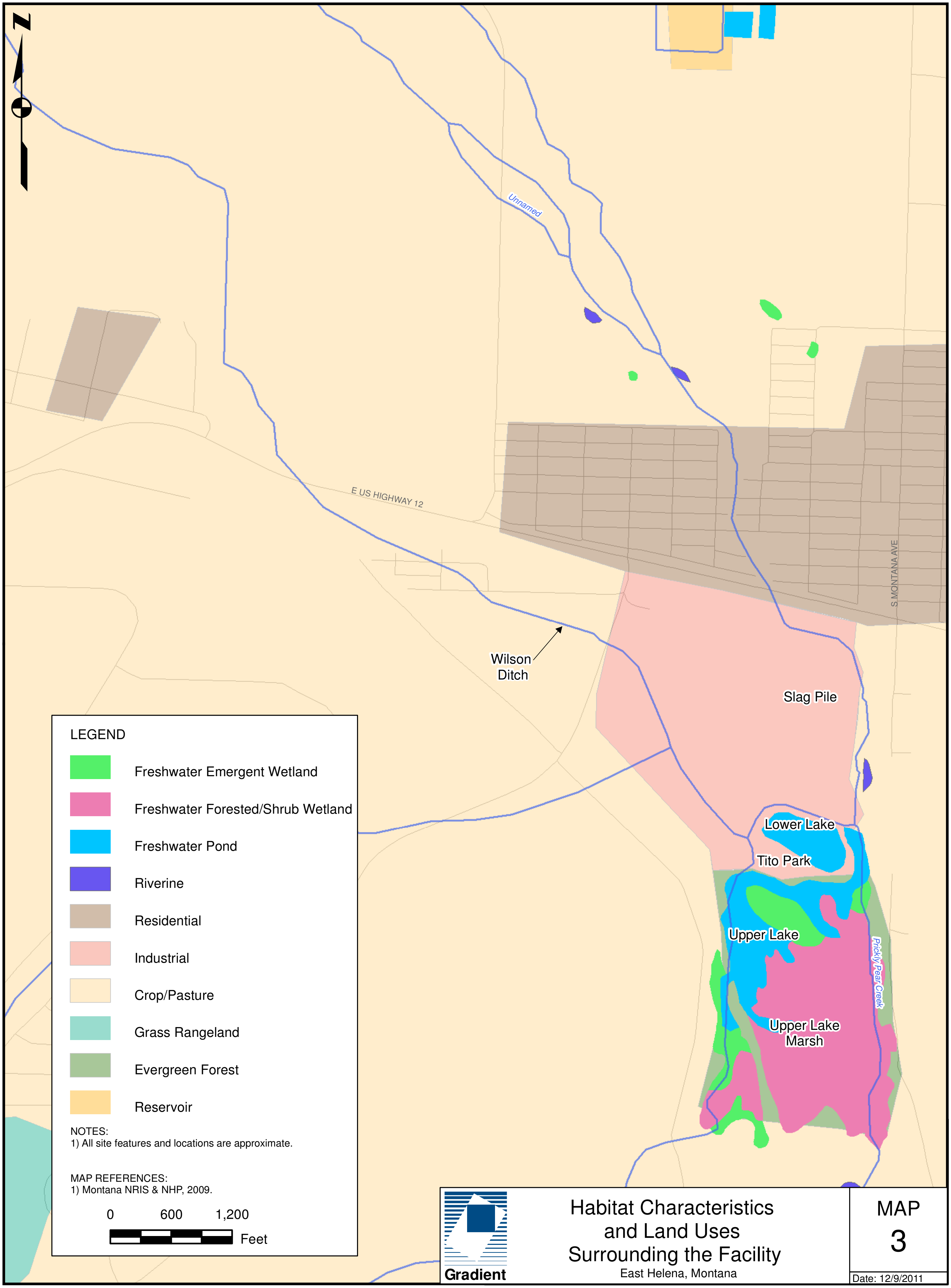
Site Overview Map

East Helena, Montana

MAP
2

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-11_SiteOverview.mxd



NOTES:
1) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS & NHP, 2009.

Gradient

Habitat Characteristics and Land Uses Surrounding the Facility

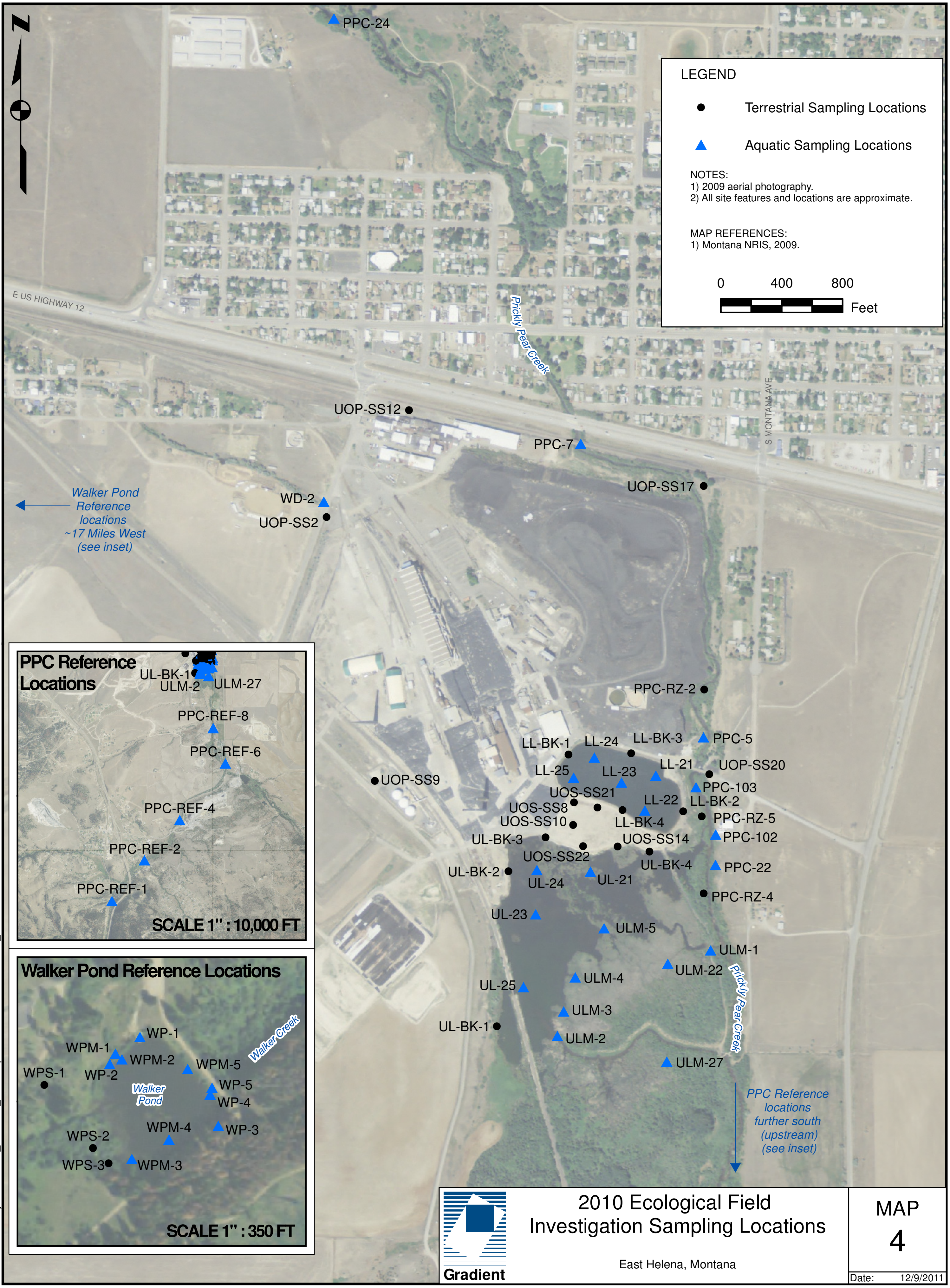
East Helena, Montana

MAP

3

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-14.mxd



NOTES:
1) 2009 aerial photography.
2) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

2010 Ecological Field Investigation Sampling Locations

East Helena, Montana

MAP
4

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-13.mxd

NOTES:
1) 2009 aerial photography.
2) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

Surface Water, Porewater, and Piezometer Sampling Locations

East Helena, Montana

MAP
5a

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CAD\GIS\100\210017_100-24_5a_water.mxd

NOTES:
1) 2009 aerial photography.
2) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

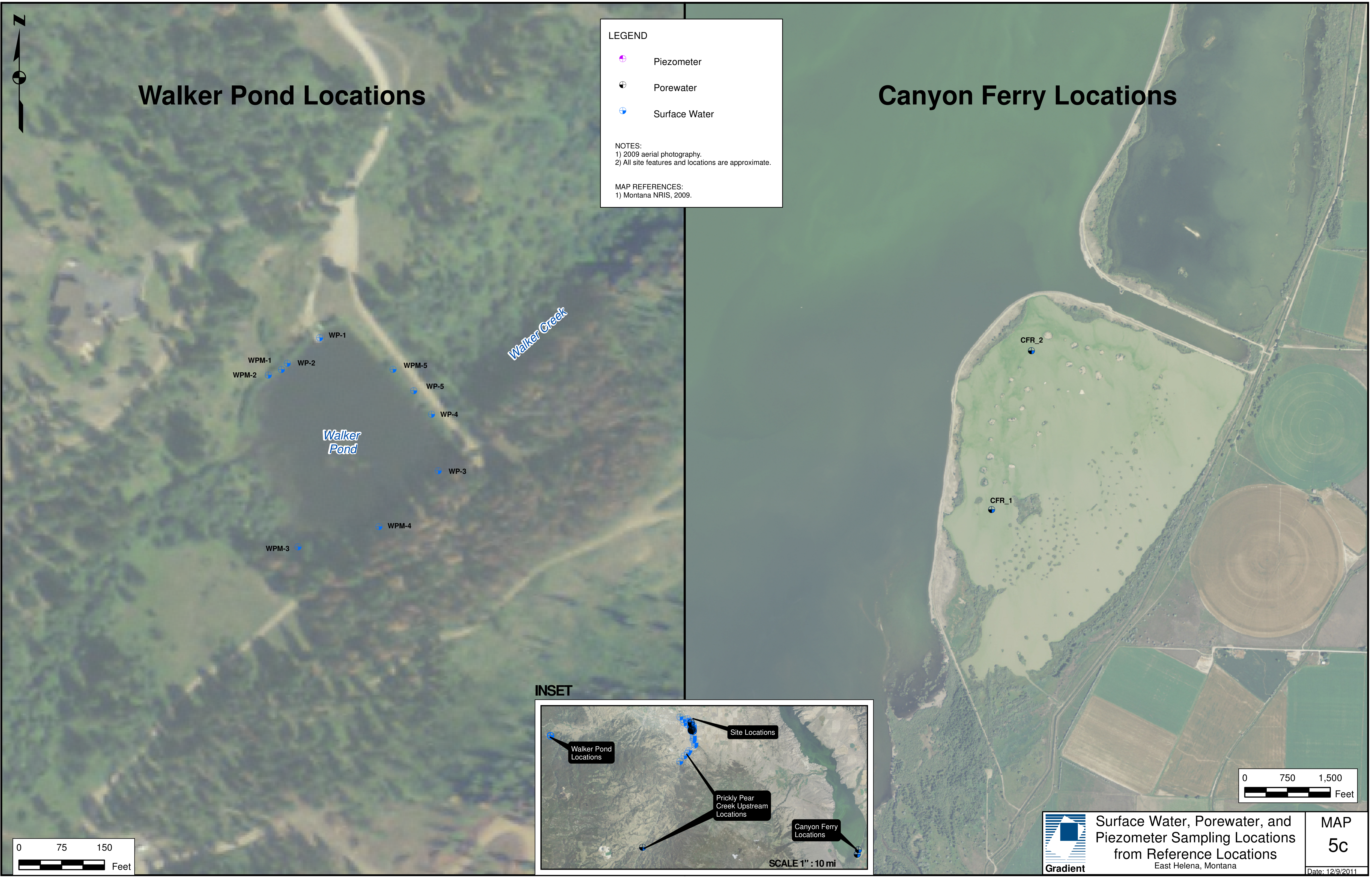
Sediment and Sediment Toxicity Sampling Locations

East Helena, Montana

MAP
5b

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-25_5b_sed.mxd



LEGEND

◑	Piezometer
◑	Porewater
◑	Surface Water

NOTES:
1) 2009 aerial photography.
2) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

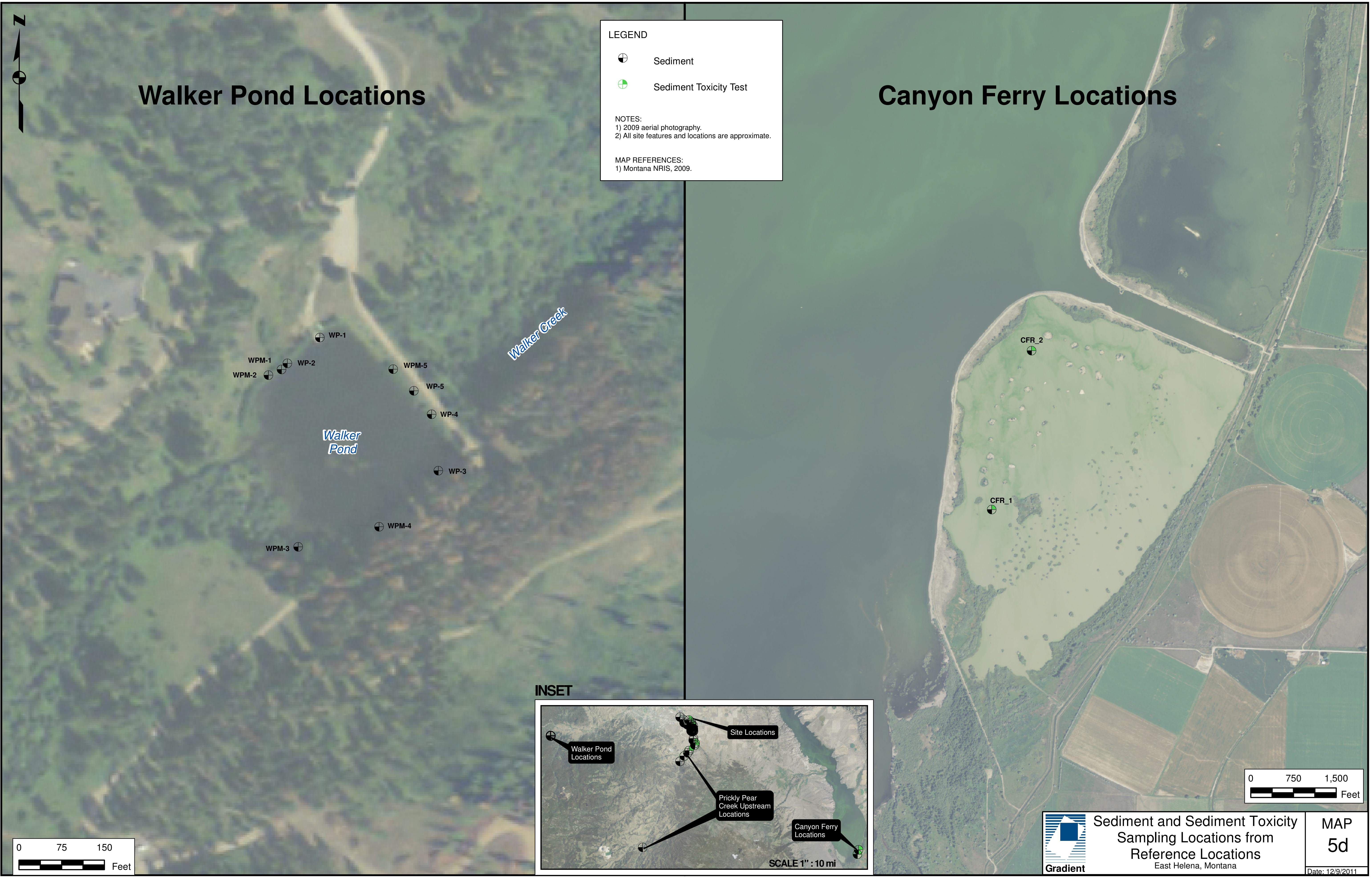
Surface Water, Porewater, and Piezometer Sampling Locations from Reference Locations

East Helena, Montana

MAP 5c

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-26_5c_water.mxd



LEGEND

◐	Sediment
◐	Sediment Toxicity Test

NOTES:
1) 2009 aerial photography.
2) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

Sediment and Sediment Toxicity Sampling Locations from Reference Locations

East Helena, Montana

MAP
5d

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-27_5d_sed.mxd

LEGEND

◐ Game Fish

◐ Piscivorous Fish

◐ Forage Fish

NOTES:
1) * Sample represents a composite collected from multiple locations throughout Upper Lake and Upper Lake Marsh.
2) 2009 aerial photography.
3) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

Fish Sampling Locations

East Helena, Montana

MAP
6a

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-28_6a_fish.mxd

NOTES:
1) * Sample represents a composite collected from multiple locations throughout Upper Lake and Upper Lake Marsh.
2) 2009 aerial photography.
3) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

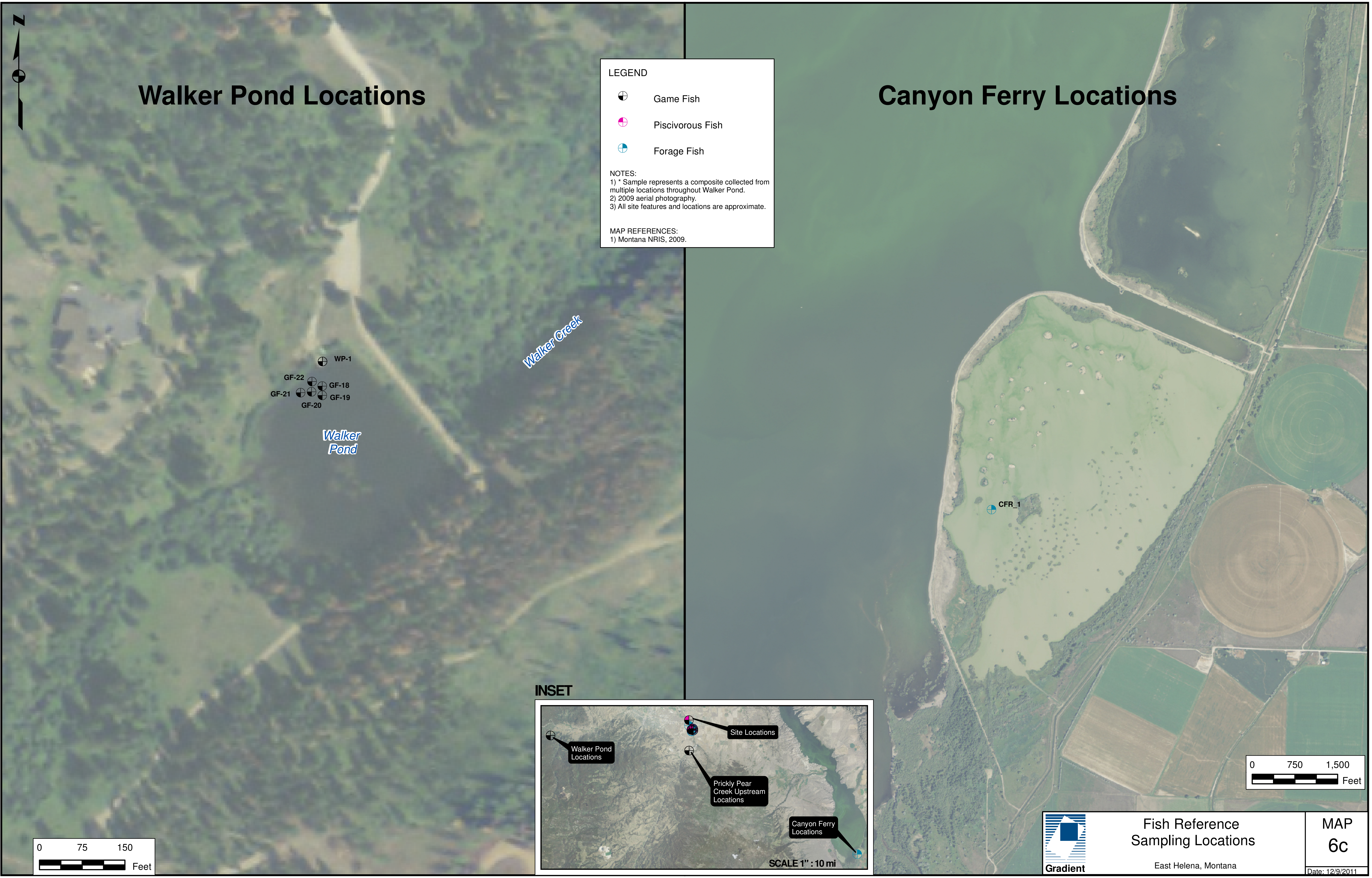
Other Aquatic Biota
Sampling Stations

East Helena, Montana

MAP
6b

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-29_6b_otherAq.mxd



LEGEND

◐	Game Fish
◐	Piscivorous Fish
◐	Forage Fish

NOTES:
1) * Sample represents a composite collected from multiple locations throughout Walker Pond.
2) 2009 aerial photography.
3) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

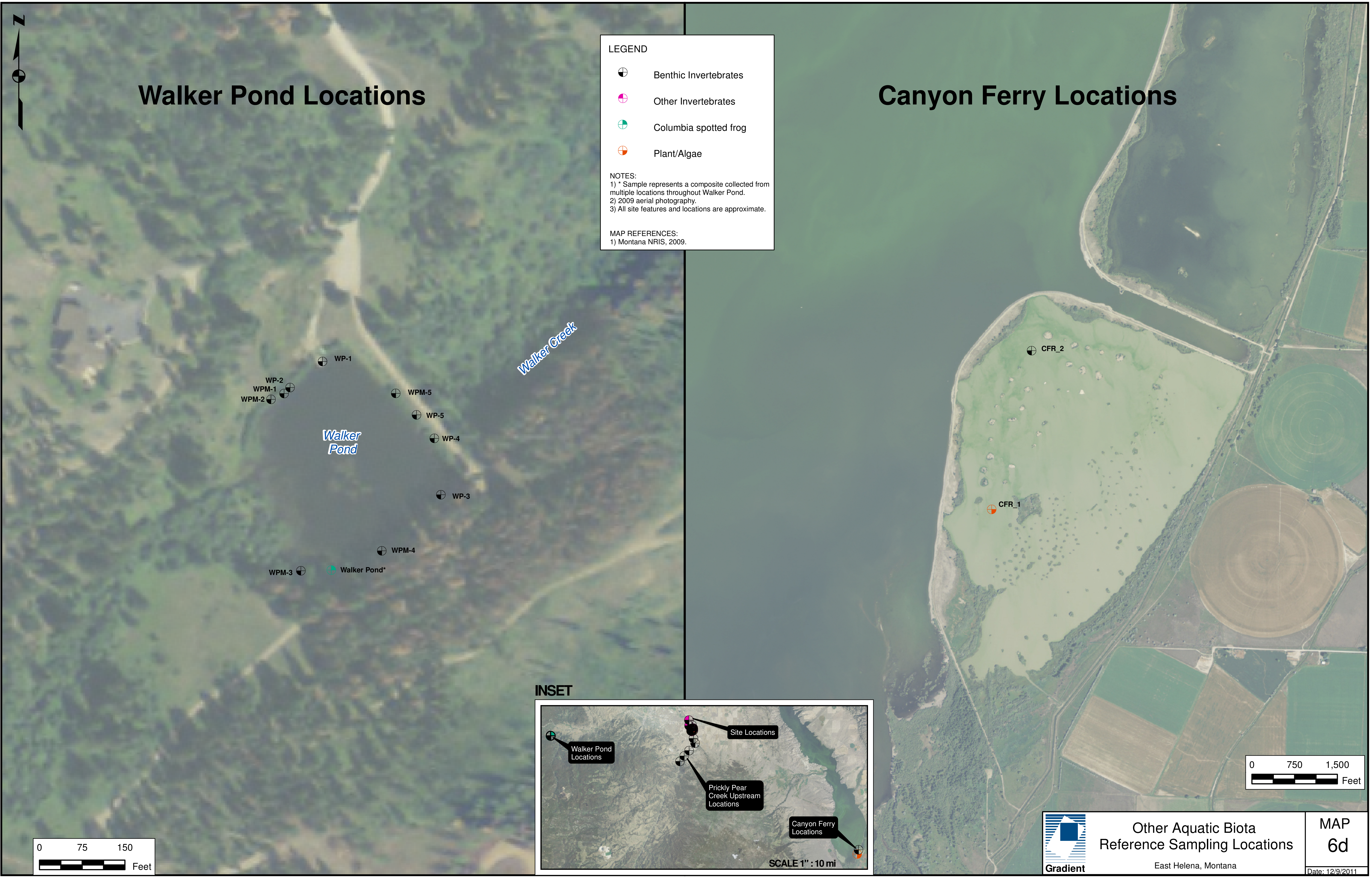
Fish Reference Sampling Locations

East Helena, Montana

MAP
6c

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100210017_100-30_6c_fish.mxd



LEGEND
◐ Benthic Invertebrates
◐ Other Invertebrates
◐ Columbia spotted frog
◐ Plant/Algae

NOTES:
1) * Sample represents a composite collected from multiple locations throughout Walker Pond.
2) 2009 aerial photography.
3) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

Gradient

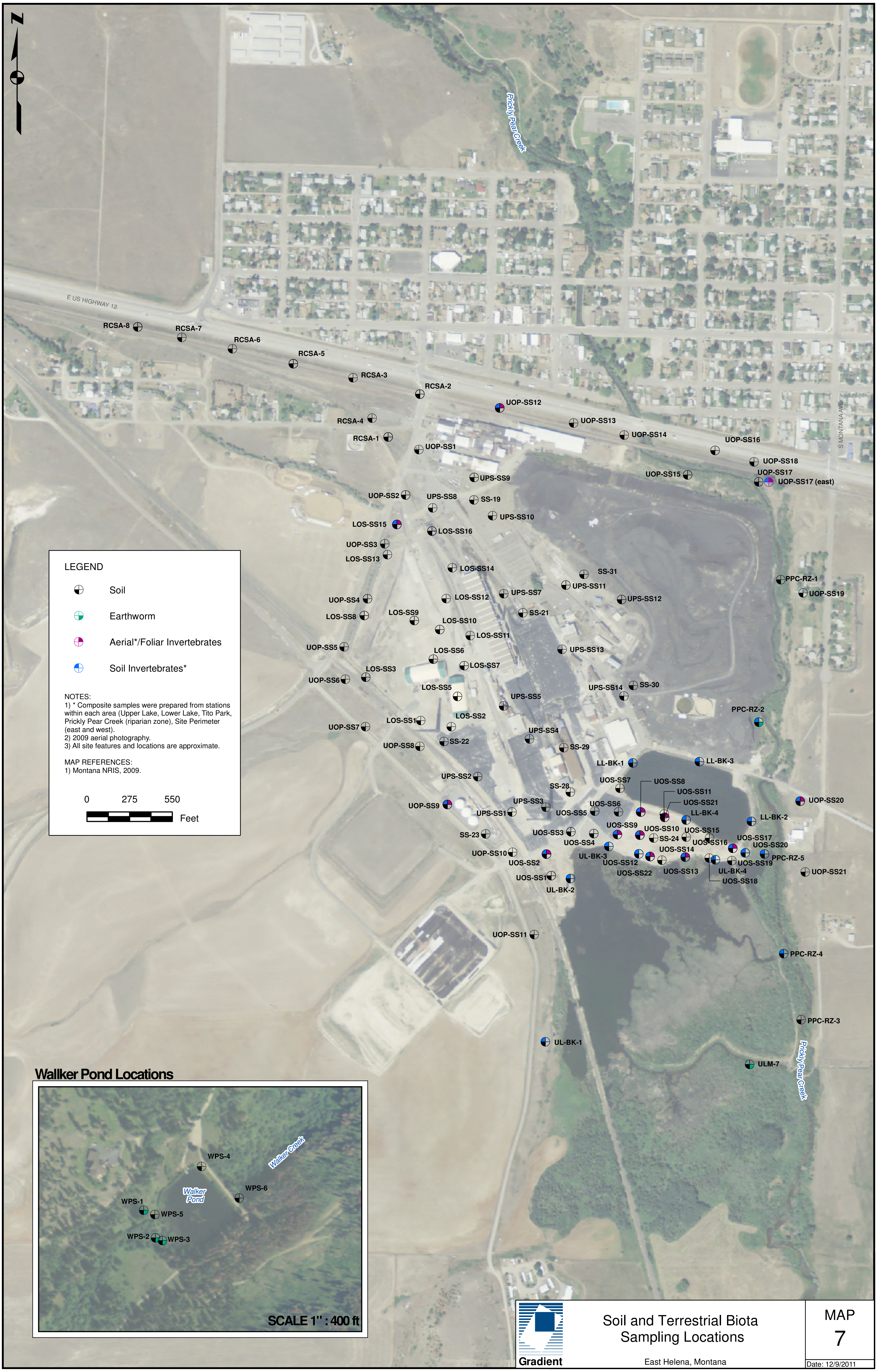
Other Aquatic Biota Reference Sampling Locations

East Helena, Montana

MAP
6d

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-31_6d_otherAq.mxd



LEGEND

⊕	Soil
⊕	Earthworm
⊕	Aerial*/Foliar Invertebrates
⊕	Soil Invertebrates*

NOTES:
1) * Composite samples were prepared from stations within each area (Upper Lake, Lower Lake, Tito Park, Prickly Pear Creek (riparian zone), Site Perimeter (east and west).
2) 2009 aerial photography.
3) All site features and locations are approximate.

MAP REFERENCES:
1) Montana NRIS, 2009.

0 275 550
Feet

Gradient

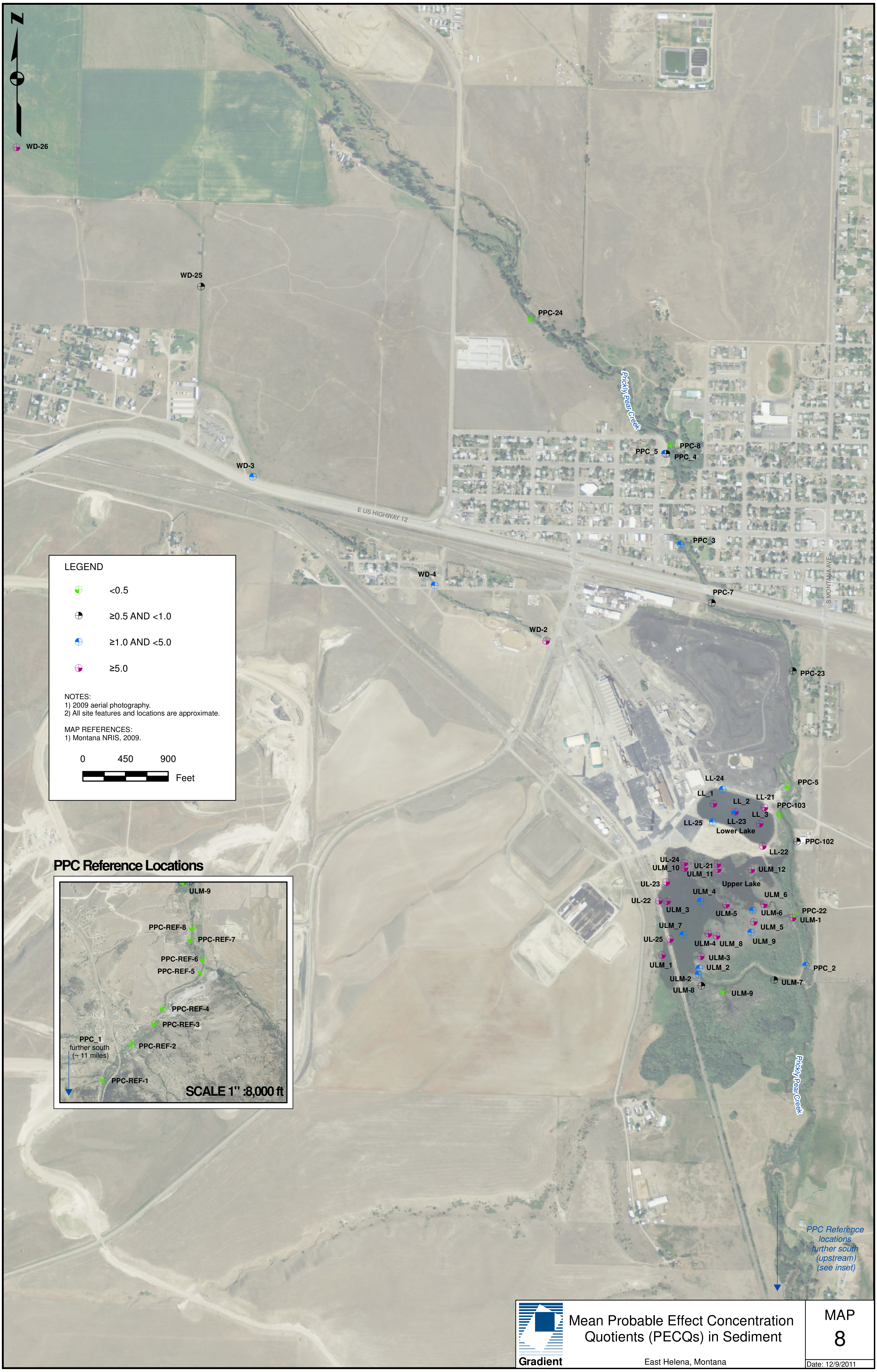
Soil and Terrestrial Biota
Sampling Locations

East Helena, Montana

MAP
7

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CAD\GIS\100\210017_100-22_SL.mxd



Gradient

Mean Probable Effect Concentration Quotients (PECQs) in Sediment

East Helena, Montana

MAP

8

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-23_SWSD_PEC.mxd

LEGEND

● Avian Egg Location

NOTES:
1) 2009 aerial photography.

MAP REFERENCES:
1) Montana NRIS, 2009.

0 350 700
Feet

Gradient

US FWS Avian Egg Collection Locations

East Helena, Montana

MAP
9

Date: 12/9/2011

File Path: G:\Projects\210017_Montana_Env\Graphics\CADGIS\100\210017_100-32.mxd

Appendix A

2010 Ecological Field Investigation Report

Geotechnical
Environmental
Water Resources
Ecological

GEI Consultants

Technical Memorandum

Field Report – Former ASARCO East Helena Facility Baseline Ecological Risk Assessment Biological Sampling

1.0 Introduction

The purpose of this memorandum is to summarize the biological sampling effort conducted July 26 through August 4, 2010 in support of the Baseline Ecological Risk Assessment (BERA) for the former ASARCO East Helena facility (Facility). Tasks associated with this sampling event included the collection of: benthic macroinvertebrates (BI), other aquatic invertebrates (OA), forage fish (FF), piscivorous fish (PF), game fish (GF), amphibians (AP), soil invertebrates (SI), and earthworms (EW), as well as the characterization of terrestrial and aquatic habitats and bird communities. Activities were conducted at a variety of sites within the Facility including: Prickly Pear Creek (PPC), Lower Lake (LL), Upper Lake (UL), Upper Lake Marsh (ULM), Wilson Ditch (WD), Tito Park (UOS) and upland locations around the perimeter of the Facility (UOP). Reference areas were also sampled including: Prickly Pear Creek (i.e., upstream of the Facility; PPC-REF) and Walker Pond (WP) and its marsh (WPM).

GPS coordinates for all sites visited are provided in Table 1 and sample locations are presented in Figure 1. Photographs taken at each site are provided in Appendix A. Biota collected and surveyed, and habitat assessments conducted at each of these locations are described in detail below (see Appendix B for copies of all data sheets completed in the field).

2.0 Methods

2.1 Biota Sampling

Methods for biological sample collection were generally consistent across sites and are summarized in Table 2. Per the scientific collection permit issued by the Montana Department of Fish, Wildlife & Parks, collection of fish was attempted with the following gear: beach seine, dip net, baited traps, gill net, rod and reel, and backpack electroshocker. Processing of fish included identification to species, examination for visible anomalies, and measurement of total length and weight. Benthic invertebrates and other aquatic invertebrates were generally collected with kick nets and were identified visually in the field to higher taxonomic levels (e.g., Order) to provide an overview of relative taxonomic composition of the tissue samples. Terrestrial invertebrates were collected with a combination of pitfall traps, coverboards, and digging by hand and were also identified to Order in the field to provide an overview of relative taxonomic composition in the tissue samples. Amphibians were collected by hand and identified to species in the field.

Due to analytical requirements, a minimum mass of ten grams was established as the goal for all samples. This minimum mass was verified in the field by weighing each sample container while accounting for the corresponding tare weight of an empty container. With the exception of earthworm samples, all biota were collected into laboratory-supplied containers and kept cool, on ice, until the end of each day when samples were transferred into freezers until shipment via overnight delivery. Earthworm samples were collected into a plastic container lined with paper towels, kept in a cool, dark place, and allowed to depurate overnight. Following depuration, earthworms were rinsed with distilled water, transferred into laboratory-supplied containers, and placed into freezers until shipment via overnight delivery.

2.2 Habitat Assessments

Habitat assessments were generally conducted on the same day(s) that biota were sampled for a given area. Within each area, sites for habitat assessments were selected to be representative of the habitat present and/or were established in locations where data would be most useful for the BERA (e.g., on Prickly Pear Creek, the sites adjacent to the facility were evaluated). Aquatic habitat assessment methods followed different methodologies for streams versus lakes/marshes as described below.

For stream habitats, a modified version of the U.S. Forest Service R1/R4 (R1/R4) Fish and Fish Habitat Standard Inventory Procedures Handbook (Overton et al. 1997) as well as EPA's Rapid Bioassessment Protocols (RBP) for Use in Streams and Rivers (Barbour et al. 1998) were followed. Similar definitions for habitat types and methodologies described in the original R1/R4 procedures (Overton et al. 1997) were used, but the field form was modified and the number of parameters measured was reduced. Field sampling of stream habitats consisted of identifying and measuring the habitat types present within the study reach. Habitat units were identified and measurements were made within each habitat type including: length, wetted width, bank width, average depth, maximum depth, substrate type, percent surface fines, percent undercut bank, percent eroding bank, dominant substrate types, and dominant bank vegetation types. Further evaluation of physical instream and riparian habitat features was performed following EPA's Rapid Bioassessment Protocol (RBP) method (Barbour et al. 1998). Habitat parameters were divided into three categories: 1) primary, 2) secondary, and 3) tertiary. Primary parameters are expected to have the greatest direct influence on the resident communities and include characterization of the bottom substrate, available instream cover, embeddedness, and current velocity and depth regime. Secondary parameters relate to channel morphology and include sediment deposition, channel flow status, channel alteration, and frequency of riffles. Tertiary parameters concentrate on the riparian zone by evaluating bank stability, bank vegetation, and width of the riparian zone. The primary and secondary parameters were scored on a scale of 0-20 while the tertiary parameters were scored on a scale of 0-10 for each bank (0-20 for each category). All scores were then added from each category to provide a total condition rating by site.

For lake and marsh habitats, EPA's Environmental Monitoring and Assessment Program (EMAP) Surface Waters – Field Operations Manual for Lakes (Baker et al. 1997) was followed. Each site was divided up into units based on the locations visited for benthic invertebrate sampling (i.e., each site sampled for benthic invertebrates was evaluated for physical habitat). At each location, the following habitat features were assessed: riparian zone canopy layer, understory, and ground cover vegetation extent and type, shoreline substrate type, bank features, human influence, and littoral zone substrate type, macrophyte presence, and fish cover availability and type.

A terrestrial habitat assessment was also generally conducted on the same day(s) that biota were sampled for a given area. The study areas were categorized by cover type and habitat features of importance to wildlife in each cover type were assessed. Within each cover type, dominant plant groups present, plant abundance, and estimates of coverage were made in the riparian zones and uplands (where applicable). In addition, general observations of land use and other characteristics were noted.

2.3 Wildlife Surveys

A qualitative bird survey was conducted in all Facility and reference areas. Observations of birds by sight and sound were conducted during early morning and dusk periods for no more than four hours per day per site. Bird surveys generally followed protocols such as Hamel et al. 1996 and similar point count methods. However, modification of standard methods occurred as necessary. At sites with excessive noise or obstructive vegetation, it was not possible to perform surveys from fixed locations. In such cases, the surveyor periodically moved around the site to ensure adequate coverage of the entire area. Due to these conditions, survey duration was not standardized or limited, and instead varied depending on the amount of time needed for the surveyor to thoroughly cover each site.

Incidental wildlife sightings were also recorded. These observations are not described explicitly in this report; however Table 3 provides a detailed account of the species observed, date and time of sighting, proximity to defined sites, habitat type, and observed activity for each sighting. Noteworthy observations that should be considered during refinement of the BERA conceptual site model are also discussed in section 5.0 Other Observations.

3.0 Results – Facility Sites

3.1 Prickly Pear Creek (PPC)

Aquatic samples targeted for collection at Prickly Pear Creek (PPC) included: six benthic macroinvertebrate composites, three other aquatic invertebrate composites, three forage fish composites, five piscivorous fish, five game fish, and two amphibians. Terrestrial samples to be collected included five earthworm composites and three soil invertebrate composites. All of the target aquatic samples, two of the five earthworm samples, and two of the three soil invertebrate samples were obtained during this collection effort. Aquatic and terrestrial habitat and bird community surveys were also conducted at PPC.

3.1.1 Aquatic Biota

PPC was sampled for aquatic biota from south to north (i.e., from upstream to downstream) on July 28 and August 1. In particular, sites PPC-22, 5, 102, 103, and 7, were sampled on July 28 and PPC-24 was sampled on August 1.

Benthic macroinvertebrate samples were taken with a kick net at six discrete locations along PPC including: PPC-22, 5, 102, 103, 7, and 24, in that order. Taxa observed in PPC BI samples generally included Ephemeroptera, Plecoptera, and Trichoptera (collectively referred to as EPT), Coleoptera, Diptera, Amphipoda, Odonata, and Hemiptera (Table 4[1]).

Other aquatic invertebrates were either collected (via kicknet) at a single location or composited across multiple sites along PPC until sufficient sample mass (i.e., approximately 10 grams) was obtained. In particular, the first OA sample collected in PPC was composited across the first three sites sampled (PPC-22, 5, and 102), the second was collected entirely at PPC-103, and the third was collected entirely at PPC-24. Generally, OA samples included Gastropoda and Hirudinea (Table 5[1]).

Forage fish samples were collected using a backpack electroshocker and were comprised of mottled sculpin ranging from 55 to 98 mm in length and 1.6 to 10.0 g in weight (Table 8). Two of the three forage fish composite samples were collected at PPC-22 and the third was collected at PPC-05. No visible anomalies were observed in any of the fish collected.

Backpack electroshocker was also used to collect brown trout, representing the piscivorous fish class, at PPC. Five individual fish were collected in three areas spanning the entire length of PPC locations: near PPC-22 (three fish), throughout the reach established by PPC-102 and 103 (one fish), and near PPC-24 (one fish). The brown trout collected ranged from 155 to 241 mm and 39 to 140 g (Table 9). No visible anomalies were observed in any of the fish collected.

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[1] A key of common names associated with the taxa identified is provided at the bottom of Table 4 and Table 5.

Larger brown trout were also sampled to represent the game fish class in PPC. Two fish were collected with backpack electroshocker within the reach established by PPC-102 and 103 and three fish were sampled near PPC-24. Individuals ranged from 300 to 415 mm and 295 to 750 g (Table 10). No visible anomalies were observed in any of the fish collected.

Finally, four amphibian samples were hand-collected near PPC. Columbia spotted frogs ranging from 8 to 15 g were found in the area between PPC (near PPC-22) and the Upper Lake Marsh (near ULM-1) along the causeway separating the two (Table 11). These organisms were likely exposed to water/sediments from both areas and were therefore assumed to meet the sampling requirements for both PPC and the ULM.

3.1.2 Terrestrial Biota

A thorough search for earthworms was conducted throughout the riparian zone of PPC; however, only at PPC-RZ-2 were earthworms identified and collected. Two composite samples of ten and 15 g were collected by hand on July 31 and August 3 (Table 6). At all other PPC-RZ sites, the topsoil layer was very shallow and underneath it either extremely sandy soil, indicative of alluvial sediments, or an overabundance of willow roots were present. Both conditions would preclude the ability of earthworms to burrow in these soils, thus the difficulty in obtaining these organisms was not surprising.

Soil invertebrate collection was attempted at three PPC-RZ sites (i.e., PPC-RZ-2, 4, and 5). At each of these locations, either pitfall traps or coverboards were deployed on July 27 and checked daily until August 4. Two composite soil invertebrate samples were obtained during this time (Table 7). One, collected entirely at PPC-RZ-4, was comprised of Hymenoptera, Trichoptera, and Coleoptera. The other, collected across all three sites, included Hymenoptera, Gastropoda, and Coleoptera.

3.1.3 Habitat Assessments

3.1.3.1 Aquatic

Aquatic habitat features were evaluated on July 28 along the 198 meter reach defined by PPC-5 and 103 (i.e., the PPC sites most adjacent to the Facility). Six different habitat types were present in this reach, though three of these were directly related to the bridge/dam that was located in the middle of the segment (Table 12). Stream widths varied widely throughout the reach, with the narrowest portions associated with the riffle habitats, intermediate portions associated with the run habitats, and widest portions associated with the areas adjacent to the dam (Table 12). Similar trends were observed with respect to depth in these habitat types (i.e., shallowest in riffles, deepest in dam areas) (Table 12). Only in the runs located at the upstream and downstream ends of the reach was any evidence of eroding banks (2 – 3 m) observed and no areas with undercut banks were noted (Table 12).

The predominant bank cover type present throughout the site was willow, although sedges, grasses, trees, and boulders were also observed (Table 13). Substrates above the dam were dominated by cobble while those below were dominated by sand (Table 13). Percent fines by grid measurements followed the same trend, decreasing from a maximum of 31 percent to a minimum of three percent upstream of the dam, and increasing to 98 to 100 percent downstream (Table 13). Finally, the RBP scores calculated suggested this segment of PPC falls within the “sub-optimal” category with factors such as pool variability, channel sinuosity, and riparian vegetative zone width contributing the lowest scores measured (Table 14).

3.1.3.2 Terrestrial

Terrestrial habitat features were evaluated on July 27 in the area surrounding PPC-RZ-2, concurrent with where the bird surveys were conducted (see Section 3.1.4). This heavily disturbed area was adjacent to both the slag pile and a road that goes throughout the Facility. Average vegetation height was greater than one meter and was dominated by a moderately-diverse assemblage of shrubs (i.e., greater than 50 percent), though some grasses were also present as were a few scattered trees.

3.1.4 Bird Surveys

A survey of visible and audible birds was conducted in the area surrounding PPC-RZ-2 in the evening of July 27 and the morning of July 28. In both instances, noise from a nearby plant precluded the ability of the surveyor to hear without difficulty. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

3.2 Upper Lake (UL)

Aquatic samples targeted for collection in the Upper Lake (UL) included: five benthic macroinvertebrate composites, three other aquatic invertebrate composites, three forage fish composites, five piscivorous fish, five game fish, and one amphibian. Terrestrial samples to be collected included two earthworm composites and two soil invertebrate composites. Again, almost all of the aquatic biota collection was completed for the UL; however earthworms were not found anywhere along the bank of the UL and only one of the two soil invertebrate samples was obtained. Aquatic and terrestrial habitat and bird community surveys were also conducted at the UL.

3.2.1 Aquatic Biota

The UL was sampled for aquatic biota on July 30 and 31. All benthic invertebrate, other invertebrate, and forage fish samples were collected on July 30 as were two of the five game fish samples. All other aquatic samples were collected on July 31.

Benthic macroinvertebrate samples were taken at five locations around the perimeter (via kick net) and offshore (via Ponar) of the UL, including: UL-21A, 21B, 24, 23, and 25, in that order. UL-21A and 21B were located just east and west of UL-21, respectively. Additional effort was expended in this area since sediments collected at UL-21 had among the highest metals concentrations reported in previous studies. Taxa observed in UL BI samples collected along the shoreline generally included Ephemeroptera, Coleoptera, Diptera, Amphipoda, Odonata, and Hemiptera (Table 4). Samples collected offshore were expectedly absent of benthic invertebrates, though a small number of oligochaetes were found at four of the five UL offshore sites. It was subsequently determined that the best method of benthic invertebrate collection in lakes was with a kicknet and use of a Ponar was discontinued.

Other aquatic invertebrates were composited across multiple sites around the UL until sufficient sample mass (i.e., approximately 10 grams) was obtained. In particular, the first OA sample in the UL (collected via kick net) was composited across UL-21B and 23, the second was composited across UL-21A, 21B, 23 and 24, and the third was composited across UL-23 and 25. Generally, OA samples in the UL included Gastropoda and Hirudinea, but a Crustacea was found in the third OA sample (Table 5).

Forage fish collected included two composite samples of fathead minnow and three of white sucker. One sample of each species was collected in minnow traps deployed at UL-21B and two white sucker samples and one fathead minnow sample were collected in minnow traps deployed at UL-21A. Across samples, fathead minnow ranged from 38 to 69 mm in length and 0.7 to 4.0 g in weight (Table 8). White sucker ranged from 68 to 100 mm and 2.9 to 9.1 g (Table 8). No visible anomalies were observed in any of the fish collected.

Piscivorous fish in a size class suitable for wildlife consumption were noticeably absent in the UL while benthic detritivorous fish (i.e., white suckers) were abundant. Consequently, benthic detritivores were replaced for piscivores at this location. Additionally, to approximate concentrations in piscivores, both the fillet and carcasses of the game fish collected (see below) were analyzed. Five composite samples of three white suckers each were collected in a gillnet that was deployed near UL-

21. The fish collected ranged from 202 to 228 mm and 96 to 142 g (Table 9). No visible anomalies were observed in any of the fish collected.

Both brown trout and rainbow trout were collected in the UL to represent the game fish class. Two rainbow trout ranging from 450 to 489 mm and 1200 to 1250 g were collected in a gillnet deployed near UL-23. Three brown trout ranging from 275 to 338 mm and 245 to 460 g were collected in gillnets deployed both near UL-21 and UL-23 (Table 10). No visible anomalies were observed in any of the fish collected.

Although frogs were seen and heard near UL-24, we were unable to capture any at this location.

3.2.2 Terrestrial Biota

A thorough search for earthworms was conducted around the perimeter of the UL; however, habitat was not suitable to support these types of organisms. Along the north bank of the UL, soils were heavily compacted and very dry thus precluding the ability of earthworms to burrow and obtain the resources required for survival. According to Facility personnel, the entire area between the Upper and Lower Lakes, including Tito Park, has been covered with a clay cap. Clayey soils are generally very dense and are therefore problematic for burrowing earthworms. Coupled with the dry conditions in this area, it was not surprising that we were unable to collect earthworms along this bank. On the west bank, soils were examined for earthworms along a transect that started in the riparian zone and extended upslope approximately 5 meters. The moisture gradient of the soils quickly went from extremely wet to extremely dry and no earthworms were found in any of the soils investigated. Given this quick transition in moisture content, it appears that the appropriate habitat for earthworms was not present in these soils. Finally, the south and east banks of the UL consisted of marsh-like habitat, which was also too moist to support earthworm communities.

Soil invertebrate collection was attempted at four UL bank sites (i.e., UL-BK-1, 2, 3, and 4). At each of these locations, coverboards were deployed on July 26 or July 28 and checked daily until August 4. In addition, on July 30, a PFT was deployed at UL-BK-1 and checked daily until August 4. One composite soil invertebrate sample was obtained during this time (Table 7). This sample, which contained organisms from all four UL-BK sites, was comprised of Hymenoptera and Coleoptera.

3.2.3 Habitat Assessments

3.2.3.1 Aquatic

Aquatic habitat features were evaluated on July 30 around the entire perimeter of the UL. Human influences were observed in the following forms: buildings, commercial facilities, walls/dikes/revetments, litter/trash dump/landfill, roads/railroads, and pasture/hayfield.

The riparian zone had either deciduous vegetation or no vegetation at all in both the canopy layer and understory (Table 15). Where vegetation was present, the canopy layer included a sparse number of trees with a diameter at breast height (DBH) less than or equal to 0.3 m, whereas trees with a DBH greater than or equal to 0.3 m were absent (Table 15). The understory consisted entirely of woody shrubs and saplings; tall herbs, forbs, and grasses were absent (Table 15). Ground cover was generally barren, though sparse herbs, forbs, grasses and woody shrubs and seedlings were observed at some UL sites (Table 15). Inundated vegetation was observed to a moderate extent at most UL sites (Table 15). The shoreline substrate zone was predominantly fine soil/sediment and/or loose sand, though cobble/gravel and vegetated portions of the shoreline were also observed (Table 15). The angle of the bank around the perimeter was steep (i.e., between 30° and 75°) at all sites (Table 15). Water levels were at or above the high water mark or the high water mark was not evident (Table 15).

The littoral zone bottom substrate was dominated by silt clay/muck materials, though at some sites sparse and/or moderate quantities of cobble, gravel, sand, and/or woody debris were also observed

(Table 17). All UL substrates were black in color and had an anoxic odor (Table 17). A heavy to very heavy amount of submergent and sparse amount of floating macrophytes were observed at all sites (Table 17). No emergent macrophytes were present at any of the sites (Table 17). Sparse or moderate to very heavy density fish cover was present in the following forms: aquatic weeds, brush or woody debris, overhanging vegetation, and human structures (Table 17). Finally, fish habitat included both human and natural features consisting of covered areas made up of vegetated structures (Table 17).

3.2.3.2 *Terrestrial*

Terrestrial habitat features were evaluated on July 28 in the area surrounding UOS-SS14, concurrent with where the bird surveys were conducted (see below). Having sampled around the entire perimeter of the UL, the surveyor was also able to take into consideration habitats observed beyond those visible from the vantage point of UOS-SS14. The average vegetation height observed was greater than one meter. Upland plant assemblages surrounding the lake were dominated by grasses and shrubs (i.e., willows), while riparian plants included mostly cattails. Among these plants was a moderate diversity of five to 15 common species with 15 – 50 percent being shrubs and only a few scattered trees.

3.2.4 Bird Surveys

A survey of visible and audible birds was conducted from the north bank of the UL (from the vantage point of UOS-SS14) in the morning of July 28 and the evening of July 30. In both instances, noise from a nearby plant precluded the ability of the surveyor to hear without difficulty. Birds identified during both surveys and the typical foods consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

3.3 Upper Lake Marsh (ULM)

Aquatic samples targeted for collection in the Upper Lake Marsh (ULM) included: five benthic macroinvertebrate composites, three other aquatic invertebrate composites, three forage fish composites, and one amphibian. Terrestrial samples to be collected included three earthworm composites. More than 100 percent of the target aquatic biota for the ULM was collected during this sampling event but earthworms were not found. Aquatic and terrestrial habitat and bird community surveys were also conducted at the ULM.

3.3.1 Aquatic Biota

The ULM was sampled for aquatic biota on July 29, July 30, and August 1. All of the benthic invertebrate and most of the other aquatic invertebrate and forage fish samples were collected on July 29. The rest of the forage fish samples were collected on July 30 and the last other aquatic invertebrate sample was collected on August 1.

Benthic macroinvertebrate samples were taken via kicknet at five locations around the perimeter of the ULM, including: ULM-1, 2, 3, 4, and 5, in that order. An attempt was made to locate the ULM locations identified in the BERA Work Plan (Gradient 2010); however we were unable to reach those locations and so new sites that covered the spatial extent of the marsh were established. Taxa observed in ULM BI samples generally included Ephemeroptera, Coleoptera, Diptera, Amphipoda, Odonata, and Hemiptera (Table 4).

Other aquatic invertebrates were composited across multiple sites around ULM until sufficient sample mass (i.e., approximately 10 grams) was obtained. In particular, the first OA sample collected in the ULM (via kick net) was composited across ULM-2 and 5, the second was composited across ULM-3 and 4, and the third was collected entirely at ULM-4. Generally, OA samples in the ULM included Gastropoda and Hirudinea, but a Crustacea was found in the first OA sample (Table 5).

Forage fish collected included two composite samples of nine to ten grams of unidentifiable young of the year (YOY) fish, one of fathead minnow, and one of longnose dace. The YOY were collected via kicknet at ULM-3 and 5, and the fathead minnow and longnose dace were caught in minnow traps deployed at ULM-2. Within the composite, fathead minnow ranged from 45 to 66 mm in length and 0.4 to 2.5 g in weight (Table 8). Longnose dace ranged from 63 to 96 mm and 2.2 to 7.1 g (Table 8). No visible anomalies were observed in any of the fish collected except one longnose dace with a shortened caudal fin collected at ULM-2.

The aforementioned Columbia spotted frogs collected between PPC (near PPC-22) and the Upper Lake Marsh (near ULM-1) along the causeway separating the two (Table 11) are likely exposed to water/sediments from both areas. Therefore, these samples were assumed to meet the sampling requirements for both PPC and the ULM.

3.3.2 Terrestrial Biota

A thorough search for earthworms was conducted throughout the ULM; however, only at ULM-27 were earthworms identified and collected. This site was located along PPC and actually resembled riparian rather than marsh habitat. Here, one composite sample of 10 g was collected on August 1 and three composite samples of 20 g each were collected on August 3 (Table 6). At all other ULM sites, the soil was too moist to support earthworm communities and none were found.

3.3.3 Habitat Assessments

3.3.3.1 Aquatic

Aquatic habitat features were evaluated on July 29 at each of the ULM sites. Human influences were observed in the following forms: walls/dikes/revetments and roads/railroads.

The riparian zone of two of the five ULM sites had deciduous vegetation in the understory; otherwise no vegetation was present in the canopy or understory of the ULM (Table 15). Where riparian vegetation was present, sparse trees of mixed sizes and only sparse or moderate quantities of woody shrubs and saplings and tall herbs, forbs, and grasses were observed (Table 15). Ground cover at all of the ULM sites was very heavily comprised of inundated vegetation, though sparse woody shrubs and seedlings, and herbs, forbs, and grasses were also observed at some of the sites (Table 15). The shoreline substrate was very heavily vegetated, though moderate amounts of fine soil/sediment were also observed at each of the ULM sites (Table 15). The angle of the bank around the perimeter was less than or equal to 30° and water levels were generally at or above the high water mark or the high water mark was not evident except at ULM-1 (Table 15). At this site, the vertical distance from the waterline to the high water mark was one meter and the horizontal distance was two meters (Table 15).

The littoral zone bottom substrate was dominated by silt clay/muck materials, though at some sites sparse to moderate quantities of sand and woody debris were also observed (Table 17). All ULM substrates were black in color and had an anoxic odor (Table 17). A sparse to moderate amount of submergent and floating macrophytes were observed at all sites (Table 17). No emergent macrophytes were present at any of the sites (Table 17). Sparse or moderate to very heavy density fish cover was present in the following forms: aquatic weeds, snags, brush or woody debris, and overhanging vegetation (Table 17). Finally, fish habitat included both human and natural features consisting of both open and covered, areas made up of vegetated and/or mixed structures (Table 17).

3.3.3.2 Terrestrial

Terrestrial habitat features were evaluated on July 29 along the eastern side of the UL along the marshy edge, concurrent with where the bird surveys were conducted (see below). Having sampled around the entire perimeter of the Upper Lake and its marshy areas, the surveyor was also able to take into consideration habitats observed beyond those visible from the eastern side of the Lake. All marsh habitats consisted of a plant assemblage with low diversity including mostly cattails, plus one to two other shrub species and a few scattered trees. Correspondingly, average vegetation height was over one meter.

3.3.4 Bird Surveys

A survey of visible and audible birds was conducted in the along the eastern side of the Upper Lake along the marshy edge (generally from the vantage point of ULM-1) in the morning and evening of July 29. In the morning, noise from a nearby plant precluded the ability of the surveyor to hear without difficulty, but in the evening noise was less severe. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

3.4 Lower Lake (LL) and Tito Park (UOS)

Aquatic samples targeted for collection in the Lower Lake (LL) also included: five benthic macroinvertebrate composites, three other aquatic invertebrate composites, three forage fish composites, and one amphibian. Terrestrial samples to be collected included two earthworm composites and four soil invertebrate composites (i.e., two along the bank of the LL and two in the Tito Park [UOS] area). Similar to other areas, almost all of the target aquatic biota and soil invertebrate samples were collected while earthworms were not identified anywhere along the bank of the LL or in Tito Park. Aquatic and terrestrial habitat and bird community surveys were also conducted at the LL/Tito Park area.

3.4.1 Aquatic Biota

LL was sampled for aquatic biota July 31. All samples were collected on this day.

Benthic macroinvertebrate samples were taken via kicknet at five locations around the perimeter of the LL, including: between LL-21 and 22 and at LL-22, 25, 24, and 21, in that order. Taxa observed in LL BI samples generally included Ephemeroptera, Trichoptera, Coleoptera, Diptera, Amphipoda, Odonata, Acari, and Hemiptera (Table 4).

Other aquatic invertebrates were either collected at a single location or composited across multiple sites around the LL until sufficient sample mass (i.e., approximately 10 grams) was obtained. In particular, the first OA sample was collected entirely at LL-22 in a minnow trap that was deployed overnight. The second OA sample was collected via kicknet and composited across LL-22 and 25, and the third was composited across LL-24 and 25. Generally, OA samples in the LL included Gastropoda and Hirudinea (Table 5).

Forage fish collected included three composite samples of fathead minnows. Two of the three composites were collected via minnow traps deployed between LL-24 and 25 and LL-24 and 21. The third composite, which also included YOY, was collected via kicknet between LL-25 and 22. Across the composites, fathead minnow (YOY excluded) ranged from 35 to 71 mm in length and 0.4 to 4.4 g in weight (Table 8). No visible anomalies were observed in any of the fish collected.

Amphibians were neither seen nor heard around the LL, thus we were unable to capture any at this location.

3.4.2 Terrestrial Biota

A thorough search for earthworms was conducted around the perimeter of the LL; however, at none of the sites did the habitat present support these types of organisms. Around the entire bank, soils were heavily compacted and very dry thus precluding the ability of the earthworms to burrow and obtain the resources required for survival. According to Facility personnel, the entire area between the Upper and Lower Lakes, including Tito Park, has been covered with a clay cap. Clayey soils are generally very dense and are therefore problematic for burrowing earthworms. Coupled with the dry conditions in this area, it was not surprising that we were unable to collect earthworms around the LL.

Soil invertebrate collection was attempted at four LL bank sites (i.e., LL-BK-1, 2, 3, and 4). At each of these locations, coverboards were deployed on July 26 and checked daily until August 4. On July 27, an additional PFT was deployed at both LL-BK-1 and 4 and checked daily until August 4. Two composite soil invertebrate samples were obtained during this time (Table 7). One sample, which contained organisms from LL-BK-1 and 3, contained the following taxa: Coleoptera, Lepidoptera, Opiliones, Aranea, and Hymenoptera. The other sample, which contained organisms from all four LL-BK sites, was comprised of these same species, plus Chilopoda. The most common species in both of these samples was a larval dytiscid beetle of the genus *Stictotarsus*. As adults and larvae, these organisms are aquatic but the larvae tend to pupate on bank soils, where our pitfall traps were located. LL-BK-1, which was the most vegetated among the sites, tended to be the most productive location for collecting these organisms. Given the life history of these species is predominantly associated with aquatic habitats, these samples may be more appropriate for evaluation in the aquatic context.

Soil invertebrate collection was also attempted at five Tito Park sites (i.e., UOS-SS-8, 10, 22, 14, and 22). At each of these locations, either pitfall traps or coverboards were deployed on July 26 and checked daily until August 4. In addition, on August 1, all coverboards previously deployed at the LL were relocated to Tito Park and checked daily until August 4. Finally, on August 2, sweep nets were used to capture additional soil and aerial/foliar invertebrates in Tito Park. Two composite soil invertebrate samples were obtained during this time (Table 7). Both samples contained organisms from all five Tito Park sites. One sample was limited to true soil invertebrates and was comprised of Hymenoptera, Coleoptera, and Aranea. The other sample, which contained aerial/foliar insects, contained the following taxa: Orthoptera, Lepidoptera, Coleoptera, Trichoptera, Hymenoptera, Odonata, and Hemiptera.

3.4.3 Habitat Assessments

3.4.3.1 *Aquatic*

Aquatic habitat features were evaluated on July 31 around the entire perimeter of the LL. Human influences were observed in the following forms: buildings, commercial facilities, walls/dikes/revetments, litter/trash dump/landfill, and roads/railroads.

The riparian zone of two of the five LL sites had deciduous vegetation in the understory; otherwise no vegetation was present in the canopy or understory of the LL (Table 15). Where riparian vegetation was present, only sparse quantities of trees with a DBH less than 0.3 m, woody shrubs and saplings, and tall herbs, forbs, and grasses were observed (Table 15). Ground cover at most of the LL sites was barren though at LL-25 and 24 herbs, forbs, and grasses were the dominant ground cover. Sparse quantities of woody shrubs and seedlings, inundated vegetation, and herbs, forbs, and grasses also contributed to the ground cover at some of the sites (Table 15). The shoreline substrate around the LL was a mix of several materials including: boulders, cobble/gravel, loose sand, fine soil/sediment, vegetation, and other non-natural features (Table 15). The angle of the bank around the perimeter was less than or equal to 30° and water levels were generally 0.3 vertical m below the high water mark (Table 15). Horizontal distance to the high water mark around the LL ranged from zero to 1.5 m (Table 15).

Similar to the riparian zone shoreline substrate composition, the littoral zone bottom substrate was also a mix of materials including: boulders, cobble, gravel, sand, silt clay/muck, and woody debris (Table 17). All LL substrates were either black or brown in color and most had an anoxic odor (Table 17). Macrophytes were generally absent in the LL except at LL-23 where only a sparse amount of submergent and floating macrophytes were observed (Table 17). No emergent macrophytes were present at any of the sites (Table 17). Fish cover was also generally absent except at a few sites where sparse or moderate to very heavy density fish cover was present in the following forms: brush or woody debris, rock ledges or sharp drop-offs, boulders, and human structures (Table 17).

Correspondingly, fish habitat was generally open with the only covered areas made up of artificial structures (Table 17).

3.4.3.2 Terrestrial

Terrestrial habitat features were evaluated on July 28 in the area surrounding LL-BK-4, concurrent with where the bird surveys were conducted (see below). The Tito Park area was also surveyed at this time from this location. Average vegetation height was less than 0.15 meters, reflecting grasses being the predominant vegetation type. Species diversity was low, with only one shrub, two to three grasses, and one herbaceous species being present. There were no trees present in this heavily disturbed area, which was situated between two roads used to access the Facility as well as the slag pile.

3.4.4 Bird Surveys

A survey of visible and audible birds was conducted in the area surrounding the Lower Lake (from the vantage point of LL-BK-4) in the morning of July 28 and the evening of July 30. The Tito Park area was also surveyed at these times from this location. In both instances, noise from a nearby plant precluded the ability of the surveyor to hear without difficulty. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

3.5 Wilson Ditch (WD)

Aquatic and terrestrial habitat and bird community surveys were conducted in the Wilson Ditch (WD) area. Biota were not targeted for collection in WD; however upon conducting the habitat assessments it was determined that aquatic biota are likely to occupy this stream. Consequently, one benthic invertebrate composite, one other aquatic invertebrate composite, and one forage fish composite samples were taken.

3.5.1 Aquatic Biota

WD was sampled for aquatic biota near WD-2, just downstream of the culvert that conveys water from the Upper Lake to the ditch, on August 1. Taxa observed in the single BI composite sample collected at this location included: EPT, Coleoptera, Diptera, Amphipoda, and Hemiptera (Table 4). Other aquatic invertebrates observed in the WD composite collected included Gastropoda and Hirudinea (Table 5). Unidentifiable YOY forage fish were captured during invertebrate sampling, and so a single composite of these organisms was also collected for comparison with those sampled in the ULM and LL (Table 8).

3.5.2 Habitat Assessments

3.5.2.1 Aquatic

Aquatic habitat features were evaluated on July 31 along a 108 meter reach of WD. Only three different habitat types were present in this reach: three runs, four low gradient riffles, and one glide (Table 12). Stream widths were consistent throughout the reach, with both the average wetted and bank widths not varying at all across the three habitat types (Table 12). Depths were also relatively constant throughout the reach, though runs generally were the deepest, followed by the glide and the low gradient riffles (Table 12). Only in one of the runs was any evidence of eroding banks (3.5 m) observed and no areas with undercut banks were noted (Table 12).

The predominant bank cover type present throughout the site was willow, although sedges, grasses, trees, and boulders were also observed (Table 13). Substrates consisting of sand, gravel, and cobble were generally evenly distributed, although fines were recorded as the third most dominant substrate type in the downstream most run and the glide (Table 13). Percent fines by grid measurements varied widely but generally increased downstream as the habitat transitioned to runs (Table 13).

Finally, the RBP scores calculated suggested this segment of Wilson Ditch falls within the "sub-optimal" category with factors such as pool substrate characterization and variability, sediment deposition, and channel sinuosity contributing the lowest scores measured (Table 14).

3.5.2.2 Terrestrial

Terrestrial habitat features were evaluated on July 31 along WD, concurrent with where the bird surveys were conducted (see below). Average vegetation height was between 0.15 and one meter, owing to the predominant vegetation type being grasses that were approximately 0.75 meters tall. A few other herbaceous plants were also present, as were autumn olive shrubs, and a couple small patches of trees. Moderate species diversity existed among the plant assemblage present at WD, which appeared to be heavily influenced by human activity.

3.5.3 Bird Surveys

A survey of visible and audible birds was conducted along WD in the morning and evening of July 31. In the evening, noise precluded the ability of the surveyor to hear without difficulty, but in the morning noise was less severe. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

3.6 Upland Perimeter (UOP)

Only terrestrial biota were targeted for collection at the Upland Perimeter (UOP) locations including: five earthworm composites and five soil invertebrate composites. Earthworms were not identified or collected anywhere along the perimeter of the Facility. Two soil invertebrate samples each were collected on the east and west sides of the Facility (i.e., four samples total), although one of the two samples for each side included foliar and aerial insects that do not have as much contact with the soil compared to strictly terrestrial invertebrates. Aquatic and terrestrial habitat and bird community surveys conducted in the WD and PPC areas were assumed to meet the sampling requirements for the UOP sites as discussed below.

3.6.1 Terrestrial Biota

A thorough search for earthworms was conducted around the Upland Perimeter sites; however, at none of the sites did the habitat present support these types of organisms. Soils were generally heavily compacted and very dry thus precluding the ability of the earthworms to burrow and obtain the resources required for survival.

Soil invertebrate collection was attempted at five Upland Perimeter sites: two located on the east side of the Facility (i.e., UOP-SS-17 and 20) and three located on the west side of the Facility (i.e., UOP-SS-2, 9, and 12). At each of these locations, either pitfall traps or coverboards were deployed on July 28 and checked daily until August 4. Additionally, on August 2 sweep nets were used to capture soil and aerial/foliar invertebrates on both the east and west side of the Facility. Four composite soil invertebrate samples were obtained during this time (Table 7). Two of these were collected from east side UOP sites, and the other two collected from west side UOP sites. For each of the two samples collected on either side of the Facility, one of the composites was limited to true soil invertebrates while the other was limited to aerial/foliar invertebrates. The taxa observed in the soil invertebrate samples generally included: Hymenoptera, Coleoptera, Aranea, Acari, and Hemiptera (Table 7). The taxa observed in the aerial/foliar invertebrate samples generally included: Orthoptera, Diptera, Coleoptera, Neuroptera, Hemiptera, Homoptera, Odonata, Lepidoptera, and Trichoptera (Table 7).

3.6.2 Habitat Assessments

3.6.2.1 Terrestrial

The terrestrial habitat assessment conducted on July 31, in which WD and the road perpendicular to WD were evaluated, was assumed to be representative of the Upland Perimeter sites located along this road on the east side of the Facility (see above). Similarly, the terrestrial habitat assessment conducted on PPC on July 27 was assumed to be representative of the Upland Perimeter sites located along the Creek on the west side of the Facility (see above).

3.6.3 Bird Surveys

A survey of visible and audible birds was conducted along the road perpendicular to WD (where several of the Upland Perimeter sites on the east side of the Facility were located) in the morning and evening of July 31. In the evening, noise precluded the ability of the surveyor to hear without difficulty, but in the morning noise was less severe. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19. The bird survey conducted along PPC was assumed to capture birds that are likely found at the Upland Perimeter sites on the west side of the Facility as these are located adjacent to the Creek.

4.0 Results – Reference Sites

4.1 Prickly Pear Creek – Upstream

Aquatic samples targeted for collection at the upstream portion of Prickly Pear Creek (PPC-REF) included: five benthic macroinvertebrate composites and five game fish. No terrestrial biota were designated for collection in this area. More than 100 percent of the target samples were obtained during this collection effort. Aquatic and terrestrial habitat and bird community surveys were also conducted along the upstream portion of PPC.

4.1.1 Aquatic Biota

PPC was sampled upstream of the Facility for aquatic biota from south to north (i.e., from upstream to downstream) on July 27. All samples were collected on this day.

Benthic macroinvertebrate samples were taken with a kick net at five discrete locations along PPC including: PPC-REF-8, 6, 4, 2, and 1, in that order. Taxa observed in PPC-REF BI samples generally included EPT, Coleoptera, Diptera, Odonata, Acari, and Tubificidae (Table 4).

Brown trout were sampled to represent the game fish class in the upstream portion of PPC. Five fish were collected with backpack electroshocker in the area surrounding PPC-REF-4 (i.e., the most central of the PPC-REF sites). Individuals ranged from 275 to 360 mm in length and 172 to 480 g in weight (Table 10). No visible anomalies were observed in any of the fish collected.

4.1.2 Habitat Assessments

4.1.2.1 Aquatic

Aquatic habitat features were evaluated on July 27 along a 123 meter reach surrounding PPC-REF-4. Only two different habitat types were present in this reach: four runs, and two low gradient riffles (Table 12). Stream widths were consistent throughout the reach, with both the average wetted and bank widths only varying by one meter across the two habitat types (Table 12). Depths were generally 40 percent higher in the runs than in the low gradient riffles (Table 12). Eroding banks (3 – 9 m) were observed in the majority of the habitat units. Twenty percent of the most downstream low gradient riffle bank was undercut (Table 12).

The predominant bank vegetation type present throughout the site was trees, although at the upstream and downstream boundaries of the reach grasses were most dominant (Table 13). Substrates were overwhelmingly sandy, with some areas of cobble and gravel (Table 13). Percent fines by grid measurements varied widely but generally were highest in the low gradient riffles and lowest in the runs (Table 13). Finally, the RBP scores calculated suggested this segment of the upstream portion of PPC falls within the “sub-optimal” category, with factors such as epifaunal substrate/available cover, sediment deposition, and channel sinuosity contributing the lowest scores measured (Table 14).

4.1.2.2 Terrestrial

Terrestrial habitat features were evaluated on July 27 and August 1 at two sites along the upstream portion of Prickly Pear Creek (i.e., PPC-REF-8 and 4, respectively). At PPC-REF-8 (the most downstream site along the Creek reference segment), average vegetation height was greater than one meter in the immediate riparian zone where riparian trees and shrubs extended approximately 20 feet up the bank. Beyond this zone, herbaceous vegetation and grasses ranging from 0.15 to one meter in height were present. A moderate diversity of five to 15 common plants was observed at PPC-REF-8, though greater than 50 percent was shrubland in the riparian area immediately adjacent to the Creek. At PPC-REF-4, a similar average vegetation height was observed, though grasses, riparian trees, and shrubs of moderate species diversity were distributed equally throughout the area.

4.1.3 Bird Surveys

A survey of visible and audible birds was conducted at two sites along the upstream portion of PPC (i.e., PPC-REF-1 and 4) in the morning and evening of August 1. Noise was moderate at both sites during both morning and evening surveys. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

4.2 Walker Pond (WP) and Walker Pond Marsh (WPM)

Aquatic samples targeted for collection at Walker Pond (WP), which served as the reference area for the UL and LL, included: five benthic macroinvertebrate composites and five game fish. Five earthworm composites were also designated for collection in this area. Aquatic and terrestrial samples targeted for collection at Walker Pond (WPM), which served as the reference area for both the ULM and the Facility upland areas, included: five benthic macroinvertebrate composites and five earthworm composites. More than 100 percent of the target samples were obtained during this collection effort. Aquatic and terrestrial habitat and bird community surveys were also conducted around Walker Pond and its marsh-like areas, which were established by the flows of Walker Creek.

4.2.1 Aquatic Biota

WP and its marsh-like areas were sampled on August 3. All samples were collected on this day.

Benthic macroinvertebrate samples were taken via kicknet at ten locations around the perimeter of WP, five of which were located in marsh-like habitat, including: WP-1, WPM-1, WP-2, WPM-2, WPM-3, WPM-5, WP-5, WP-4, WP-3, WPM-4, in that order. Taxa observed across both WP and WPM BI samples generally included Ephemeroptera, Trichoptera, Coleoptera, Diptera, Odonata, Amphipoda, and Hemiptera, although Megaloptera were also observed in two of the five WP sites (Table 4).

Rainbow trout were sampled to represent the game fish class in WP. Five fish were collected with either gillnet (deployed near the center of WP extending towards shore) or hook and line. Rainbow trout individuals ranged from 224 to 330 mm in length and 93 to 390 g in weight (Table 10). No visible anomalies were observed in any of the fish collected.

Columbia spotted frogs were seen and heard around the perimeter of WP, especially in the marsh--like areas near WPM-2 and 3. One such frog was hand-collected near WP-4.

4.2.2 Terrestrial Biota

Earthworms were sampled from three locations around the perimeter of WP (i.e., WPS-1, 2, and 3). At each site, two composite samples of 11 to 30 g were collected on August 4.

4.2.3 Habitat Assessments

4.2.3.1 Aquatic

Aquatic habitat features were evaluated on August 3 around the entire perimeter of WP (including its marsh-like areas) concurrent with where the bird surveys were conducted (see below). Human influences were observed in the following forms: docks, walls/dikes/revetments, roads, and evidence of logging.

The riparian zone had a mix of deciduous and coniferous vegetation in both the canopy layer and understory (Table 16). The canopy layer included a sparse or moderate number of trees with a DBH less than or equal to 0.3 m whereas trees with a DBH greater than or equal to 0.3 m were generally absent or sparse (Table 16). The understory consisted of woody shrubs and saplings to a moderate extent, and tall herbs, forbs, and grasses more sparsely (Table 16). Ground cover at both the WP and WPM sites was heavily comprised of herbs, forbs, and grasses while woody shrubs and seedlings were observed to a moderate or sparse extent (Table 16). Inundated vegetation was more often observed at the WPM sites (Table 16). The shoreline substrate zone was predominantly vegetated, though sparse amounts of boulders, cobble/gravel, loose sand, and fine soil/sediment were also observed around the WP and WPM sites (Table 16). The angle of the bank around the perimeter was less than or equal to 30° at half of the sites and between 30° and 75° at the other half of the sites (Table 16). Water levels were at or above the high water mark at all WP and WPM sites (Table 16).

The littoral zone bottom substrate was dominated by sandy and/or silt clay/muck materials, though at some sites sparse quantities of boulders, cobble, and gravel were also observed (Table 18). All substrates were either brown or black in color and none emitted any kind of odor (Table 18). Submergent and floating macrophytes were observed at all sites, though generally only in sparse or moderate amounts (Table 18). No emergent macrophytes were present at any of the WP and WPM sites (Table 18). Sparse or moderate to heavy density fish cover was present in the following forms: aquatic weeds, brush or woody debris, overhanging vegetation, rock ledges or sharp drop-offs, and docks (Table 18). Finally, fish habitat included both human and natural features consisting of both open and covered areas, made up of vegetated, woody, and/or artificial structures (Table 18).

4.2.3.2 Terrestrial

Terrestrial habitat features were evaluated on August 3 around the entire perimeter of WP (including its marsh-like areas) concurrent with where the bird surveys were conducted (see below). Vegetation height varied from 0.15 to one meter where grasses and wildflowers were present (approximately 50 percent of habitat area) and was greater than one meter were shrubs were present (other approximately 50 percent of habitat area). Species diversity was moderate in the area surrounding the lake where alternating sections of shrubs and grasses/wildflowers were present. No trees were observed in the riparian area immediately surrounding WP, but ten to 15 feet beyond the riparian area evergreens approximately 50 feet tall were scattered throughout. These trees were being actively thinned along the east and west sides of the Pond and the east side was also eroded for approximately 50 feet.

4.2.4 Bird Surveys

A survey of visible and audible birds was conducted around the entire perimeter of WP (including its marsh-like areas) in the evening of August 3 and the morning of August 4. In the evening, noise precluded the ability of the surveyor to hear without difficulty, but in the morning noise was less severe. Birds identified during both surveys and the foods typically consumed by each species (Tekiela 2004, Putnam and Kennedy 2005) are provided in Table 19.

5.0 Other Observations

In addition to the biota collected and habitats characterized as described above, the following other observations are worth noting as they relate to the conceptual site model to be refined for the BERA:

- On more than one occasion, humans were observed fishing on PPC near the dam between PPC-103 and PPC-5.
- There was evidence of trespassing on the Facility (e.g., empty cans and bottles and other litter).
- Large aquatic mammals (i.e., beavers, muskrats) were observed in the UL.
- Reptiles (i.e., turtles) were observed in the LL.
- Many small terrestrial mammals (i.e. rabbits) were observed throughout the Facility.
- Large mammals (i.e. deer) were observed adjacent to the Facility, but not inside.

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Table 1: GPS coordinates for all sites visited for biota collection or habitat assessments.

Site	Easting	Northing
Prickly Pear Creek		
PPC-102	1361540.9497100	858998.9365000
PPC-103	1361410.9152400	859309.3983000
PPC-22	1361539.2864000	858798.4234600
PPC-24	1359031.6574500	864351.8370950
PPC-5	1361459.8805800	859635.5845980
PPC-7	1360653.9922900	861560.8318020
PPC-RZ-2	1361465.2277200	859947.8608710
PPC-RZ-4	1361461.4493500	858611.0294180
PPC-RZ-5	1361450.1142900	859117.0616590
Upper Lake		
UL-21	1360717.8295700	858753.8519420
UL-23	1360357.7073900	858474.1893790
UL-24	1360366.1086500	858764.7193720
UL-25	1360277.3845200	857997.3045880
UL-BK-1	1360102.6185400	857738.3978040
UL-BK-2	1360179.3119300	858756.1593380
UL-BK-3	1360423.6509500	858980.1568750
UL-BK-4	1361105.5551500	858885.0545910
Upper Lake Marsh		
ULM-1	1361506.9728900	858238.3785890
ULM-2	1360500.5960300	857675.4035200
ULM-3	1360541.5415000	857836.7807090
ULM-4	1360618.1083500	858060.5098600
ULM-5	1360807.3548500	858382.8662190
ULM-22	1361225.8449000	858150.6371320
Lower Lake & Tito Park		
LL-21	1361147.1073000	859384.0140960
LL-22	1361075.4156600	859155.4348880
LL-23	1360922.0289100	859338.9656230
LL-24	1360743.6334300	859502.4748620
LL-25	1360606.7496300	859370.4742770
LL-BK-1	1360573.7032200	859520.7384500
LL-BK-2	1361327.2990600	859148.6715000
LL-BK-3	1360985.5133500	859529.0807750
LL-BK-4	1360928.8269200	859158.6822710
UOS-SS10	1360604.6405500	859060.4214770
UOS-SS14	1360896.8902600	858918.3974050
UOS-SS21	1360764.1999300	859174.8106240
UOS-SS22	1360670.1294700	858921.7935330
UOS-SS8	1360610.2636700	859208.3818490
Upland Perimeter		
UOP-SS12	1359525.6883000	861780.8987750
UOP-SS17	1361461.5653600	861283.9347650
UOP-SS2	1358983.6685500	861081.6707650
UOP-SS20	1361498.5824900	859392.8126980
UOP-SS9	1359301.5831300	859347.6658770
Wilson Ditch		
WD-2	1358965.1542900	861182.6999960
Prickly Pear Creek Upstream (Reference)		
PPC-REF-1	1353271.5585800	839035.2263230
PPC-REF-2	1355930.6674100	842387.5422320
PPC-REF-4	1358831.1540200	845681.6610180
PPC-REF-6	1362612.2075200	850316.5589000
PPC-REF-8	1361587.3908100	853221.7116910
Walker Pond (Reference)		
WP-1	1273134.4749700	855057.7093610
WP-2	1273047.6969500	854979.8074020
WP-3	1273360.4398900	854802.8097680
WP-4	1273336.2047700	854893.0226860
WP-5	1273341.4094000	854912.1691080
WPS-1	1272859.6727800	854920.0731980
WPS-2	1272999.9269700	854738.5905680
WPS-3	1273044.9173800	854694.6929000
Walker Pond Marsh (Reference)		
WPM-1	1273063.8537800	855009.8731230
WPM-2	1273082.3959900	854993.5348540
WPM-3	1273111.2760500	854707.3016770
WPM-4	1273217.6736100	854763.7216450
WPM-5	1273271.6017500	854965.6961090

NAD_1983_StatePlane_Montana_FIPS_2500_Feet

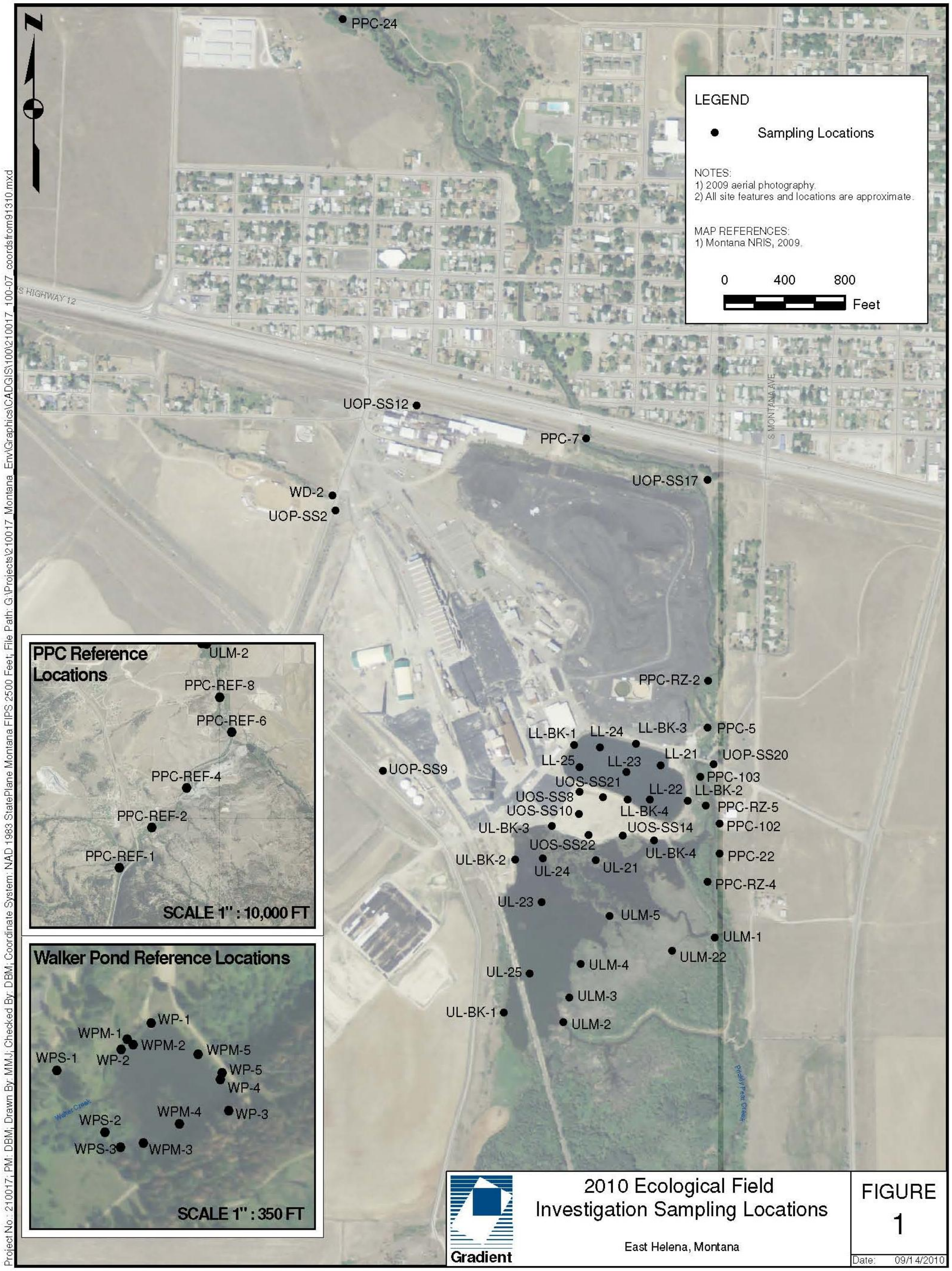


Figure 1: Map of 2010 ecological field investigation sampling locations.

Table 2: Summary of sample collection methodologies for each of the Facility and reference sites.

	Terrestrial				Lake			Marsh		Stream	
Biota	Upland Perimeter	Tito Park	Lake Bank	Riparian Zone	Upper Lake	Lower Lake	Walker Pond	Upper Lake	Walker Pond	Prickly Pear Creek	Wilson Ditch
Benthic macroinvertebrates	–	–	–	–	kick net, ponar	kick net, minnow trap	kick net	kick net	kick net	kick net	kick net
Other aquatic invertebrates	–	–	–	–	kick net	kick net	kick net	kick net	kick net	kick net	kick net
Forage fish	–	–	–	–	minnow trap	kick net, minnow trap	–	kick net, minnow trap	–	backpack electroshocker	kick net
Piscivorous fish	–	–	–	–	gill net	–	–	–	–	backpack electroshocker	–
Game fish	–	–	–	–	gill net, rod and reel	–	gill net, rod and reel	–	–	backpack electroshocker	–
Amphibians	–	–	–	–	–	–	hand	hand	–	hand	–
Soil invertebrates	pitfall traps, cover boards, sweep nets	pitfall traps, cover boards, sweep nets	pitfall traps, cover boards	pitfall traps, cover boards	–	–	–	–	–	–	–
Earthworms	shovel	–	–	shovel	–	–	–	–	–	–	–

Table 3: Incidental wildlife sightings at Facility and reference sites.

Site	Date	Time	Species (Number)	Habitat Type	Activity	Distance from Site	Collected for Tissues	Notes
Lower Lake	Various Times	–	Canada Goose (5+)	Lake	Swimming	0 ft	No	
Road Between Marsh and PPC	Various times	–	Columbia Spotted Frog (7)	Marsh	Swimming	25-50 ft	Only 4 collected	
Upper Lake	All Days	–	Double Crested Cormorant (3)	Lake/Marsh	Perched/Swimming	0 ft	No	Reported on birding sheet but were present every day
Upper Lake	All Days	–	American White Pelican (3)	Lake/Marsh	Perched/Swimming	0 ft	No	Reported on birding sheet but were present every day
Lower Lake	7/30/10	All Day	Canada Goose	Lake	Swimming	0 ft	No	
Tito Park	7/30/10	8:30	Rabbit	Open Shrub	Hopping	0 ft	No	Saw from car
Tito Park Edge	7/30/10	10:30	Osprey	Edge	Perched	500 ft	No	Perched on tower at O_2 Facility
SW Upper Lake	7/30/10	10:30	White Tailed Deer	Grassland	Running	200 ft	No	
Lower Lake	7/29/10-7/30/10	16:00	Ring-Necked Greibe (2)	Lake	Swimming	0 ft	No	
Central Upper Lake	7/30/10	18:30	Beaver	Lake/Marsh	Swimming	0 ft	No	
Lower Lake	7/30/10	19:30	Turtle	Lake	Swimming	0 ft	No	Either a Slider or Painted
West Edge Upper Lake	8/1/10	9:00	Wood Duck	Lake	Swimming	0 ft	No	Mother and 6 chicks
Upper Lake Marsh	8/1/10	15:00	House Wren	Marsh	Perched	0 ft	No	
Road Between Marsh and PPC	8/1/10	15:30	Rabbit	Marsh	Hopping	50 ft	No	
Road Between Marsh and PPC	8/1/10	17:00	American Goldfinch	Marsh	Perched	50 ft	No	Observed during afternoon "free birding"
Road Between Marsh and PPC	8/1/10	17:00	House Wren	Marsh	Perched	50 ft	No	Observed during afternoon "free birding"

Table 3. Incidental wildlife sightings at Facility and reference sites (continued).

Site	Date	Time	Species (Number)	Habitat Type	Activity	Distance from Site	Collected for Tissues	Notes
Lower Lake	8/1/10	17:00	Turtles (6)	Lake	Basking/Swimming	0 ft	No	
At Entrance to Site	8/1/10	18:00	Rabbit	Edge of Parking	Hopping	N/A	No	
Upper Lake	8/2/10	10:00	Great Blue Heron	Lake/Marsh	Flying	0 ft	No	
Upper Lake	8/2/10	10:30	Marsh Wren (8)	Lake/Marsh	Perched	0 t	No	
Upper Lake	8/2/10	10:30	Canada Goose (13)	Lake	Swimming/Feeding	0 ft	No	
Upper Lake	8/2/10	10:30	Eastern Kingbird (3)	Lake	Feeding	0 ft	No	
Upper Lake Edge	8/2/10	11:00	Muskrat	Lake Edge	Swimming	0 ft	No	Swam into home on lake edge
Upper Lake	8/2/10	11:00	Green-Winged Teal (2)	Lake	Preening/Swimming	0 ft	No	
Walker Pond	8/3/10	11:00	Columbia Spotted Frog	Lake Edge/Marsh	Swimming	0 ft	No	4 adults and several tadpoles
Walker Pond	8/3/10	11:00	Great Blue Heron	Lake Edge	Standing Onshore	0 ft	No	

Table 4: Summary of benthic invertebrates collected at Facility and reference sites.

Site	Sample ID	Sample Location(s)	Species	Comments
Prickly Pear Creek Upstream (Creek Reference)	BI-01	PPC-REF-8	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera	
	BI-02	PPC-REF-6	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Acari/Tubificidae	
	BI-03	PPC-REF-4	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Odonata	
	BI-04	PPC-REF-2	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Odonata	
	BI-05	PPC-REF-1	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Odonata	
Prickly Pear Creek	BI-06	PPC-22	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera	
	BI-07	PPC-05	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Amphipoda	
	BI-08	PPC-102	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-09	PPC-103	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-10	PPC-7	Ephemeroptera/Plecoptera/Trichoptera/Diptera	
	BI-11	PPC-24	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Odonata/Hemiptera	
Upper Lake	BI-17	UL-21A	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	Sample collected just east of UL-21
	BI-18	UL-21B	Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Oligochaeta	Sample collected just west of UL-21
	BI-19	UL-24	Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Oligochaeta	
	BI-20	UL-23	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Oligochaeta	
	BI-21	UL-25	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Oligochaeta	
Upper Lake Marsh	BI-12	ULM-1	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-13	ULM-2	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-14	ULM-3	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-15	ULM-4	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-16	ULM-5	Ephemeroptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	

Acari = Water mites, Amphipoda = Scuds, sideswimmers, Coleoptera = Beetles, Diptera = True flies, Ephemeroptera = Mayflies, Hemiptera = True bugs, Megaloptera = Dobsonflies, hellgrammites, Odonata = Dragonflies, damselflies, Plecoptera = Stoneflies, Trichoptera = Caddisflies, Tubificidae = Oligochaetes

Table 4: Summary of benthic invertebrates collected at Facility and reference sites (continued).

Site	Sample ID	Sample Location(s)	Species	Comments
Lower Lake	BI-22	LL-22/21	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Acari	Sample collected between these two locations
	BI-23	LL-22	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Acari	
	BI-24	LL-25	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Acari	
	BI-25	LL-24	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Acari	
	BI-26	LL-21	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Acari	
Wilson Ditch	BI-27	WD	Ephemeroptera/Plecoptera/Trichoptera/Coleoptera/Diptera/Amphipoda/Hemiptera	
Walker Pond (Lake Reference)	BI-28	WP-1	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-30	WP-2	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Megaloptera	
	BI-34	WP-5	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera/Megaloptera	
	BI-35	WP-4	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-36	WP-3	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
Walker Pond Marsh (Marsh Reference)	BI-29	WPM-1	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-31	WPM-2	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-32	WPM-3	Ephemeroptera/Trichoptera/Coleoptera/Diptera/Odonata/Amphipoda/Hemiptera	
	BI-33	WPM-5	Ephemeroptera/Plecoptera/Coleoptera/Diptera/Odonata/Amphipoda	
	BI-37	WPM-4	Ephemeroptera/Plecoptera/Coleoptera/Diptera/Odonata/Amphipoda	

Acari = Water mites, Amphipoda = Scuds, sideswimmers, Coleoptera = Beetles, Diptera = True flies, Ephemeroptera = Mayflies, Hemiptera = True bugs, Megaloptera = Dobsonflies, hellgrammites, Odonata = Dragonflies, damselflies, Plecoptera = Stoneflies, Trichoptera = Caddisflies, Tubificidae = Oligochaetes

Table 5: Summary of other aquatic invertebrates collected at Facility and reference sites.

Site	Sample ID	Sample Location(s)	Species
Prickly Pear Creek	OA-01	PPC-22/5/102	Gastropoda/Hirudinea
	OA-02	PPC-103	Gastropoda
	OA-12	PPC-24	Gastropoda/Hirudinea/Bivalvia
Upper Lake	OA-05	UL-21B/23	Gastropoda/Hirudinea
	OA-06	UL-23/21A/21B/24	Gastropoda/Hirudinea
	OA-07	UL-23/25	Gastropoda/Hirudinea/Crustacea
Upper Lake Marsh	OA-03	ULM-2/5	Gastropoda/Hirudinea/Crustacea
	OA-04	ULM-3/4	Gastropoda/Hirudinea
	OA-11	ULM-4	Gastropoda/Hirudinea
Lower Lake	OA-08	LL-22	Gastropoda/Hirudinea
	OA-09	LL-22/25	Gastropoda/Hirudinea
	OA-10	LL-24/25	Gastropoda/Hirudinea
Wilson Ditch	OA-13	WD	Gastropoda/Hirudinea

Bivalvia = Clams, Crustacea = Crustaceans, Gastropoda = Snails, Hirudinea = Leeches

Table 6: Summary of earthworms collected at Facility and reference sites.

Site	Sample ID	Sample Location	Comments
Prickly Pear Creek	EW-01	PPC-RZ-2	
	EW-04	PPC-RZ-2	
Upper Lake Marsh	EW-02	ULM-27	Location more resembles riparian area rather than marsh
	EW-03	ULM-27	
	EW-05	ULM-27	
	EW-06	ULM-27	
Walker Pond (Lake Reference)	EW-07	WPS-2	
	EW-08	WPS-2	
	EW-09	WPS-1	
	EW-10	WPS-1	
	EW-11	WPS-3	
	EW-12	WPS-3	

Table 7: Summary of soil invertebrates collected at Facility and reference sites.

Site	Sample ID	Sample Location(s)	Species	Comments
Prickly Pear Creek Riparian Zone	SI-03	PPC-RZ-4	Hymenoptera/Trichoptera/Coleoptera	
	SI-07	PPC-RZ-2/4/5	Hymenoptera/Gastropoda/Coleoptera	
Upper Lake	SI-08	UL-BK-1/2/3/4	Hymenoptera/Coleoptera	
Lower Lake	SI-01	LL-BK-1/3	Coleoptera/Lepidoptera/Opiliones/Aranea/Hymenoptera	
	SI-02	LL-BK-1/2/3/4	Coleoptera/Lepidoptera/Opiliones/Aranea/Hymenoptera/Chilopoda	
Tito Park	SI-06	UOS-SS-8/10/14/21/22	Orthoptera/Lepidoptera/Coleoptera/Trichoptera/Hymenoptera/Odonata/Hemiptera	Aerial/foliar
	SI-09	UOS-SS-8/10/14/21/22	Hymenoptera/Coleoptera/Aranea	
Upland Perimeter East	SI-04	UOS-SS-2/9	Orthoptera/Coleoptera/Neuroptera/Hemiptera/Homoptera/Lepidoptera	Aerial/foliar
	SI-10	UOS-SS-17/20	Hymenoptera/Coleoptera/Aranea/Acari/Hemiptera	
Upland Perimeter West	SI-05	UOS-SS-17	Coleoptera/Orthoptera/Diptera/Odonata/Hemiptera/Trichoptera	Aerial/foliar
	SI-11	UOS-SS-2/9/12	Hymenoptera/Coleoptera/Aranea	

Acari = Water mites, Aranea = Spider, Chilopoda = Centipedes, Coleoptera = Beetles, Gastropoda = Snails, Hemiptera = True bugs, Homoptera = Leaf hoppers, Hymenoptera = Wasps, Lepidoptera = Moths, Neuroptera = Lacewings, Odonata = Dragonflies, damselflies, Opiliones = Harvestmen (daddy longlegs), Orthoptera = Grasshoppers, crickets, Trichoptera = Caddisflies

Table 8: Summary of forage fish collected at Facility and reference sites.

Site	Sample ID	Sample Location	Species	Length (mm)	Weight (g)	Method	Comments
Prickly Pear Creek	FF-01	PPC-22	Mottled sculpin	58	2.2	BE	
				65	2.4	BE	
				58	1.9	BE	
				63	2.8	BE	
				55	1.6	BE	
	FF-02	PPC-22	Mottled sculpin	87	6.3	BE	
				63	2.3	BE	
				65	2.7	BE	
	FF-03	PPC-05	Mottled sculpin	98	10.0	BE	
				83	7.3	BE	
				57	2.3	BE	
Upper Lake	FF-06	UL-21B	White sucker	82	5.4	MT	
				70	3.5	MT	
				68	2.9	MT	
				82	6.3	MT	
	FF-07	UL-21B	Fathead minnow	38	0.7	MT	
				52	1.3	MT	
				51	1.2	MT	
				44	0.9	MT	
				69	4.0	MT	
				48	1.0	MT	
				57	1.8	MT	

YOY = Young of the year, unidentifiable species

BE = Backpack electroshocker, MT = Minnow Trap, KN = Kick net

Table 8: Summary of forage fish collected at Facility and reference sites (continued).

Site	Sample ID	Sample Location	Species	Length (mm)	Weight (g)	Method	Comments
Upper Lake (continued)	FF-08	UL-21A	White sucker	87	7.0	MT	
				73	3.8	MT	
				81	5.0	MT	
				71	3.5	MT	
				80	5.3	MT	
	FF-09	UL-21A	Fathead minnow	63	2.3	MT	
				42	0.8	MT	
				45	0.9	MT	
	FF-10	UL-21A	White sucker	100	9.1	MT	
				88	7.0	MT	
				82	6.4	MT	
				85	7.5	MT	
Upper Lake Marsh	FF-04	ULM-3	YOY	–	9.0	KN	Composite weight
	FF-05	ULM-5	YOY	–	10.0	KN	Composite weight
	FF-11	ULM-2	Fathead minnow	52	1.1	MT	
				50	1.0	MT	
				66	2.5	MT	
				46	0.9	MT	
				51	1.0	MT	
				53	1.3	MT	
				45	0.4	MT	
				45	0.7	MT	
				51	1.1	MT	
				52	1.2	MT	
				47	0.9	MT	

YOY = Young of the year, unidentifiable species

BE = Backpack electroshocker, MT = Minnow Trap, KN = Kick net

Table 8: Summary of forage fish collected at Facility and reference sites (continued).

Site	Sample ID	Sample Location	Species	Length (mm)	Weight (g)	Method	Comments
Upper Lake Marsh (continued)	FF-12	ULM-2	Longnose dace	85	4.6	MT	
				71	3.1	MT	
				63	2.2	MT	
				72	3.0	MT	
				69	2.6	MT	
				87	5.3	MT	
				73	3.6	MT	Shortened caudal fin
				96	7.1	MT	
				79	4.2	MT	
Lower Lake	FF-13	LL-24/25	Fathead minnow	71	4.4	MT	
				69	4.0	MT	
	FF-14	LL-24/21	Fathead minnow	64	3.1	MT	
				70	3.9	MT	
	FF-15	LL-25/22	YOY	–	~7.6	KN	
			Fathead minnow	55	2.0	KN	
			Fathead minnow	35	0.4	KN	
Wilson Ditch	FF-16	WD-2	YOY	–	15.0	KN	Composite weight

YOY = Young of the year, unidentifiable species

BE = Backpack electroshocker, MT = Minnow Trap, KN = Kick net

Table 9: Summary of piscivorous fish collected at Facility and reference sites.

Site	Sample ID	Sample Location	Species	Length (mm)	Weight (g)	Method	Comments
Prickly Pear Creek	PF-01	PPC-22	Brown trout	155	39	BE	
	PF-02	PPC-22		172	51	BE	
	PF-03	PPC-22		206	81	BE	
	PF-04	PPC-102/103		220	108	BE	
	PF-10	PPC-24		241	140	BE	
Upper Lake	PF-05	near UL-21	White sucker	218	126	GN	White suckers (benthic detritivore) sampled in the absence of appropriate piscivores
				220	118	GN	
				202	105	GN	
	PF-06	near UL-21	White sucker	225	121	GN	
				218	120	GN	
				205	102	GN	
	PF-07	near UL-21	White sucker	222	131	GN	
				202	96	GN	
				209	105	GN	
	PF-08	near UL-21	White sucker	223	111	GN	
				225	135	GN	
				225	133	GN	
	PF-09	near UL-21	White sucker	228	142	GN	
				204	106	GN	
				219	142	GN	

BE = Backpack electroshocker, GN = Gillnet

Table 10: Summary of game fish collected at Facility and reference sites.

Site	Sample ID	Sample Location	Species	Length (mm)	Weight (g)	Method	Comments
Prickly Pear Creek Upstream (Creek Reference)	GF-01	PPC-REF-4	Brown trout	360	480	BE	
	GF-02			319	284	BE	
	GF-03			301	250	BE	
	GF-04			307	234	BE	
	GF-05			286	209	BE	
	GF-06			275	172	BE	
Prickly Pear Creek	GF-07	PPC-102/103	Brown trout	415	750	BE	
	GF-08	PPC-102/103		380	550	BE	
	GF-15	PPC-24		355	448	BE	
	GF-16	PPC-24		300	295	BE	
	GF-17	PPC-24		311	305	BE	
Upper Lake	GF-09	near UL-23	Rainbow trout	450	1200	GN	
	GF-10	near UL-21	Brown trout	338	460	GN	
	GF-11	near UL-21	Brown trout	275	282	GN	
	GF-12	near UL-21	White sucker	335	535	GN	Not analyzed
	GF-13	near UL-23	Brown trout	278	245	GN	
	GF-14	near UL-23	Rainbow trout	489	1250	GN	
Walker Pond (Lake Reference)	GF-18	WP	Rainbow trout	330	390	GN/HL	
	GF-19	WP		225	102	GN/HL	
	GF-20	WP		224	107	GN/HL	
	GF-21	WP		229	93	GN/HL	
	GF-22	WP		225	101	GN/HL	

BE = Backpack electroshocker, GN = Gillnet, HL = Hook and line

Table 11: Summary of amphibians collected at Facility and reference sites.

Site	Sample ID	Sample Location	Species	Weight (g)	Comments
Prickly Pear Creek / Upper Lake Marsh	AP-01	Between PPC-22 and ULM-1	Columbia spotted frog	10.0	These organisms likely exposed to both ULM and PPC water and sediments
	AP-02			8.0	
	AP-03			15.0	
	AP-04			8.5	
Walker Pond (Lake Reference)	AP-05	WP-4	Columbia spotted frog	20.0	

Table 12: Physical habitat characteristics measured at Facility and reference stream sites.

Habitat Type	No. of Units	Total Length (m)	Average Width (m)		Average Depth (cm)		Average Eroding Bank (m)	Average Undercut Bank (%)
			Wetted	Bankfull	Average	Max		
Prickly Pear Creek Upstream (Reference)								
RUN	4	92	7	11	59	78	4	0
LGR	2	31	8	12	37	50	5	10
Prickly Pear Creek								
RUN	2	104	16	17	65	112	3	0
LGR	1	28	6	13	45	70	0	0
HGR	1	25	8	19	40	80	0	0
SMA	1	17	19	19	unknown	>150	0	0
Bridge/dam outfall	1	6	19	19	–	–	0	0
DMA	1	18	19	37	–	>150	0	0
Wilson Ditch								
RUN	3	42	2	3	20	28	1	0
LGR	4	38	2	3	14	22	0	0
GLD	1	28	2	3	15	20	0	0

LGR = Low Gradient Riffle, HGR = High Gradient Riffle, RUN = Run, GLD = Glide, SMA = Scour middle artificial, DMA = Dammed main artificial, GLD = Glide

Table 13: Substrate and bank vegetation characteristics measured at Facility and reference stream sites. Habitat units are listed from downstream to upstream.

Habitat Units	Dominant Substrate			% Fines by Grid	Dominant Bank Vegetation		
	#1	#2	#3		#1	#2	#3
Prickly Pear Creek Upstream (Reference)							
RUN	sand	cobble	gravel	29	grass	forb	tree
RUN	sand	gravel	cobble	14	tree	grass	forb
LGR	sand	cobble	gravel	40	tree	grass	forb
RUN	sand	gravel	cobble	17	tree	forb	grass
LGR	cobble	sand	gravel	36	tree	grass	forb
RUN	sand	cobble	gravel	32	grass	tree	forb
Prickly Pear Creek							
RUN	cobble	sand	gravel	31	willow	sedge	tree
LGR	cobble	gravel	sand	16	willow	sedge	–
HGR	cobble	gravel	Sand	3	willow	–	–
SMA	cobble	unknown	unknown	9	cement wall	boulder	willow
Bridge/dam outfall	concrete	–	–	0	–	–	–
DMA	sand	–	–	100	willow	grass	–
RUN	sand	gravel	cobble	98	willow	grass	–
Wilson Ditch							
RUN	sand	gravel	fines	69	grass	Russian olive	forb
LGR	gravel	sand	cobble	24	Russian olive	grass	forb
GLD	sand	gravel	fines	40	grass	forb	Russian olive
LGR	cobble	gravel	sand	6	grass	forb	Russian olive
RUN	cobble	gravel	sand	50	grass	forb	Russian olive
LGR	cobble	gravel	sand	9	grass	forb	Russian olive
RUN	sand	gravel	cobble	57	grass	forb	Russian olive
LGR	gravel	cobble	sand	10	forb	grass	Russian olive

LGR = Low Gradient Riffle, HGR = High Gradient Riffle, RUN = Run, GLD = Glide, SMA = Scour middle artificial, DMA = Dammed main artificial, GLD = Glide

Table 14: RBP habitat parameters and scores measured at Facility and reference stream sites.

	Assigned Scores (out of possible 20)			
Habitat Parameter	**PPC-REF**	**PPC (above dam)**	**PPC (below dam)**	**WD**
Epifaunal substrate/Available cover	11	2	15	12
Pool substrate characterization	13	7	16	9
Pool variability	13	12	7	5
Sediment deposition	9	7	18	9
Channel flow status	20	19	19	16
Channel alteration	14	11	13	12
Channel sinuosity	8	9	9	9
Bank stability (score both banks)	18	18	16	18
Vegetative Protection (score both banks)	20	20	20	16
Riparian vegetative zone width (score each bank riparian zone)	11	9	11	11
Total (out of possible 200)	**137**	**114**	**144**	**117**

Condition Category Score Ranges: 200 – 154 = Optimal, 153 – 101 = Suboptimal, 100 – 48 = Marginal, 47 – 0 = Poor

Table 15: Riparian zone physical habitat characteristics measured at Facility sites (Upper and Lower Lakes).

		Upper Lake					Upper Lake Marsh					Lower Lake				
Riparian Zone Physical Habitat Characteristics		**21A**	**21B**	**24**	**23**	**25**	**1**	**2**	**3**	**4**	**5**	**25**	**24**	**21**	**22**	**23**
Vegetation Type	Canopy Layer > 5 m	D	D	N	N	D	N	N	N	N	N	N	N	N	N	N
	Understory 0.5 – 5 m	D	D	N	N	D	D	D	N	N	N	D	D	N	N	N
Canopy Layer	Trees ≥ 0.3 m DBH	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Trees ≤ 0.3 m DBH	1	1	0	0	1	1	0	0	0	0	1	1	0	0	0
Understory	Woody Shrubs and Saplings	1	1	1	1	1	1	0	0	0	1	1	1	0	1	1
	Tall Herbs, Forbs and Grasses	0	0	0	0	0	1	2	2	2	2	1	1	0	1	0
Ground Cover	Woody Shrubs and Seedlings	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1
	Herbs, Forbs, and Grasses	1	1	1	1	0	1	1	0	0	0	4	4	1	1	1
	Inundated Vegetation	2	2	2	1	2	4	4	4	4	4	0	0	1	0	0
	Barren or Buildings	4	4	4	4	4	0	0	0	0	0	1	1	4	4	4
Shoreline Substrate Zone	Bedrock (> 4000 mm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Boulders (250 – 4000 mm)	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
	Cobble/Gravel- (2 – 64 mm)	1	1	1	4	1	0	0	0	0	0	0	1	2	1	1
	Loose Sand (0.06 – 2 mm)	2	2	2	2	3	0	0	0	0	0	0	1	2	3	3
	Fine Soil/Sediment (<0.06 mm)	3	3	3	1	2	2	2	2	2	2	0	0	0	3	3
	Vegetated	1	1	1	1	1	4	4	4	4	4	3	3	1	1	1
	Other (Pavement)	0	0	0	0	0	0	0	0	0	0	3	2	2	0	0
Bank Features	Angle (V=Near Vertical; S=30-75°; G=<30°)	S	S	S	S	S	G	G	G	G	G	G	G	G	V	V
	Vertical Distance from Waterline to High Water Mark (m)	0	0	0	0	0	1.0	0	0	0	0	0.3	0.3	0.3	0.3	0.3
	Horizontal Distance from Waterline to High Water Mark (m)	0	0	0	0	0	2.0	0	0	0	0	0	0.75	0.75	1.5	0.3

DBH = Diameter (diam.) at breast height

Vegetation Type Score Ranges: N=None; D=Deciduous; C=Coniferous; M=Mixed

Areal Coverage Category Score Ranges: 0 = Absent; 1 = Sparse (<10%); 2 = Moderate (10-40%); 3 = Heavy (40-75%); 4 = Very Heavy (>75%)

Table 16: Riparian zone physical habitat characteristics measured at reference sites (Walker Pond and Walker Pond Marsh).

		Walker Pond					Walker Pond Marsh				
Riparian Zone Physical Habitat Characteristics		**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Vegetation Type	Canopy Layer > 5 m	D	D	M	C	M	D	M	M	M	C
	Understory 0.5 – 5 m	D	D	M	C	M	D	M	M	M	C
Canopy Layer	Trees ≥ 0.3 m DBH	0	0	0	1	1	0	0	1	1	1
	Trees ≤ 0.3 m DBH	1	1	2	0	1	1	1	2	2	1
Understory	Woody Shrubs and Saplings	2	2	2	1	1	2	1	2	2	1
	Tall Herbs, Forbs and Grasses	1	1	1	1	1	1	1	1	1	1
Ground Cover	Woody Shrubs and Seedlings	2	2	2	1	1	2	1	2	3	1
	Herbs, Forbs, and Grasses	3	3	3	3	4	3	4	3	2	4
	Inundated Vegetation	1	1	1	0	1	2	1	3	2	1
	Barren or Buildings	0	0	0	3	2	0	0	0	0	2
Shoreline Substrate Zone	Bedrock (> 4000 mm)	0	0	0	0	0	0	0	0	0	0
	Boulders (250 – 4000 mm)	0	0	1	0	1	0	0	0	0	0
	Cobble/Gravel- (2 – 64 mm)	1	0	1	1	1	0	0	0	0	1
	Loose Sand (0.06 – 2 mm)	1	0	1	3	2	0	0	0	0	2
	Fine Soil/Sediment (<0.06 mm)	0	0	0	0	0	0	0	1	0	0
	Vegetated	4	4	4	3	3	4	4	4	4	3
	Other (Pavement)	0	0	0	0	0	0	0	0	0	0
Bank Features	Angle (V=Near Vertical; S=30-75°; G=<30°)	G	G	S	S	S	G	G	G	S	S
	Vertical Distance from Waterline to High Water Mark (m)	0	0	0	0	0	0	0	0	0	0
	Horizontal Distance from Waterline to High Water Mark (m)	0	0	0	0	0	0	0	0	0	0

DBH = Diameter (diam.) at breast height

Vegetation Type Score Ranges: N=None; D=Deciduous; C=Coniferous; M=Mixed

Areal Coverage Category Score Ranges: 0 = Absent; 1 = Sparse (<10%); 2 = Moderate (10-40%); 3 = Heavy (40-75%); 4 = Very Heavy (>75%)

Table 17: Littoral zone physical habitat characteristics measured at Facility sites (Upper and Lower Lakes).

Littoral Zone Physical Habitat Characteristics		**Upper Lake**					**Upper Lake Marsh**					**Lower Lake**				
		21A	**21B**	**24**	**23**	**25**	**1**	**2**	**3**	**4**	**5**	**25**	**24**	**21**	**22**	**23**
General	Station Depth at 10 m Offshore (m)	>1.5	>1.5	1.2	>1.5	1.2	>1.5	1.35	1.35	1.5	1.5	>1.5	>1.5	>1.5	>1.5	>1.5
	Surface Film Type (S=Scum; A=Algal Mat; P=Oily: N=None)	A	A	A	A	A	A	A	A	A	A	N	N	N	N	N
Bottom Substrate	Bedrock (>4000 mm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Boulders (250 – 4000 mm)	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
	Cobble (64 – 250 mm)	1	1	1	0	0	0	0	0	0	0	2	2	2	1	1
	Gravel (2 – 64 mm)	1	1	2	1	1	0	0	0	0	0	2	2	2	1	1
	Sand (0.06 – 2 mm)	1	1	2	1	1	1	2	1	1	0	2	2	2	4	3
	Silt Clay or Muck (<0.06 mm)	4	4	4	4	4	4	4	4	4	4	1	2	3	2	3
	Woody Debris	1	1	0	0	1	1	1	0	1	0	0	0	0	0	1
	Color (BL=Black; GY=Gray; BR=Brown; RD=Red; N=None)	BL	BL	BL	BL	BL	BL	BL	BL	BL	BL	BL	BL	BL	BR	BR
	Odor (S=H_2S; A=Anoxic; P=Oil; C=Chemical; N=None)	A	A	A	A	A	A	A	A	A	A	A	A	A	N	A
Macrophytes	Submergent	3	3	4	3	4	2	1	2	2	2	0	0	0	0	1
	Emergent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Floating	1	1	1	1	1	2	1	1	2	2	0	0	0	0	0
	Total Weed Cover	3	3	4	3	4	2	1	2	2	2	0	0	0	0	1
	Do Macrophytes Extend Lakeward?	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	N	N	N
Fish Cover	Aquatic Weeds	2	2	2	2	2	2	1	2	2	2	0	0	0	0	0
	Snags (>0.3 m diameter)	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
	Brush or Woody Debris (<0.3 m diam.)	1	1	0	0	1	1	1	1	1	1	0	0	0	0	1
	Inundated Live Trees (>0.3 m diam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Overhanging Vegetation (<1 m above surface)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	Rock Ledges or Sharp Dropoffs	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0
	Boulders	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
	Human Structures Such as Docks	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0

Bottom Substrate & Macrophyte Score Ranges: 0 = Absent; 1 = Sparse (<10%); 2 = Moderate (10-40%); 3 = Heavy (40-75%); 4 = Very Heavy (>75%)

Fish Cover Score Ranges: 0 = Absent; 1 = Present but Sparse; 2 = Present in Moderate to Very Heavy Density

Table 17: Littoral zone physical habitat characteristics measured at Facility sites (Upper and Lower Lakes) (continued).

Littoral Zone Physical Habitat Characteristics		Upper Lake					Upper Lake Marsh					Lower Lake				
		21A	**21B**	**24**	**23**	**25**	**1**	**2**	**3**	**4**	**5**	**25**	**24**	**21**	**22**	**23**
Littoral Fish Habitat Classification	Disturbance (H=Human; N=Natural; M=Mixed)	M	M	H	H	H	M	M	M	M	M	H	H	H	H	H
	Cover Class (C=Cover; O=Open; M=Mixed)	C	C	C	C	C	M	M	M	M	M	O	O	O	O	O
	Cover Type (A=Artificial; F=Fill; V=Veg.; W=Woody; B=Boulders; M=Mixed; N=None)	V	V	V	V	V	M	V	V	V	V	N	A	N	N	N
	Substrate (M=Mud/Muck; S=Sand/Gravel; C=Cobble/Boulder; B=Bedrock)	M	M	M	M	M	M	M	M	M	M	S	M	M	S	M
	Gear (G=Gill Net; T=Trap Net; K=Kick Net; M=Minnow Trap; S=Seine; 0=None)	GK	GK	K	K	GK	S	S	K	0	K	KM	KM	KM	KM	KM

Bottom Substrate & Macrophyte Score Ranges: 0 = Absent; 1 = Sparse (<10%); 2 = Moderate (10-40%); 3 = Heavy (40-75%); 4 = Very Heavy (>75%)

Fish Cover Score Ranges: 0 = Absent; 1 = Present but Sparse; 2 = Present in Moderate to Very Heavy Density

Table 18: Littoral zone physical habitat characteristics measured at reference sites (Walker Pond and Walker Pond Marsh).

Littoral Zone Physical Habitat Characteristics		Walker Pond					Walker Pond Marsh				
		1	2	3	4	5	1	2	3	4	5
General	Station Depth at 10 m Offshore (m)	>1.5	>1.5	>1.5	>1.5	>1.5	>1.5	>1.5	>1.5	>1.5	>1.5
	Surface Film Type (S=Scum; A=Algal Mat; P=Oily: N=None)	N	N	N	A	A	N	N	N	N	A
Bottom Substrate	Bedrock (>4000 mm)	0	0	0	0	0	0	0	0	0	0
	Boulders (250 – 4000 mm)	1	0	0	0	0	0	0	0	0	0
	Cobble (64 – 250 mm)	1	0	1	1	1	0	0	0	0	0
	Gravel (2 – 64 mm)	2	1	1	2	1	1	2	0	1	1
	Sand (0.06 – 2 mm)	3	2	2	4	3	2	3	1	2	2
	Silt Clay or Muck (<0.06 mm)	1	4	3	1	3	3	3	4	3	4
	Woody Debris	0	0	2	0	0	0	0	0	0	0
	Color (BL=Black; GY=Gray; BR=Brown; RD=Red; N=None)	BR	BR	BR	BR	BR	BR	BR	BL	BL	BL
	Odor (S=H_2S; A=Anoxic; P=Oil; C=Chemical; N=None)	N	N	N	N	N	N	N	N	N	N
Macrophytes	Submergent	2	2	1	1	1	2	2	1	1	1
	Emergent	0	0	0	0	0	0	0	0	0	0
	Floating	1	1	1	1	1	1	1	1	1	1
	Total Weed Cover	2	2	1	1	1	2	2	1	1	1
	Do Macrophytes Extend Lakeward?	Y	N	N	N	N	Y	Y	N	N	N
Fish Cover	Aquatic Weeds	2	2	1	1	1	2	2	1	1	1
	Snags (>0.3 m diam.)	0	0	0	0	0	0	0	0	0	0
	Brush or Woody Debris (<0.3 m diameter)	0	0	2	0	0	0	1	1	1	0
	Inundated Live Trees (>0.3 m diam.)	0	0	0	0	0	0	0	0	0	0
	Overhanging Vegetation (<1 m above surface)	1	1	2	0	1	1	1	1	1	1
	Rock Ledges or Sharp Dropoffs	0	0	0	1	0	0	0	0	0	0
	Boulders	0	0	0	0	0	0	0	0	0	0
	Human Structures Such as Docks	1	0	0	0	0	0	0	0	0	0

Bottom Substrate & Macrophyte Score Ranges: 0=Absent; 1=Sparse (<10%); 2= Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%)

Fish Cover Score Ranges: 0=Absent; 1=Present but Sparse; 2=Present in Moderate to Very Heavy Density

Table 18: Littoral zone physical habitat characteristics measured at reference sites (Walker Pond and Walker Pond Marsh) (continued).

		Walker Pond					Walker Pond Marsh				
Littoral Zone Physical Habitat Characteristics		**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Littoral Fish Habitat Classification	Disturbance (H=Human; N=Natural; M=Mixed)	M	N	N	N	N	N	N	N	N	N
	Cover Class (C=Cover; O=Open; M=Mixed)	M	M	M	M	M	M	M	M	M	M
	Cover Type (A=Artificial; F=Fill; V=Veg.; W=Woody; B=Boulders; M=Mixed; N=None)	V/A	V	W	V	V	V	V	V	V	V
	Substrate (M=Mud/Muck; S=Sand/Gravel; C=Cobble/Boulder; B=Bedrock)	S	M/S	M/S	S	M/S	M	M/S	M/S	M/S	M/S
	Gear (G=Gill Net; T=Trap Net; K=Kick Net; M=Minnow Trap; S=Seine; 0=None)	GK	GK	GK	GK	GK	GK	GK	GK	GK	GK

Bottom Substrate & Macrophyte Score Ranges: 0=Absent; 1=Sparse (<10%); 2= Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%)

Fish Cover Score Ranges: 0=Absent; 1=Present but Sparse; 2=Present in Moderate to Very Heavy Density

Table 19: Bird observations (foot items typically consumed) at Facility and reference sites.

Site	**Nearest location / Surveyor's Vantage Point**	**American Crow** (fruit, insects, mammals, fish, carrion)	**American Goldfinch** (seeds, insects)	**American Redstart** (insects, seeds, berries – rarely)	**American Robin** (insects, fruits, berries, worms)	**American White Pelican** (fish)	**Barn Swallow** (insects – prefers beetles, wasps, flies)	**Belted Kingfisher** (small fish)	**Black-capped chickadee** (insects, seeds, fruits)	**California Gull** (insects, seeds, mammals)	**Cedar Waxwing** (cedar cones, fruits, insects)	**Common Yellowthroat** (insects)	**Common Raven** (insects, fruits, small animals, carrion)	**Double-crested Cormorant** (small fish, aquatic insects)	**Eastern Kingbird** (insects, fruit)	**Gray Catbird** (insects, fruit)	**Great Blue Heron** (small fish, frogs, insects, snakes)	**House Finch** (seeds, fruits, leaf buds)	**House Sparrow** (seeds, insects, fruit)	**House Wren** (insects)	**Killdeer** (insects)	**Lazuli Bunting** (insects, seeds)	**Mallard** (seeds, plants, aquatic insects)	**Marsh Wren** (insects)	**Mountain Bluebird** (insects, fruit)	**Red-breasted Nuthatch** (insects, seeds)	**Red-necked Grebe** (small fish, aquatic invertebrates, amphibians)	**Red-winged Blackbird** (seeds, insects)	**Song Sparrow** (insects, seeds)	**Swallow – unknown sp.** (insects)	**Tree Swallow** (insects)	**Western Kingbird** (insects, berries)	**Willow flycatcher** (insects)	**Yellow Warbler** (insects)	**Veery** (berries, insects)
Prickly Pear Creek Upstream (Creek Reference)	PPC-REF-1, 4		x		x		x		x		x		x			x		x	x			x			x				x		x			x	
Prickly Pear Creek, Upland Perimeter (East)	PPC-RZ-2				x					x	x				x	x					x								x	x		x			
Upper Lake	UOS-SS14, North side lake					x	x	x		x				x	x		x			x			x	x			x	x			x				
Upper Lake Marsh	ULM-1 (East side Upper Lake)								x	x	x	x		x	x	x							x	x				x	x		x		x		x
Lower Lake, Tito Park	LL-BK-4						x			x											x						x				x			x	
Wilson Ditch, Upland Perimeter (West)	WD-2, UOP-SS2	x																x	x												x				
Walker Pond, Marsh (Lake, Marsh Reference)	WP-1, 2, 3, 4, 5 WPM-1, 2, 3, 4, 5			x	x				x		x	x					x									x			x		x				

Prickly Pear Creek (On-site) – Station PPC-22 Facing Downstream

Prickly Pear Creek (On-site) – Station PPC-22 Facing Upstream

Prickly Pear Creek (On-site) – Station PPC-102 Facing Downstream

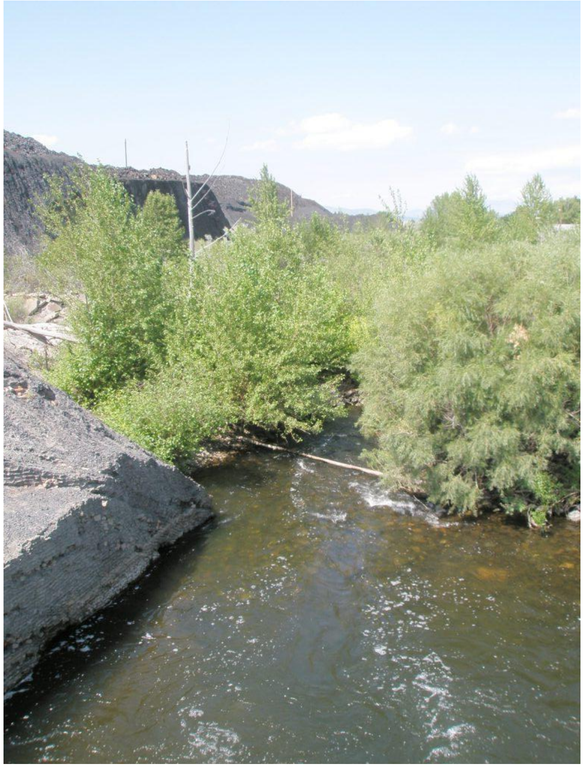
Prickly Pear Creek (On-site) – Station PPC-102 Facing Upstream

Prickly Pear Creek (On-site) – Station PPC-103 Facing Upstream

Prickly Pear Creek (On-Site) – Riparian Site Location PPC-RZ-5

Prickly Pear Creek (On-Site) – Riparian Site Location PPC-RZ-5

Prickly Pear Creek (On-Site) – Riparian Site Location PPC-RZ-4



Prickly Pear Creek (On-Site) – Facing Downstream below impoundment between PPC-103 and PPC-5

Prickly Pear Creek (On-Site) – Facing Downstream of PPC-5

Prickly Pear Creek (On-Site) – Facing Upstream of PPC-5

Upper Lake – North Bank, Facing Southwest (adjacent to Upper Lake Bank Location UL-BK-4)

Upper Lake – North Bank, Facing Southeast (adjacent to Upper Lake Bank Location UL-BK-4)

Upper Lake – West Side – Gillnet location

Upper Lake Near Location UL-24 and UL-BK-3

Upper Lake Bank (UL-BK-4)

Upper Lake Bank (UL-BK-3)

Upper Lake Bank (UL-BK-3)

Upper Lake – Beaver Sighting Near Northeast Bank

Upper Lake Bank (UL-BK-2)

Upper Lake Bank (UL-BK-2)

Upper Lake Marsh Facing North

Upper Lake Marsh Facing South

Upper Lake Marsh Facing West

Upper Lake Marsh (Minnow Trap Location)

Upper Lake Marsh (Minnow Trap Location)

Upper Lake Marsh (Facing South)

Lower Lake, East Bank, Facing West

Lower Lake (West Bank)

Lower Lake – East Bank

Lower Lake Bank (LL-BK-2)

Tito Park – East Side, Facing West

Tito Park – Middle, Facing West

Tito Park – Pitfall Trap

Tito Park – Near UOS-SS10

Tito Park – Near UOS-SS22

Tito Park – Pitfall Trap Near UOS-SS8

Wilson Ditch - Outlet

Wilson Ditch – Near Outlet, Facing West

Wilson Ditch – Near Outlet, Facing East

Wilson Ditch – Near Outlet, Facing West

Upland Perimeter – Location UOP-SS2

Upland Perimeter – Facing West, Near UOP-SS9, White-Tailed Deer Sighting

Upland Perimeter – Location UOP-SS9

Upland Perimeter – Location UOP-SS2

Upland Perimeter – Location UOP-SS12

Upland Perimeter – Near UOP-SS17

Upland Perimeter – Location UOS-SS20

Prickly Pear Creek (Reference Area) - PPC-REF-4

Example of Prickly Pear Creek (Reference Area) - PPC-REF-4
Facing Downstream

Example of Prickly Pear Creek (Reference) – Facing Upstream (PPC-REF-4)

Example of Prickly Pear Creek (Reference) – Facing Downtream (PPC-REF-4)

Walker Creek – Pond Area West Side, Facing South

Walker Creek – Pond and Marsh Area North Side, Facing South

Walker Creek – Marsh Area North Side, Facing South

Walker Creek – Pond Area North Side, Facing East

Walker Creek - Pond and Marsh Area – East Side, Facing South

Walker Creek – Pond Area - Gillnet

Benthic Invertebrate

mple ID	~ Weight (g)	Site	Date	Time	Notes (taxa observed)
BI-01	~~25~~ cac 25	PPC-REF-8	7.27.10	0920	EPTs, coleoptera (few), diptera
BI-02	20	PPC-REF-6	7.27.10	1100	EPT, CD, acari, tabificidae
BI-03	20	PPC-REF-4	7.27.10	1220	EPT, CD, odenatae
BI-04	20	PPC-REF-2	7.27.10	1612	~~EPT~~ cac CD, odenata, EPT
BI-05	20	PPC-REF-1	7.27.10	1722	EPT, CD, odenata
BI-06	15	~~PP~~PPC-22	7.28.10	1017	EPT, CD
BI-07	17	PPC-~~05~~ cac 05	7.28.10	1243	EPT, CD, amphipoda
BI-08	13	PPC-102, ~~103~~ cac	7.28.10	1600	EPT, CD, amphipoda, odenata, ~~hyn~~ hemiptera
BI-09	15	PPC-103	7.28.10	1645	EPT, CD, amphipoda, odenata, hemiptera
BI-10	20	PPC-7	7.28.10	1740	EPT, D
BI-11	20	PPC-24	cac ~~7~~8.01.10	1140	EPT, CD, hemiptera, odenata
BI-12	11	ULM-~~29~~ cac 1	7.29.10	1014	amphipoda, odenata, E, CD, hemiptera
BI-13	12	ULM-~~3~~ cac 2	7.29.10	1230	amphipoda, odenata, E, CD, hemiptera
BI-14	~~12~~ cac 10	ULM-3	7.29.10	1600	↓
BI-15	~~11~~ cac 10	ULM-4	7.29.10	1745	
BI-16	~~10~~ cac 11	ULM-5	7.29.10	1840	
BI-17	11	UL-21A	7.30.10	10:30	odenata, hemiptera, CD, E, amphipoda
BI-18	12	UL-~~24~~ 21B	7.30.10	~~101~~ cac 1133	odenata, hemiptera, CD, amphipoda, oligochaete
BI-19	11	UL-24	7.30.10	1223	odenata, hemiptera, CD, amphipoda, E, oligo
BI-20	10	UL-23	7.30.10	1450	E, odenata, amphipoda, CD, hemiptera, oligo
BI-21	16	UL-25	7.30.10	1607	E, CD, odenata, amphipoda, hemiptera, oligo
BI-22	~~20~~ cac 10	btw UL-22, 21 near UL-BK-2	7.31.10	909	hemiptera, E, T, C, D, odenata, ~~amphipoda~~ cac (sed) acari
BI-23	10	UL-22	7.31.10	1150	hemiptera, E, T, C, D, odenata, ~~amphipoda~~ cac (sed) acari
BI-24	10	UL-25	7.31.10	1345	hemiptera, E, T, C, D, odenata, ~~amphipoda~~ cac (sed)
BI-25	10	UL-24	7.31.10	1443	hemiptera, E, T, C, D, odenata, ~~amphipoda~~ cac (sed)
BI-26	11	UL-21	7.31.10	1552	hemiptera, E, T, C, D, odenata, ~~amphipoda~~ cac acari
BI-27	20	WD	8.1.10	1221	amphipoda, hemiptera, CD, EPT
BI-28	20	WP-1	8.03.10	1051	E~~P~~ cac T, CD, amphipoda, odenata, hemiptera
BI-29	20	WPM-1	8.03.10	1102	ET, CD, amphipoda, odenata, megaloptera, hemiptera
BI-30	20	WP-2	8.03.10	1129	ET, CD, ampipoda, odenates, hemiptera
BI-31	13	WPM-2	8.03.10	1159	ET, CD, amphipoda, odenata, hemiptera
BI-32	12	WPM-3	8.~~04~~ cac 03.10	1226	ET, CD, amphipoda, hemiptera, odenata
BI-33	13	WPM-5 cac	8.03.10	1340	ET, CD, amphipoda, ~~hemiptera~~ cac, odenata
BI-34	13	WP-45	8.03.10	1401	ET, CD, amphipoda, hemiptera, odenata, megaloptera
BI-35	15	WP-4	8.03.10	1431	ET, CD, amphipoda, hemiptera, odenata

Targets:			
5	PPC Upstream	✓ I |||| ✓	WO - 1
-	PPC Riparian	—	
~~5~~ cac 6	PPC Downstream	|||| ✓	
5	Upper Lake	|||| ✓	
-	Upper Lake Bank	—	
5	Upper Lake Marsh	|||| ✓	
5	Lower Lake	|||| ✓	
-	Lower Lake Bank	—	
-	Tito Park	—	
5	Lake Reference	|||| ✓	
5	Marsh Reference	|||| ✓	
-	Upland Onsite	—	
-	Upland Reference	—	

CD: coleoptera, diptera

EPT = ephemera, plecoptera, tricoptera

Sample ID	~ Weight (g)	Site	Date	Time	Notes
BL-36	11	WP-3	8.3.10	1455	E, P, C, D, hemiptera, odenata, amphipoda
BL-37	12	WPM-4	8.3.10	1524	Ē, P, C, D, hemiptera, odenata, amphipoda

done

Other Aquatic

ample ID	~ Weight (g)	Site	Date	Time	Notes (taxa, #/composite)
OA-01	11	PPC 22,25,102,103 CAC	7.28.10	1600	Gastropoda @ PPC 22, Hyrudinea @ PPC 05, same @ PPC 102,103
OA-02	20	PPC-102,3	7.28.10	1645	Gastropoda, ~~h~~ CAC
OA-03	8	ULM-2,5	7.29.10	1640	gastropoda, hyrudinae, Crustacea
OA-04	9	ULM-3,4	7.29.10	1745	gastropoda, hyrudinae
OA-05	12	ULM-~~2,4~~ [illegible] CAC	7.30.10	1000	hyrudinae, gastropoda 21B, 23
OA-06	10	UL-23 21A,21B, 24	7.30.10	1450	gastropoda, hyrudinae 21A, 21B, 24, 23
OA-07	~~10~~ CAC 11	~~A~~ UL-25, 23 CAC	7.30.10	1655	Gastropoda, Crustacea, hyrudinae 25, 23
OA-08	11	UL-22	7.31.10	1155	gastropoda, hyrudinae
OA-09	10	UL-22,25	7.31.10	1215	gastropoda, hyrudinae
OA-10	20	UL-25, 24	7.31.10	1554	gastropoda, hyrudinae
OA-11	8	ULM-4	8.1.10	0930	gastropoda, hyrudinae
OA-12	10	PPC-24	8.1.10	1140	gastropoda, Bivalvia, hyrudinae
OA-13	20	WD	8.1.10	1221	gastropoda, hyrudinae

Targets:

100%

~~3~~ CAC	PPC Upstream	—
-	PPC Riparian	—
UN 3	PPC Downstream	||| ✓
3	Upper Lake	||| ✓
-	Upper Lake Bank	—
3	Upper Lake Marsh	||| ✓
3	Lower Lake	||| ✓
-	Lower Lake Bank	—
-	Tito Park	—
-	Lake Reference	—
-	Marsh Reference	—
-	Upland Onsite	—
-	Upland Reference	—

WD-1 ✓

Earthworm

ample ID	~ Weight (g)	Site	Date	Time	Notes
EW-01	10	PPC RZ-2	7.21.10	1158	
EW-02	10	ULM-27	8.01.10	1353	
EW-03	20	ULM-27	8.03.10	0650	
EW-04	15	PPC-RZ-2	8.03.10	0843	
EW-05	20	ULM-27	8.03.10	0850	
EW-06	20	ULM-27	8.03.10	0850	
EW-07	13	WPS-2	8.04.10	0945	
EW-08	13	WPS-2	8.04.10	0945	
EW-09	11	WPS-1	8.04.10	1005	
EW-10	11	WPS-1	8.04.10	1005	
EW-11	20	WPS-3	8.04.10	1015	
EW-12	30	WPS-3	8.04.10	1015	
EW-13					
EW-14					
EW-15					
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EW-17					
EW-18					
EW-19					
EW-20					
EW-21					
W-22					
EW-23					
EW-24					
EW-25					
EW-26					
EW-27					

Targets:	-	PPC Upstream
	5	PPC Riparian II @ PPC-RZ-2 IIII ULM-27
	-	PPC Downstream
	-	Upper Lake
	2	Upper Lake Bank [illegible] UL BK. X
	3	Upper Lake Marsh I @ ULM-27 (riparian habitat)
	-	Lower Lake
	2	Lower Lake Bank x
	-	Tito Park
	-	Lake Reference
	5	Marsh Reference
	5	Upland Onsite
	5	Upland Reference

Soil Invertebrate

ample ID	~ Weight (g)	Site	Date	Time	Notes (taxa observed)
SI-01	10	~~PPC~~ 1,3 UL-1, UL-3 BK-1	7.30.10	1043	coleoptera, lepidoptera, opiliones, aranea, hymenoptera
SI-02	11	UL-BK-1·4	08.01.10	1415	chilopoda ↓ + (SRR)
SI-03	10	PPC-RI-4	08.01.10	1400	hymenoptera, tricoptera, Coleoptera
SI-04	10 (W)	SS 2,9	08.04.10	0950	orthoptera, coleoptera, neuroptera, hemiptera, homoptera, lepidoptera
SI-05	13 (E)	SS 17	08 04.10	0950	coleoptera, orthoptera, diptera, odonata, hemiptera, tricoptera.
SI-06	9	Tito Park (UOS)	08.04.10	0950	orthoptera, lepidoptera, coleoptera, tricoptera, hymenoptera, homoptera, odonata, hemiptera
SI-07	≥5	RI-2,4,5			hymenoptera, gastropoda, coleoptera
SI-08	≥3	UL-BK-1,2,3,4			hymenoptera, coleoptera
SI-09	≥3 (all)	UOS-8,10,14,21,22			hymenoptera, coleoptera, aranea
SI-10	≥6 (E)	UOS SS 17,20			hymenoptera, coleoptera, aranea, acari, hemiptera
SI-11	≥3 (W)	UOS SS-2,12,9			hymenoptera, coleoptera, aranea
SI-12					
SI-13					
SI-14					

Targets:		
	-	PPC Upstream
	3	PPC Riparian |
	-	PPC Downstream
	-	Upper Lake
	2	Upper Lake Bank
	-	Upper Lake Marsh
	-	Lower Lake
	2	Lower Lake Bank || ✓
	2	Tito Park
	-	Lake Reference
	-	Marsh Reference
	5	Upland Onsite
	-	Upland Reference

Jones

Forage Fish

ample ID	~ Weight (g)	Site	Date	Time	Notes (taxa, #/composite)
FF-01	10.9	PPC-22	7.28.10	1107	Mottled Sculpin
FF-02	11.3	PPC-22	7.28.10	1109	" "
FF-03	19.6	PPC-05	7.28.10	1240	"
FF-04	9.0	ULM-03	7.29.10	1600	unidentifiable YOY
FF-05	10.0	ULM-05	7.29.10	1850	unidentifiable YOY
FF-06	18.1	UL-~~24~~ 21B cc	7.30.10	919	white sucker
FF-07	10.9	UL-~~24~~ 21B cc	7.30.10	~~1017~~ 939 cc	fathead minnow
FF-08	24.6	UL-21A	7.30.10	954	white sucker
FF-09	4	UL-21A	7.30.10	957	fathead minnow
FF-10	30.0	UL-21A	7.30.10	1012	white sucker + extra
FF-11	12.1	ULM-02	7.30.10	1517	fathead minnow - traps set 24 hrs.
FF-12	35.7	ULM-02	7.31.10	1523	longnose dace - " " "
FF-13	8.4	cc UL-24,25	7.31.10	853	fathead minnow male, breeding; coll @ UL-BK-1
FF-14	7.0	MW UL-24,21	7.31.10	854	fathead minnow ; coll @ UL-BK-3
FF-15	10	UL-25,22	7.31.10	1325	fathead minnow YOY & fathead minnow - kicknet
FF-16	15	WD-2	8.1.10	1220	YOY : unidentifiable

Targets:	3	PPC Upstream —	3 sculpins
	-	PPC Riparian —	
	3	PPC Downstream ||| ✓	
	3	Upper Lake |||| ✓ (+2)	3 WS, 2 FHM
	-	Upper Lake Bank —	
	3	Upper Lake Marsh ||| (+1) ✓	2 YOY, 1 FHM, 1 LND
	3	Lower Lake ||| ✓	3 FHM (1 w/ YOY) 3 cc
	-	Lower Lake Bank —	
	-	Tito Park —	
	-	Lake Reference —	
	-	Marsh Reference —	
	-	Upland Onsite —	
	-	Upland Reference —	

YOY = Young of Year

Piscivorous Fish

Sample ID	~ Weight (g)	Site	Date	Time	Notes (taxa, #/composite)
PF-01	39	PPC-22	7.28.10	1117	BT
PF-02	51	PPC-22	7.28.10	1118	BT
PF-03	81	PPC - 22	7.28.10	1116	BT
PF-04	108	PPC - 102, 103	7.28.10	~~405~~ cac 1605	BT
PF-05	349	UL - near UL-A/B	7.31.10	0924	benthivore composite, WS (replaced piscivore)
PF-06	~~648~~ cac 343	↓	7.31.10	0926	↓
PF-07	~~343~~ cac 352		7.31.10	0928	
PF-08	~~323~~ cac 379		7.31.10	0930	
PF-09	~~379~~ cac 390		7.31.10	0931	
241 PF-10	140	PPC 24	8.01.10	1042	Brown trout

Targets:	~~5~~ cac —	PPC Upstream —
	-	PPC Riparian —
	5 ~~cac~~	PPC Downstream ~~||||~~ ✓ BROWN TROUT
	5	Upper Lake ~~||||~~ (benthivore) WS
	-	Upper Lake Bank —
	-	Upper Lake Marsh —
	-	Lower Lake —
	-	Lower Lake Bank —
	-	Tito Park —
	-	Lake Reference —
	-	Marsh Reference —
	-	Upland Onsite —
	-	Upland Reference —

BT: Brown trout, WS - white sucker

dow

	Game Fish (brook trout, rainbow trout - do not composite)					
	Sample ID	~ Weight (g)	Site	Date	Time	Notes (taxa)
	GF-01	400	PPC-REF-4	7.27.10	1222	Brown trout
	GF-02	284	PPC-REF-4	7.27.10	1230	Brown trout
	GF-03	250	PPC-REF-4	7.27.10	1235	Brown trout
	GF-04	234	PPC-REF-4	7.27.10	1240	Brown trout
	GF-05	209	PPC-REF-4	7.27.10	1245	Brown trout
	GF-06	172	PPC-REF-4	7.27.10	1250	Brown trout
	GF-07	750	PPC-102,103	7.28.10	~~404~~ 1604	Brown trout
	GF-08	550	PPC-102,103	7.28.10	~~405~~ 1605	Brown trout
	GF-09	1200	UL-near UL-23	7.30.10	1404	Rainbow trout
	GF-10	460	UL-near 21A,B	7.30.10	1740	Brown trout
	GF-11	282	UL-near 21A	7.31.10	916	~~Ba~~ck Brown trout
	~~GF-12~~	~~535~~	~~UL-near 21A,B~~	~~7.31.10~~	~~920~~	~~White sucker~~ DO NOT ANALYZE
	GF-13	245	UL-near UL-23	7.31.10	1644	Brown trout
4[illegible]	GF-14	1050	UL-near UL-23	7.31.10	1647	Rainbow trout
355	GF-15	448	PPC-24	8.01.10	1040	Brown trout
300	GF-16	295	PPC-24	8.01.10	1041	Brown trout
311	GF-17	305	PPC-24	8.01.10	1042	Brown trout
	GF-18	390	WP	8.03.10	1707	RBT
	GF-19	102	WP	8.03.10	1708	RBT
	GF-20	107	WP	8.03.10	1708	RBT
	GF-21	93	WP	8.03.10	1708	RBT
	GF-22	101	WP	8.03.10	1709	RBT

Targets:	5	PPC Upstream ✓ ~~IIII~~ (+1) ✓	BROWN TROUT
	-	PPC Riparian	
	5	PPC Downstream ~~IIII~~ ✓	BROWN TROUT
	5	Upper Lake ~~IIII~~ ✓	2 RBT, 3 BT
	-	Upper Lake Bank	
	-	Upper Lake Marsh	
	-	Lower Lake	
	-	Lower Lake Bank	
	-	Tito Park	
	5	Lake Reference ~~IIII~~	
	-	Marsh Reference	
	-	Upland Onsite	
	-	Upland Reference	

Amphibian					
Sample ID	~ Weight (g)	Site ULM	Date	Time	Notes (taxa, #/composite)
AP-01	10	PPC-22/*	7.28.10	1055	Columbia Spotted Frog. -*coll. btw PPC & marsh along [illegible]
AP-02 03	8	PPC-22/ULM-1	7.31.10	1215	Columbia Spotted frog -* " " " " " [illegible]
AP-03 02	15	PPC-22/*	7.28.10	1045	Columbia spotted frog * coll. btw PPC & marsh
AP-04	8.5	PPC-22 ULM-1	8.1.10	1523	Columbia Spotted Frog * " " " "
AP-05	20	WP-4	8.3.10	1416	Columbia spotted frog.

Targets:		
~~-~~ 2	PPC Upstream	-
-	PPC Riparian	-
~~-~~ 2	PPC Downstream	||| ✓
1	Upper Lake	
-	Upper Lake Bank	-
1	Upper Lake Marsh	| ✓
1	Lower Lake	
-	Lower Lake Bank	-
-	Tito Park	-
-	Lake Reference	- |
-	Marsh Reference	-
-	Upland Onsite	-
-	Upland Reference	-

Date: 7/27/10 Site: PPC-REF-01 Personnel: CC/SM/DM Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	GF-01	BT	1	360mm	450 g	BE	12:20	12:22	None
2	GF-02	BT	1	319mm	284 g	BE	12:25	12:30	None
3	GF-03	BT	1	301mm	250 g	BE	12:30	12:35	None
4	GF-04	BT	1	317mm	234 g	BE	12:35	12:40	None
5	GF-05	BT	1	286mm	209 g	BE	12:40	12:45	None
6	GF-06	BT	1	275mm	172g	BE	12:45	12:50	None
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BE = Backpack Electroshocker

BT = ~~Brook~~ Brown trout

Date: 7/28/10 Site: PPC-22 Personnel: JM, DR, SB Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	FF-01	SC	1	58	22	BE		1104	None
2	FF-01	SC	2	65	2.4	BE		1105	None
3	FF-01	SC	3	58	1.9	BE		1106	None
4	FF-01	SC	4	63	2.8	BE		1106	None
5	FF-01	SC	5	55	1.6	BE		1107	None
6	FF-02	SC	1	87	6.3	BE		1109	None
7	FF-02	SC	2	63	2.3	BE		1109	None
8	FF-02	SC	3	65	2.7	BE		1109	None
9	~~PF-01~~								
10	PF-01	BT	1	155	39	BE		1117	
11	PF-02	BT	1	172	51	BE		1118	
12	PF-03	BT	1	206	81	BE		1116	
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SC = Sculpin, BE: Backpack electroshocker, BT = Brown trout
(Mottled sculpin)

Date: 7/28/10 Site: PR-05 Personnel: TV, JM, CC Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	FF-03	SC	1	98	10.0	BE		1239	
2	FF-03	SC	2	83	7.3	BE		1240	
3	FF-03	SC	3	57	2.3	BE		1240	
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SC = Sculpin

BE = Backpack electroshocker

Date: 7.28.10 Site: PPC-102, 103 Personnel: JM, SB, CC, TV Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	BF-04	BT	1	220	108	BE		358	
2	GF-07	BT	1	415	750	BE		404	
3	GF-08	BT	1	380	550	BE		405	
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BT - Brown trout

BE : Backpack electroshocker

21B crc

Date: 7.30.10 Site: UL-24 Personnel: CC, SB Page 1 of ____

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	FF-06	WS	1	82	5.4	MT		9:12	
2	FF.06	WS	2	70	3.5	MT		9:14	
3	FF.06 crc	WS	3	68	2.9	MT		9:17	
4	FF-0~~7~~6 crc	WS	4	82	6.3	MT		9:19	
5	FF.07	FHM	1	38	0.7	MT		9:20	
6	FF-07	FHM	2	52	1.3	MT		9:22	
7	FF-07	FHM	3	51	1.2	MT		9:23	
8	FF-07 crc	FHM	4	44	0.9 crc	MT		9:25	
9	FF-~~08~~07	FHM	5	69	4 ~~6.9~~	MT		9:26	
10	FF-07	FHM	6	48	1	MT		9:27	
11	FF-07	FHM	7	57	1.8	MT		9.39	
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WS = White Sucker

MT = Minnow trap

Date: 7.30.10 Site: UL-21A Personnel: CC, SB Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	FF-08	WS	1	87	7.0	MT		940	
2	FF-08	WS	2	73	3.8	MT		949	
3	FF-08	WS	3	81	5.0	Mt		951	
4	FF-08	WS	4	71	3.5	MT		952	
5	FF-09	FHM	1	63	2.3	MT		953	
6	FF-08	WS	5	80	5.3	Mt		954	
7	FF-09	FHM	2	42	0.8	MT		956	
8	FF-09	FHM	3	45	0.9	MT		957	
9	FF-10	WS	1	100	9.1	MT		1005	
10	FF-10	WS	2	88	7.0	Mt		1006	
11	FF-10	WS	3	82	6.4	MT		1008	
12	FF-10	WS	4	85	7.5	Mt		1012	
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Date: 7.30.10 Site: UL (near M-23) Personnel: JM, DM Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	GF-09	RBT	1	450	1200	GN		1406	None
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GN: gillnet, RBT: rainbow trout

Date: 7.30.10 Site: ULM - 2 Personnel: VM, SB, CC Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	FF-11	FHM	1	52	1.1	SAC MT		1515	
2	FF-11	FHM	2	50	1.0	MT		1515	
3	FF-11	FHM	3	66	2.5	MT		1515	
4	FF-11	FHM	4	46	0.9	MT		1516	
5	FF-11	FHM	5	51	1.0	MT		1516	
6	FF-11	FHM	6	53	1.3	MT		1516	
7	FF-11	FHM	SAC ~~6~~ 7	45	0.4	MT		1516	
8	FF-11	FHM	8	45	0.7	MT		1517	
9	FF-11	FHM	9	51	1.1	MT		1517	
10	FF-11	FHM	10	52	1.2	MT		1517	
11	FF-11	FHM	11	47	0.9	MT		1517	
12	FF-12	LND	1	85	4.6	MT		1518	
13	FF-12	LND	2	71	3.1	MT		1519	
14	FF-12	LND	3	63	2.2	MT		1520	
15	FF-12	LND	4	72	3.0	MT		1520	
16	FF-12	LND	5	69	2.6	MT		1520	
17	FF-12	LND	6	87	5.3	MT		1521	
18	FF-12	LND	7	73	3.6	MT		1521	shortened tip caudal fin
19	FF-12	LND	8	96	7.1	MT		1522	
20	FF-12	LND	9	79	4.2	MT		1523	
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LND - Longnose dace
FHM - fathead minnow

Date: 7.20.10 Site: W. near 21A,B Personnel: DM, JM Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	GF-10	BT	1	338	460	GN		1740	
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Date: 7.31.10 Site: Lowa lake Personnel: SB, CE Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	FF-13	FHM	1	71	4.4	MT		853	
2	FF-13	FHM	2	69	4.0	MT		853	
3	FF-14	FHM	1	64	3.7	MT		854	
4	FF-14	FHM	~~1~~ ce 2	70	~~3.9~~ ce 3.9	MT		852	
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MT: minnow trap FHM: fathead minnow

Date: 7.31.10 Site: UPPER LAKE Personnel: JM, DM Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	GF-~~10~~ 11	BT	1	275	282	GN		916	
2	GF-~~11~~ 12	WS	1 ~~2~~ CAC	335	535	GN		920	
3	PF-05	WS	1	218	126	GN		922	
4	PF-05	WS	2	220	118	GN		923	
5	PF-05	WS	3	202	105	GN		924	
6	PF-06	WS	1	225	121	GN		924	
7	PF-06	WS	2	218	120	GN		925	
8	PF-06	WS	3	205	102	GN		925	
9	PF-07	WS	1	222	131	GN		926	
10	PF-07	WS	2	202	96	GN		927	
11	PF-07	WS	3	209	105	GN		928	
12	PF-08	WS	1	223	111	GN		928	
13	PF-08	WS	2	225	135	GN		929	
14	PF-08	WS	3	225	133	GN		929	
15	PF-09	WS	1	228	142	GN		930	
16	PF-09	WS	2	204	106	GN		930	
17	PF-09	WS	3	219	142	GN		931	CAC
18	~~PF-10~~	~~WS~~	~~1~~			~~GN~~			
19	~~PF-10~~	~~WS~~	~~2~~			~~GN~~			
20	~~PF-10~~	~~WS~~	~~3~~			~~GN~~			
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Date: 731.10 Site: LL-25, 22 Personnel: JM Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	FF-15	unidentifiable	many	unknown	unkown	Kicknet		1215	YOY
2	FF-15	FHM	1 0	55	2	Kicknet		1325	
3	FF-15	FHM	2	35	0.4	Kicknet		1325	
4									
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Date: 7.31,10 Site: VL Personnel: JM, OM Page_____of_____

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	GF-13	BT	1	278	245	GN		1644	
2	GF-14	RBT	1	489	1250	GN		1647	
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Date: 8.01.10 Site: PPC-24 Personnel: JM, DM, CC Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
1	PF-10	BT	1	241	140	BE		1042	
2	GF-15	BT	1	355	448	BE		1040	
3	GF-16	BT	1	300	295	BE		1041	
4	GF-17	BT	1	311	305	BE		1042	
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Date: 8.3.10 Site: Walker Pond Personnel: VM, DM, CC Page 1 of 1

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
	GF-18	RBT	1	330	390	GN/HL		1707	
2	GF-19	↓	1	225	102	GN/HL		1708	
3	GF-20		1	224	107	GN/HL		1708	
4	GF-21		1	229	93	GN/HL		1708	
5	GF-22		1	225	101	GN/HL		1709	
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GN = gill net
HL = hook/line

Date: ____________ Site: __________________ Personnel:________________________________ Page_____of_____

	Sample ID	SPECIES	COUNT	LENGTH	WEIGHT	METHOD	START TIME	END TIME	ABNORMALITIES
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Incidental Wildlife Sightings

Site Name	Date	Time	Species	Habitat Type	Activity	Distance from Site	Collected for Tissues?	If not at designated site		Notes
								Easting	Northing	
Titolark Edge	7/30/10	10:30 AM	Osprey	Edge	Perched	~500'	No			Perched on tower @ O2 facility
Fish Park	"	5:30 PM	Rabbit	open shrub	Hopping	0'	No			Saw from car
So. Upper Lake	"	10:30 AM	White-tailed Deer	Grassland	Running	~800'	No			
Central Upper Lake	7/30/10	6:30 PM	Beaver	Lake/Marsh	Swimming	0'	No			
Lower Lake	7/30/10	7:30 PM	Turtle	Lake	"	"	"			Either a Slider or Painted
[illegible] Upper Lake	8/1/10	9:00 AM	Wood Duck	Lake	"	0'	"			Mother + 6 Chicks
Upper Lake Marsh	8/1/10	3:00 PM	Marsh Wren	Marsh	Perched	0'	No			
Road between Marsh [illegible]	8/1/10	3:30 PM	Rabbit	Marsh	Hopping	50'	"			
At entrance to site	8/1/10	6:00 PM	"	Edge of parking	"	NA	"			
Road between Marsh + [illegible]	8/1/10	5:00 PM	American Goldfinch	Marsh	Perched	50'	"			Seen during afternoon "Free birding"
"	"	"	House Wren	"	"	"	"			"
Upper Lake	8/6/10	10:00 AM	Great Blue Heron	Lake/Marsh	Flying	0'	"			
Lower Lake	8/1/10	6:00 PM	Turtles (6)	Lake	Basking/Swimming	0'	"			
Upper Lake	8/2/10	10:30 AM	Marsh Wren (8)	Lake/Marsh	Perched	0'	"			
Lower Lake	7/30/10	midday	Canada Goose	Lake	Swimming	0'	"			
" "	various times		" " (5+)	"	"	"	"			
Upper Lake	8/2/10	10:30 AM	Canada Goose (13)	"	" Feeding	0'	"			
" "	8/2/10	"	Eastern Kingbird (5)	"	Feeding	0'	[illegible] "			
Road between Marsh [illegible]	various times		Columbia Spotted Frog (7)	Marsh	Swimming	~25-50'	[illegible]			
Upper Lake	All days		Double-crested Cormorant (3)	Lake/Marsh	Perched/Swimming	0'	No			Reported on birding sheet, but were present every day
" "	"	"	Amer. White Pelican (2)	"	"	0'	"			"
Lower Lake	7/27-7/30	9:00 AM	Ring-necked Duck (a)	Lake	Swimming	0'				
Upper Lake edge	8/2/10	11:00 AM	Muskrat	lake edge	swimming	0'	"			Swam into house on lake edge
Upper Lake	8/2/10	11:00 AM	Green-winged Teal (6)	Lake	Preening/Swimming	0'	"			
Walker Pond	8/3/10	11:00 AM	Columbia Spotted Frog	Lake/Marsh	Swimming	0'	"			4 adults + Several tadpoles
Walker Pond	8/3/10	11:00 AM	Great Blue Heron	Lake edge	Standing in [illegible]	0'	"			

10
1-sided

FISH HABITAT INVENTORY FORM

Stream: Prickly Pear Creek

Date: 27 July 10

Site: PPC-REF-4

Flow:

Comments: raining, but warm; cooler a little; [illegible] on banks

Page: 1 of 1

HABITAT UNIT #	1	2	3	4	5	6		
TYPE	RUN	RUN	LGR	RUN	LGR	RUN		
120 (m) **LENGTH**	10	39	17	9	14,2	34		
WETTED WIDTH	6.6	6.4	8.0	7.1	8.2	6.4		
BANK WIDTH	11.5	11.7	12.9	10.7	10.8	8.1		
(cm) **AVERAGE DEPTH**	50	70	40	55	33	60		
(cm) **MAXIMUM DEPTH**	65	105	50	60	50	80		
SUBSTRATE 1.	sand	sand	sand	sand	cobble	sand		
2.	cobble	gravel	cobble	gravel	sand	cobble		
3.	gravel	cobble	gravel	cobble	gravel	gravel		
% SURFACE FINES	29	14	40	17	36	32		
% UNDERCUT	0	0	20	0	0	0		
ERODING BANK ~~(ft)~~ (m)	0	69	0	3	10	3		
% BANK VEG. TYPE 1.	grass	tree	tree	tree	tree	grass		
2.	forb	grass	grass	forb	grass	tree		
3.	tree	forb	forb	grass	forb	forb		

FISH HABITAT INVENTORY FORM

Stream: Prickly Pear Creek

Date: 28 July 2010

Site: PPC-5 ⟶ PPC-~~103~~ 103 (lower)

Flow:

Comments: water high (rained all day yesterday). Site located as req'd by client; road w/ dam located ½ way through site

Page: 1 of 1

road

Dam 4.3m

slightly higher gradient

HABITAT UNIT #	1	2	3	4	5	6	7	
TYPE	RUN	LGR	HGR	SMA	bridge/ dam outfall	DMA	RUN	
(m) **LENGTH**	22.3	28	25	17	6	18	10 = 82	
WETTED WIDTH	10.1	6.2	8	18.5	18.5	18.5	18	
BANK WIDTH	13.7	13.0	19	16.5	18.5	18.5 37.0	21	
AVERAGE DEPTH	50	45	40	?	—	—	80	
MAXIMUM DEPTH (cm)	90	70	80	>150	—	>150	135	
SUBSTRATE 1.	cobble	cobble	cobble	cobble	concrete	sand	sand	
2.	sand	gravel	gravel	?	—	—	gravel	
3.	gravel	sand	sand	?	—	—	cobble	
% SURFACE FINES	31	16	3	9	0	100	98	
% UNDERCUT	0	0	0	0	0	0	0	
ERODING BANK ~~(ft)~~ (m)	2	0	0	0	0	0	3	
% BANK VEG. TYPE 1.	willow	willow	willow	cement wall	—	willow	willow	
2.	sedge	sedge	—	boulder	—	grass	grass	
3.	tree	—	—	willow	—	—	—	

split channel @ 19m from bottom (LGR) to top of unit

2.5

10
1 sided

FISH HABITAT INVENTORY FORM

Stream: Wilson Ditch
Date: 7/31/10
Site:
Flow:
Comments: Downstream end adjacent to cattle corral in gap b/w Russian Olive
Page:

HABITAT UNIT #	1	2	3	4	5	6	7	8
TYPE	RUN	LGR	GLD	LGR	RUN	LGR	RUN	LGR
LENGTH	23.4	9.0	28.3	6.4	5.4	15.7	12.7	7.0
WETTED WIDTH	1.6	1.7	2.0	1.7	1.7	2.3	2.2	2.3
BANK WIDTH	2.6	3.0	3.0	2.5	3.6	4.0	3.6	3.2
AVERAGE DEPTH	20	12	15	13	12	15	27	15
MAXIMUM DEPTH	25	15	20	20	27	25	33	27
SUBSTRATE 1.	sand	gravel	sand	cobble →	→ ~~grass~~	cobble	sand	gravel
2.	gravel	sand	gravel	gravel →	→ ~~forbes~~	gravel	gravel	cobble
3.	fines	cobble	fines	sand →	→ ~~russian olive~~	sand	cobble	sand
% SURFACE FINES by grid	69	24	40	6	50	9	57	10
% UNDERCUT	0	0	0	0	0	0	0	0
ERODING BANK (ft) (m)	0	0	0	0	3.5 RL	0	0	0
% BANK VEG. TYPE 1.	grass	russian olive	grass	grass	grass	grass	grass	forbes
2.	russian olive	grass	forbes	forbes	forbes	forbes	forbes	grass
3.	forbes	forbes	russian olive	russian olive	russian olive	russian olive	russian olive	russian olive

RL= River Left (looking downstream)

3.0 m long flume
in middle of riffle

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Prickly Pear Cr.	LOCATION PPC-REF-4
STATION #________ RIVERMILE________	STREAM CLASS
LAT __________ LONG __________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JM GD, SB	
FORM COMPLETED BY GD	DATE 29 July TIME 1250 AM [✓ PM]
	REASON FOR SURVEY BERA

	Habitat Parameter	Condition Category			
		Optimal	**Suboptimal**	**Marginal**	**Poor**
Parameters to be evaluated in sampling reach	**1. Epifaunal Substrate/ Available Cover**	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0

LB lookg)
DS

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT) cke

NG

STREAM NAME Prickly Pear Creek	LOCATION PPC-5 → PPC-~~10~~3 (lower)
STATION #____ RIVERMILE____	STREAM CLASS 103
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS GD, JM, SB	
FORM COMPLETED BY GD	DATE 28 July 2010 TIME 5:30 AM [✓ PM] REASON FOR SURVEY BERA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category					
	Optimal	Suboptimal	Marginal	Poor		Below Upper Dam
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	15	2
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	16	7
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	7	12
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	18	7
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	19	19

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Left Bank looking DS

Habitat Parameter	**Condition Category**				Below	Above
	Optimal	**Suboptimal**	**Marginal**	**Poor**	Dam	
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	13	11
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	9	9
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	8	9
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	8	9
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.		
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	10	10
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	10	10
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.		
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	5	5
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	6	4

200 153 100

Total Score __________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Wilson Ditch	LOCATION
STATION #________ RIVERMILE________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STOREᴛ #	AGENCY
INVESTIGATORS JM CC	
FORM COMPLETED BY JM	DATE ________ TIME ________ AM PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	[✓ 5] 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 [✓ 7] 6	5 ~~4~~ 3	2 1 0

Left Bank = looking downstream.

Total Score ________

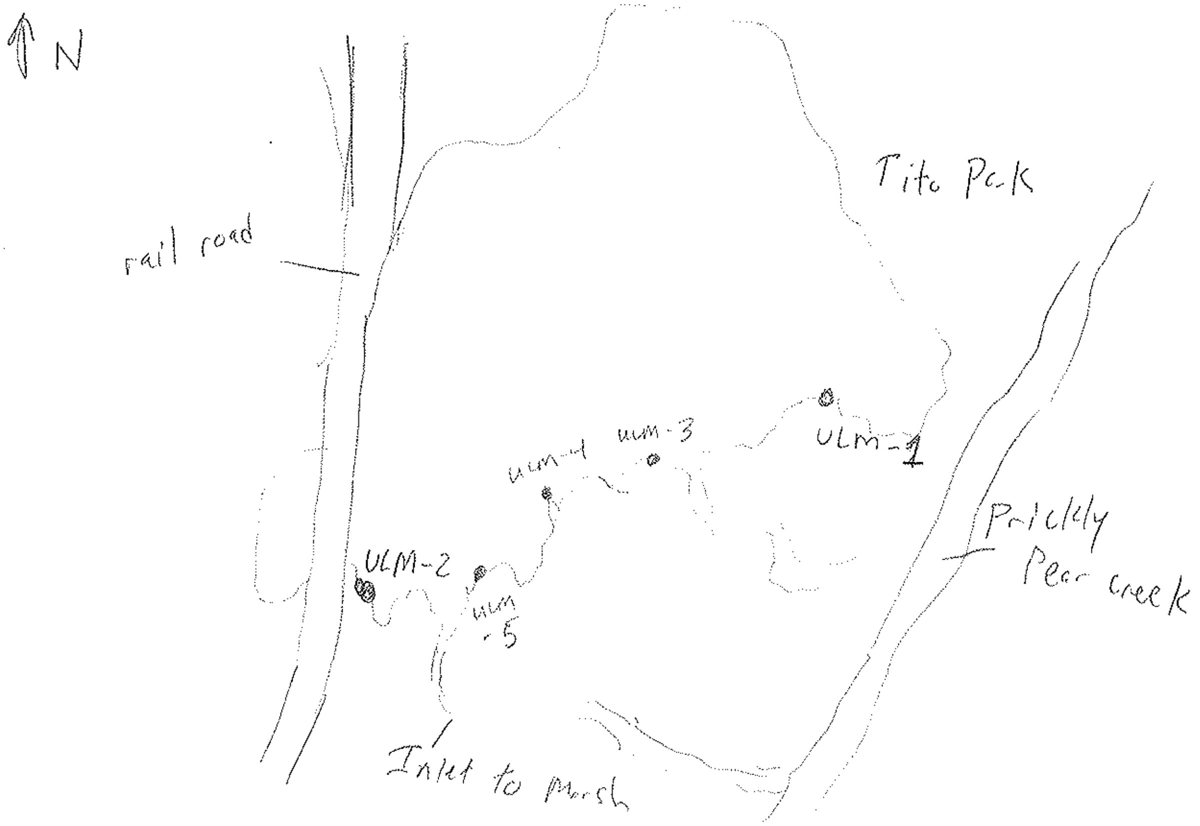
LAKE VERIFICATION FORM

LAKE NAME: Upper Lake Marsh **DATE OF VISIT:** 7 / 29 / 10 **VISIT #:** [✓ 1] 2

LAKE ID: ___ ___ ___ ___ ___ L **MODE OF ACCESS:** Vehicle Hike-in Aircraft

TEAM ID (CIRCLE): 1 2 3 4 5 6 7 8 9 10 OTHER: ______

ARROW INDICATES NORTH **MARK SITE:** L = LAUNCH X = INDEX



LAKE VERIFICATION INFORMATION

LAKE SHAPE COMPARES TO MAP? ☒ YES ☐ NO

LAKE VERIFIED BY (✓ all that apply) : ☒ GPS ☒ LOCAL CONTACT ☐ SIGNS ☐ ROADS ☐ TOPO. MAP

☐ Other (Describe Here): ☐ NOT VERIFIED (Explain in Comments)

COORDINATES	LATITUDE (dd mm ss) North	LONGITUDE (ddd mm ss) West	TYPE OF GPS FIX	SIGNAL QUALITY	GEOMETRIC QUALITY	Are GPS Coordinates w/i ±1 min. of map?
Map:	__"__'__"	___"__'__"				
Launch Site:	__"__'__"	___"__'__"	☐ 2D ☐ 3D	____	____	☐ YES ☐ NO
Index Site:	__"__'__"	___"__'__"	☐ 2D ☐ 3D	____	____	☐ YES ☐ NO

LAKE SAMPLED? ☒ YES ☐ NO

REASON NOT SAMPLED (EXPLAIN BELOW): ☐ NOT VISITED ☐ NON-TARGET ☐ INACCESSIBLE ☐ OTHER

Explanation: The lake will be sampled later in the week.

CHECK HERE IF EXPLANATION IS CONTINUED ON BACK. ☐

DESCRIBE LAUNCH SITE, LAKE DIRECTIONS, AND ADD COMMENTS ON BACK

REVIEWED BY (INITIAL):________

LAKE ID: ___ ___ ___ ___ ___ **L** **LAKE VERIFICATION FORM (continued)** **VISIT #: 1 2**

DIRECTIONS TO LAKE & LAUNCH SITE

LAUNCH SITE DESCRIPTION

GENERAL COMMENTS

EXPLANATION FOR NOT SAMPLING THE LAKE (continued from front)

REVIEWED BY (INITIAL):________

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES

LAKE NAME: Upper Lake Marsh **DATE OF VISIT:** 7/29/10 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 **OTHER:** ___

NEW STATION ID (if needed):	ULM-1	ULM-2	ULM-3	ULM-4	ULM-5					
RIPARIAN ZONE **STATION ID:**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**

VEGETATION TYPE N=NONE, D=DECID., C=CONIF., M=MIXED	CANOPY LAYER (> 5 M)	N	N	N	N	N					
	UNDERSTORY (0.5 TO 5 M)	D	D	N	N	N					

AREAL COVERAGE CATEGORIES 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (> 75%)

CANOPY LAYER (> 5 M HEIGHT)	TREES ≥ 0.3 M DBH	1	0	0	0	0					
	TREES < 0.3 M DBH	1	0	0	0	0					
UNDERSTORY (HEIGHT=0.5 TO 5 M)	WOODY SHRUBS & SAPLINGS	1	0	0	0	1					
	TALL HERBS, FORBS, & GRASSES	2	2	2	2	2					
GROUND COVER (< 0.5 M HEIGHT)	WOODY SHRUBS & SEEDLINGS	1	1	0	0	1					
	HERBS, FORBS, & GRASSES	1	1	0	0	0					
	STANDING WATER OR INUNDATED VEGETATION	4	4	4	4	4					
	BARREN OR BUILDINGS	0	0	0	0	0					
SHORELINE SUBSTRATE ZONE	BEDROCK (> 4000 MM; BIGGER THAN A CAR)	0	0	0	0	0					
	BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	0	0	0	0	0					
	COBBLE/GRAVEL (2 - 250 MM; LADYBUG - BASKETBALL SIZE)	0	0	0	0	0					
	LOOSE SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	0	0	0	0	0					
	OTHER FINE SOIL/SEDIMENT (< 0.06 MM; NOT GRITTY)	2	2	2	2	2					
	VEGETATED	4	4	4	4	4					
	OTHER (EXPLAIN IN COMMENTS)	0	0	0	0	0					
BANK FEATURES (WITHIN PLOT)	ANGLE: V = NEAR VERTICAL/UNDERCUT, S = 30-75°, G =<30°	G	G	G	G	G					
	VERTICAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	1.0	0.0	0	0	0					
	HORIZONTAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	2.0	0.0	0	0	0					

HUMAN INFLUENCE 0 = ABSENT CHECK (✓) = PRESENT WITHIN PLOT **B** = OBSERVED ADJACENT TO OR BEHIND PLOT

BUILDINGS	0	0	0	0	0					
COMMERCIAL	0	0	0	0	0					
PARK FACILITIES	0	0	0	0	0					
DOCKS/BOATS	0	0	0	0	0					
WALLS, DIKES, OR REVETMENTS	✓	B	B	0	0					
LITTER, TRASH DUMP, OR LANDFILL	0	0	0	0	0					
ROADS OR RAILROAD	✓	B	B	B	B					
ROW CROPS	0	0	0	0	0					
PASTURE OR HAYFIELD	0	0	0	0	0					
ORCHARD	0	0	0	0	0					
LAWN	0	0	0	0	0					
OTHER (EXPLAIN IN COMMENTS)	0	0	0	0	0					

FLAG CODES: **K** = MEASUREMENT OR OBSERVATION NOT OBTAINED; **U** = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE COMMENTS FORM.

REVIEWED BY (INITIAL): ______

LAKE ID: ___ ___ ___ ___ ___ L **PHYSICAL HABITAT CHARACTERIZATION FORM (continued)** **VISIT #:** 1 2

NEW STATION ID (if needed):	ULM -1	ULM -2	VLM -3	VLM -4	VLM -5					
LITTORAL ZONE **STATION ID:**	A	B	C	D	E	F	G	H	I	J
STATION DEPTH (M) AT 10 M OFFSHORE	1.50	1.35	1.35	1.50	1.50					
SURFACE FILM TYPE (S=SCUM, A=ALGAL MAT, P=OILY, N=NONE/OTHER)	A	A	A	A	A					
BOTTOM SUBSTRATE: AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY (>75%)										
BEDROCK (>4000 MM; LARGER THAN A CAR)	0	0	0	0	0					
BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	0	0	0	0	0					
COBBLE (64 - 250 MM; TENNIS BALL - BASKETBALL SIZE)	0	0	0	0	0					
GRAVEL (2 TO 64 MM; LADYBUG TO TENNIS BALL SIZE)	0	0	0	0	0					
SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	1	2	1	1	0					
SILT, CLAY, OR MUCK (< 0.06 MM; NOT GRITTY)	4	4	4	4	4					
WOODY DEBRIS	1	1	0	1	0					
COLOR (BL=BLACK, GY=GRAY, BR=BROWN, RD=RED, N=NONE OR OTHER)	BL	BL	BL	BL	BL					
ODOR (S=H_2S, A=ANOXIC, P=OIL, C=CHEMICAL, N=NONE)	A	A	A	A	A					
MACROPHYTES AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY(>75%)										
SUBMERGENT	2	1	2	2	2					
EMERGENT	0	0	0	0	0					
FLOATING	2	1	1	2	2					
TOTAL WEED COVER	2	1	2	2	2					
DO MACROPHYTES EXTEND LAKEWARD? (Y OR N)?	N	N	Y	Y	Y					
FISH COVER 0=ABSENT 1=PRESENT BUT SPARSE 2=PRESENT IN MODERATE TO VERY HEAVY DENSITY										
AQUATIC WEEDS	2	1	2	2	2					
SNAGS > 0.3 M DIAMETER	1	1	0	0	0					
BRUSH OR WOODY DEBRIS < 0.3 M DIAMETER	1	1	1	1	1					
INUNDATED LIVE TREES > 0.3 M DIAMETER	0	0	0	0	0					
OVERHANGING VEGETATION < 1 M ABOVE SURFACE	1	1	1	1	1					
ROCK LEDGES OR SHARP DROPOFFS	0	0	0	0	0					
BOULDERS	0	0	0	0	0					
HUMAN STRUCTURES (E.G., DOCKS, LANDINGS, PILINGS, RIPRAP, ETC.)	0	0	0	0	0					
LITTORAL FISH HABITAT CLASSIFICATION										
DISTURBANCE (H=HUMAN N=NATURAL M=MIXED)	M	M	M	M	M					
COVER CLASS (C=COVER, O=OPEN, M=MIXED)	M	M	M	M	M					
COVER TYPE (A=ARTIFICIAL F=FILL V=VEG. W=WOODY B=BOULDERS M=MIXED N=NONE)	M	V	V	V	V					
SUBSTRATE (M=MUD/MUCK, S=SAND/GRAVEL, C=COBBLE/BOULDER, B=BEDROCK)	M	M	M	M	M					
GEAR (G=GILL NET, T=TRAP NET, S=SEINE, 0=NONE)	S	S	KN	0	KN					
GEAR LOCATION (DIST. & DIR. TO NEAREST REPRES. MACROHABITAT)	—	—	—	—						

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE PHYSICAL CHARACTERIZATION HABITAT COMMENTS FORM.

REVIEWED BY (INITIAL): ______

KN = Kick Net

LAKE VERIFICATION FORM

LAKE NAME: UPPER LAKE **DATE OF VISIT:** 7 /30 /10 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **MODE OF ACCESS:** [✓ VEHICLE] HIKE-IN AIRCRAFT

TEAM ID (CIRCLE): 1 2 3 4 5 6 7 8 9 10 OTHER:______

ARROW INDICATES NORTH **MARK SITE:** L = LAUNCH X = INDEX

See map of marsh.

LAKE VERIFICATION INFORMATION

LAKE SHAPE COMPARES TO MAP? ☐ YES ☐ NO

LAKE VERIFIED BY (✓ all that apply) : ☑ GPS ☑ LOCAL CONTACT ☐ SIGNS ☐ ROADS ☐ TOPO. MAP

☐ Other (Describe Here): ☐ NOT VERIFIED (Explain in Comments)

COORDINATES	LATITUDE (dd mm ss) North	LONGITUDE (ddd mm ss) West	TYPE OF GPS FIX	SIGNAL QUALITY	GEOMETRIC QUALITY	Are GPS Coordinates w/i ±1 min. of map?	
Map:	___"___'___"	____"___'___"					
Launch Site:	___"___'___"	____"___'___"	☐ 2D ☐ 3D	______	______	☐ YES	☐ NO
Index Site:	___"___'___"	____"___'___"	☐ 2D ☐ 3D	______	______	☐ YES	☐ NO

LAKE SAMPLED? ☑ YES ☐ NO

REASON NOT SAMPLED (EXPLAIN BELOW): ☐ NOT VISITED ☐ NON-TARGET ☐ INACCESSIBLE ☐ OTHER

Explanation: Sampled with Gill nets in multiple locations and kick nets at all five locations assessed.

CHECK HERE IF EXPLANATION IS CONTINUED ON BACK. ☐

DESCRIBE LAUNCH SITE, LAKE DIRECTIONS, AND ADD COMMENTS ON BACK

REVIEWED BY (INITIAL):________

LAKE ID: ___ ___ ___ ___ ___ **L** **LAKE VERIFICATION FORM (continued)** **VISIT #: 1 2**

DIRECTIONS TO LAKE & LAUNCH SITE

LAUNCH SITE DESCRIPTION

GENERAL COMMENTS

EXPLANATION FOR NOT SAMPLING THE LAKE (continued from front)

REVIEWED BY (INITIAL):________

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES

LAKE NAME: UPPER LAKE **DATE OF VISIT:** 7 / 30 / 10 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 OTHER: ___

	NEW STATION ID (if needed):	UL-21A	UL-21B	UL-24	UL-23	UL-25					
RIPARIAN ZONE	**STATION ID:**	A	B	C	D	E	F	G	H	I	J
VEGETATION TYPE N=NONE, D=DECID., C=CONIF., M=MIXED	CANOPY LAYER (> 5 M)	D	D	N	N	D					
	UNDERSTORY (0.5 TO 5 M)	D	D	N	N	D					

AREAL COVERAGE CATEGORIES 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (> 75%)

		A	B	C	D	E	F	G	H	I	J
CANOPY LAYER (> 5 M HEIGHT)	TREES ≥ 0.3 M DBH	0	0	0	0	0					
	TREES < 0.3 M DBH	1	1	0	0	1					
UNDERSTORY (HEIGHT=0.5 TO 5 M)	WOODY SHRUBS & SAPLINGS	1	1	1	1	1					
	TALL HERBS, FORBS, & GRASSES	0	0	0	0	0					
GROUND COVER (< 0.5 M HEIGHT)	WOODY SHRUBS & SEEDLINGS	1	1	1	1	1					
	HERBS, FORBS, & GRASSES	1	1	1	1	0					
	STANDING WATER OR INUNDATED VEGETATION	3 2	2	2	1	2					
	BARREN OR BUILDINGS	4	4	4	4	4					
SHORELINE SUBSTRATE ZONE	BEDROCK (> 4000 MM; BIGGER THAN A CAR)	0	0	0	0	0					
	BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	0	0	1	0	0					
	COBBLE/GRAVEL (2 - 250 MM; LADYBUG - BASKETBALL SIZE)	1	1	1	4	1					
	LOOSE SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	2	2	2	2	3					
	OTHER FINE SOIL/SEDIMENT (< 0.06 MM; NOT GRITTY)	~~4~~ 3	3	3	0	2					
	VEGETATED	1	1	1	1	1					
	OTHER (EXPLAIN IN COMMENTS)	—	—	—	—	—					
BANK FEATURES (WITHIN PLOT)	ANGLE: V = NEAR VERTICAL/UNDERCUT, S = 30-75°, G =<30°	S	S	S	S	S					
	VERTICAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	0.0	0.0	0	0	0.0					
	HORIZONTAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	0.0	0.0	0	0	0.0					

HUMAN INFLUENCE 0 = ABSENT CHECK (✓) = PRESENT WITHIN PLOT B = OBSERVED ADJACENT TO OR BEHIND PLOT

	A	B	C	D	E	F	G	H	I	J
BUILDINGS	0	B	B	B	0					
COMMERCIAL	B	B✓	✓	✓	✓					
PARK FACILITIES	0	0	0	0	0					
DOCKS/BOATS	0	0	0	0	0					
WALLS, DIKES, OR REVETMENTS	0	0	✓	0	✓					
LITTER, TRASH DUMP, OR LANDFILL	0	0	0	✓	B					
ROADS OR RAILROAD	✓	✓	✓	✓	✓					
ROW CROPS	0	0	0	0	0					
PASTURE OR HAYFIELD	0	0	0	B	B					
ORCHARD	0	0	0	0	0					
LAWN	0	0	0	0	0					
OTHER (EXPLAIN IN COMMENTS)	0	0	0	0	0					

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE COMMENTS FORM.

REVIEWED BY (INITIAL): ______

LAKE ID: ___ ___ ___ ___ ___ L **PHYSICAL HABITAT CHARACTERIZATION FORM (continued)** VISIT #: 1 2

NEW STATION ID (if needed):	21A	21B	24	23	25					
LITTORAL ZONE STATION ID:	A	B	C	D	E	F	G	H	I	J
STATION DEPTH (M) AT 10 M OFFSHORE	>1.50	>1.50	1.20	>1.50	1.20					
SURFACE FILM TYPE (S=SCUM, A=ALGAL MAT, P=OILY, N=NONE/OTHER)	A	A	A	A	A					
BOTTOM SUBSTRATE: AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY (>75%)										
BEDROCK (>4000 MM; LARGER THAN A CAR)	0	0	0	0	0					
BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	0	0	0	0	0					
COBBLE (64 - 250 MM; TENNIS BALL - BASKETBALL SIZE)	1	1	1	0	0					
GRAVEL (2 TO 64 MM; LADYBUG TO TENNIS BALL SIZE)	1	1	2	1	1					
SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	1	1	2	1	1					
SILT, CLAY, OR MUCK (< 0.06 MM; NOT GRITTY)	4	4	4	4	4					
WOODY DEBRIS	1	1	0	0	1					
COLOR (BL=BLACK, GY=GRAY, BR=BROWN, RD=RED, N=NONE OR OTHER)	BL	BL	BL	BL	BL					
ODOR (S=H_2S, A=ANOXIC, P=OIL, C=CHEMICAL, N=NONE)	A	A	A	A	A					
MACROPHYTES AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY(>75%)										
SUBMERGENT	3	3	4	3	4					
EMERGENT	0	0	0	0	0					
FLOATING	1	1	1	1	1					
TOTAL WEED COVER	3	3	4	3	4					
DO MACROPHYTES EXTEND LAKEWARD? (Y OR N)?	Y	Y	Y	Y	Y					
FISH COVER 0=ABSENT 1=PRESENT BUT SPARSE 2=PRESENT IN MODERATE TO VERY HEAVY DENSITY										
AQUATIC WEEDS	2	2	2	2	2					
SNAGS > 0.3 M DIAMETER	0	0	0	0	0					
BRUSH OR WOODY DEBRIS < 0.3 M DIAMETER	1	1	0	0	1					
INUNDATED LIVE TREES > 0.3 M DIAMETER	0	0	0	0	0					
OVERHANGING VEGETATION < 1 M ABOVE SURFACE	1	1	1	1	1					
ROCK LEDGES OR SHARP DROPOFFS	0	0	0	0	0					
BOULDERS	0	0	0	0	0					
HUMAN STRUCTURES (E.G., DOCKS, LANDINGS, PILINGS, RIPRAP, ETC.)	0	0	2	0	0					
LITTORAL FISH HABITAT CLASSIFICATION										
DISTURBANCE (H=HUMAN N=NATURAL M=MIXED)	m	m	H	H	H					
COVER CLASS (C=COVER, O=OPEN, M=MIXED)	C	C	C	C	C					
COVER TYPE (A=ARTIFICIAL F=FILL V=VEG. W=WOODY B=BOULDERS M=MIXED N=NONE)	V	V	V	V	V					
SUBSTRATE (M=MUD/MUCK, S=SAND/GRAVEL, C=COBBLE/BOULDER, B=BEDROCK)	m	m	M	m	M					
GEAR (G=GILL NET, T=TRAP NET, S=SEINE, 0=NONE)	G	G	0	0	G					
GEAR LOCATION (DIST. & DIR. TO NEAREST REPRES. MACROHABITAT)	Kick net at all sites									

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE PHYSICAL CHARACTERIZATION HABITAT COMMENTS FORM.

REVIEWED BY (INITIAL): _______

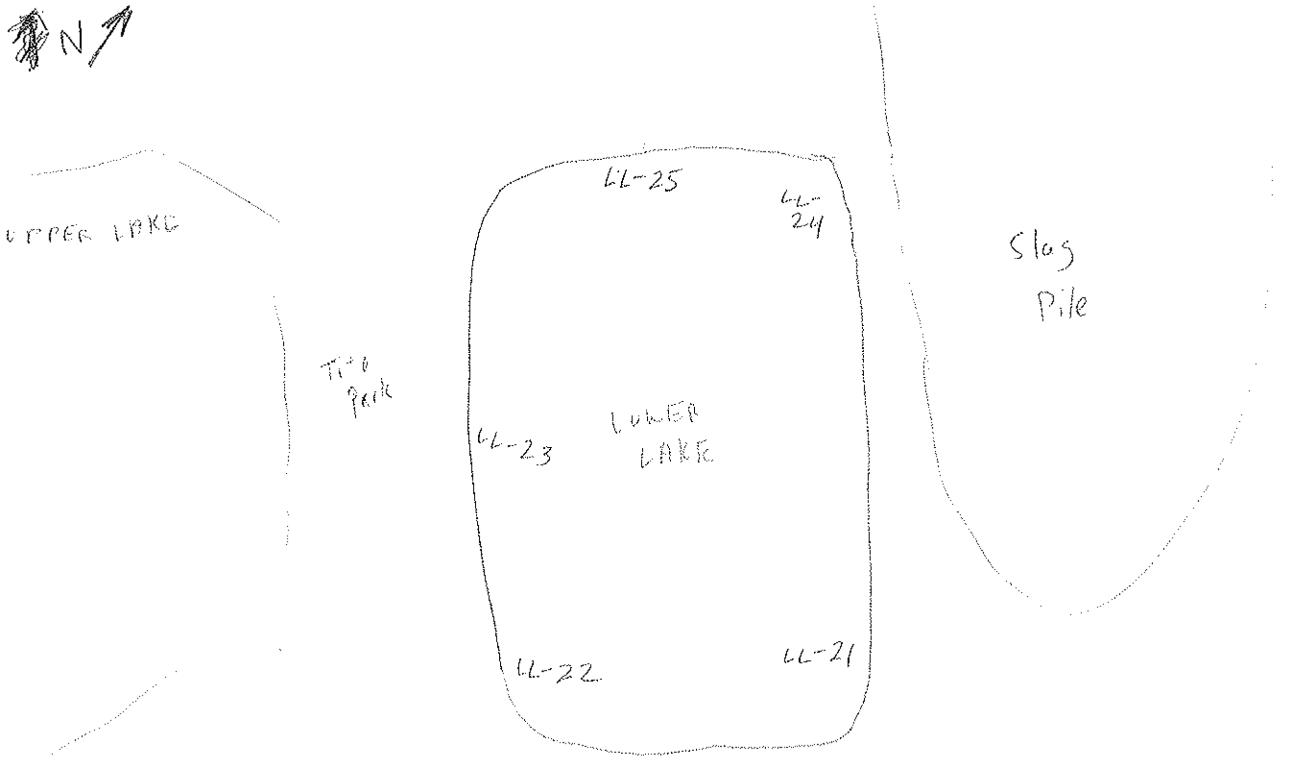
LAKE VERIFICATION FORM

LAKE NAME: Lower Lake **DATE OF VISIT:** 7 / 31 / 2010 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **MODE OF ACCESS:** [✓ VEHICLE] HIKE-IN AIRCRAFT

TEAM ID (CIRCLE): 1 2 3 4 5 6 7 8 9 10 OTHER:______

ARROW INDICATES NORTH **MARK SITE:** L = LAUNCH X = INDEX



LAKE VERIFICATION INFORMATION

LAKE SHAPE COMPARES TO MAP? ☑ YES ☐ NO

LAKE VERIFIED BY (✓ all that apply): ☑ GPS ☑ LOCAL CONTACT ☐ SIGNS ☐ ROADS ☐ TOPO. MAP

☐ Other (Describe Here): ☐ NOT VERIFIED (Explain in Comments)

COORDINATES	LATITUDE (dd mm ss) North	LONGITUDE (ddd mm ss) West	TYPE OF GPS FIX	SIGNAL QUALITY	GEOMETRIC QUALITY	Are GPS Coordinates w/i ±1 min. of map?
Map:	___" ___' ___"	____" ___' ___"				
Launch Site:	___" ___' ___"	____" ___' ___"	☐ 2D ☐ 3D	_____	_____	☐ YES ☐ NO
Index Site:	___" ___' ___"	____" ___' ___"	☐ 2D ☐ 3D	_____	_____	☐ YES ☐ NO

LAKE SAMPLED? ☑ YES ☐ NO

REASON NOT SAMPLED (EXPLAIN BELOW): ☐ NOT VISITED ☐ NON-TARGET ☐ INACCESSIBLE ☐ OTHER

Explanation: Minnow Traps and Kick nets.

CHECK HERE IF EXPLANATION IS CONTINUED ON BACK. ☐

DESCRIBE LAUNCH SITE, LAKE DIRECTIONS, AND ADD COMMENTS ON BACK

REVIEWED BY (INITIAL):________

LAKE ID: ___ ___ ___ ___ ___ L **LAKE VERIFICATION FORM (continued)** **VISIT #:** 1 2

DIRECTIONS TO LAKE & LAUNCH SITE

LAUNCH SITE DESCRIPTION

GENERAL COMMENTS

EXPLANATION FOR NOT SAMPLING THE LAKE (continued from front)

REVIEWED BY (INITIAL):________

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES

LAKE NAME: Lower Lake **DATE OF VISIT:** 7 / 31 / 10 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 **OTHER:** ___

NEW STATION ID (if needed):	LL-25	LL-24	LL-21	LL-22	LL-23					
RIPARIAN ZONE **STATION ID:**	A	B	C	D	E	F	G	H	I	J
VEGETATION TYPE N=none, D= decid., C=conif., M=mixed — CANOPY LAYER (> 5 M)	N	N	N	N	N					
UNDERSTORY (0.5 TO 5 M)	D	D	N	N	N					

AREAL COVERAGE CATEGORIES 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (> 75%)

		A	B	C	D	E	F	G	H	I	J
CANOPY LAYER (> 5 M HEIGHT)	TREES ≥ 0.3 M DBH	0	0	6	0	0					
	TREES < 0.3 M DBH	1	1	0	0	0					
UNDERSTORY (HEIGHT=0.5 TO 5 M)	WOODY SHRUBS & SAPLINGS	1	1	0	1	1					
	TALL HERBS, FORBS, & GRASSES	1	1	0	1	0					
GROUND COVER (< 0.5 M HEIGHT)	WOODY SHRUBS & SEEDLINGS	1	1	0	1	1					
	HERBS, FORBS, & GRASSES	4	4	1	1	1					
	STANDING WATER OR INUNDATED VEGETATION	0	0	1	0	0					
	BARREN OR BUILDINGS	1	1	4	4	4					
SHORELINE SUBSTRATE ZONE	BEDROCK (> 4000 MM; BIGGER THAN A CAR)	0	0	0	0	0					
	BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	0	1	0	1	1					
	COBBLE/GRAVEL (2 - 250 MM; LADYBUG - BASKETBALL SIZE)	0	1	2	1	1					
	LOOSE SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	0	1	2	3	3					
	OTHER FINE SOIL/SEDIMENT (< 0.06 MM; NOT GRITTY)	0	0	0	3	3					
	VEGETATED	3	3	1	1	1					
	Pavement OTHER (EXPLAIN IN COMMENTS)	3	2	2	0	0					
BANK FEATURES (WITHIN PLOT)	ANGLE: V = NEAR VERTICAL/UNDERCUT, S = 30-75°, G =<30°	G	G	G	V	V					
	VERTICAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	0.3	0.3	0.3	0.3	0.3					
	HORIZONTAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	0	0.75	0.75	1.5	0.3					

HUMAN INFLUENCE 0 = ABSENT CHECK (✓) = PRESENT WITHIN PLOT B = OBSERVED ADJACENT TO OR BEHIND PLOT

	A	B	C	D	E	F	G	H	I	J
BUILDINGS	✓	✓	✓	0	B					
COMMERCIAL	✓	✓	✓	✓	✓					
PARK FACILITIES	0	0	0	0	0					
DOCKS/BOATS	0	0	0	0	0					
WALLS, DIKES, OR REVETMENTS	0	✓	✓	B	B					
LITTER, TRASH DUMP, OR LANDFILL	B	✓	✓	0	0					
ROADS OR RAILROAD	✓	✓	✓	✓	✓					
ROW CROPS	0	0	0	0	0					
PASTURE OR HAYFIELD	0	0	0	0	0					
ORCHARD	0	0	0	0	0					
LAWN	0	0	0	0	0					
OTHER (EXPLAIN IN COMMENTS)	—	—	—	—	—					

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE COMMENTS FORM.

REVIEWED BY (INITIAL): ______

LAKE ID: __ __ __ __ __ L **PHYSICAL HABITAT CHARACTERIZATION FORM (continued)** VISIT #: 1 2

NEW STATION ID (if needed):	LL-25	LL-24	LL-21	LL-22	LL-23					
LITTORAL ZONE STATION ID:	A	B	C	D	E	F	G	H	I	J
STATION DEPTH (M) AT 10 M OFFSHORE	71.5	71.5	>1.5	71.5	71.5					
SURFACE FILM TYPE (S=SCUM, A=ALGAL MAT, P=OILY, N=NONE/OTHER)	N	N	N	N	N					
BOTTOM SUBSTRATE: AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY (>75%)										
BEDROCK (>4000 MM; LARGER THAN A CAR)	0	0	0	0	0					
BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	1	1	0	0	1					
COBBLE (64 - 250 MM; TENNIS BALL - BASKETBALL SIZE)	3	3	2	1	1					
GRAVEL (2 TO 64 MM; LADYBUG TO TENNIS BALL SIZE)	3	3	2	1	1					
SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	2	2	2	4	3					
SILT, CLAY, OR MUCK (< 0.06 MM; NOT GRITTY)	1	2	3	2	3					
WOODY DEBRIS	0	0	0	0	1					
COLOR (BL=BLACK, GY=GRAY, BR=BROWN, RD=RED, N=NONE OR OTHER)	BL	BL	BL	BR	BR					
ODOR (S=H_2S, A=ANOXIC, P=OIL, C=CHEMICAL, N=NONE)	A	A	A	N	A					
MACROPHYTES AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY(>75%)										
SUBMERGENT	0	0	0	0	1					
EMERGENT	0	0	0	0	0					
FLOATING	0	0	0	0	0					
TOTAL WEED COVER	0	0	0	0	1					
DO MACROPHYTES EXTEND LAKEWARD? (Y OR N)?	N	N	N	N	N					
FISH COVER 0=ABSENT 1=PRESENT BUT SPARSE 2=PRESENT IN MODERATE TO VERY HEAVY DENSITY										
AQUATIC WEEDS	0	0	0	0	0					
SNAGS > 0.3 M DIAMETER	0	0	0	0	0					
BRUSH OR WOODY DEBRIS < 0.3 M DIAMETER	0	0	0	0	1					
INUNDATED LIVE TREES > 0.3 M DIAMETER	0	0	0	0	0					
OVERHANGING VEGETATION < 1 M ABOVE SURFACE	0	0	0	0	0					
ROCK LEDGES OR SHARP DROPOFFS	2	2	1	0	0					
BOULDERS	1	1	0	0	0					
HUMAN STRUCTURES (E.G., DOCKS, LANDINGS, PILINGS, RIPRAP, ETC.)	0	2	0	0	0					
LITTORAL FISH HABITAT CLASSIFICATION										
DISTURBANCE (H=HUMAN N=NATURAL M=MIXED)	H	H	H	H	H					
COVER CLASS (C=COVER, O=OPEN, M=MIXED)	O	O	O	O	O					
COVER TYPE (A=ARTIFICIAL F=FILL V=VEG. W=WOODY B=BOULDERS M=MIXED N=NONE)	N	A	N	N	N					
SUBSTRATE (M=MUD/MUCK, S=SAND/GRAVEL, C=COBBLE/BOULDER, B=BEDROCK)	S	M	M	S	M					
GEAR (G=GILL NET, T=TRAP NET, S=SEINE, 0=NONE)	KN MT	KN MT	KN MT	KN MT	KN MT					
GEAR LOCATION (DIST. & DIR. TO NEAREST REPRES. MACROHABITAT)										

FLAG CODES: **K** = MEASUREMENT OR OBSERVATION NOT OBTAINED; **U** = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE PHYSICAL CHARACTERIZATION HABITAT COMMENTS FORM.

REVIEWED BY (INITIAL): ______

KN = Kick Net
MT = minnow trap

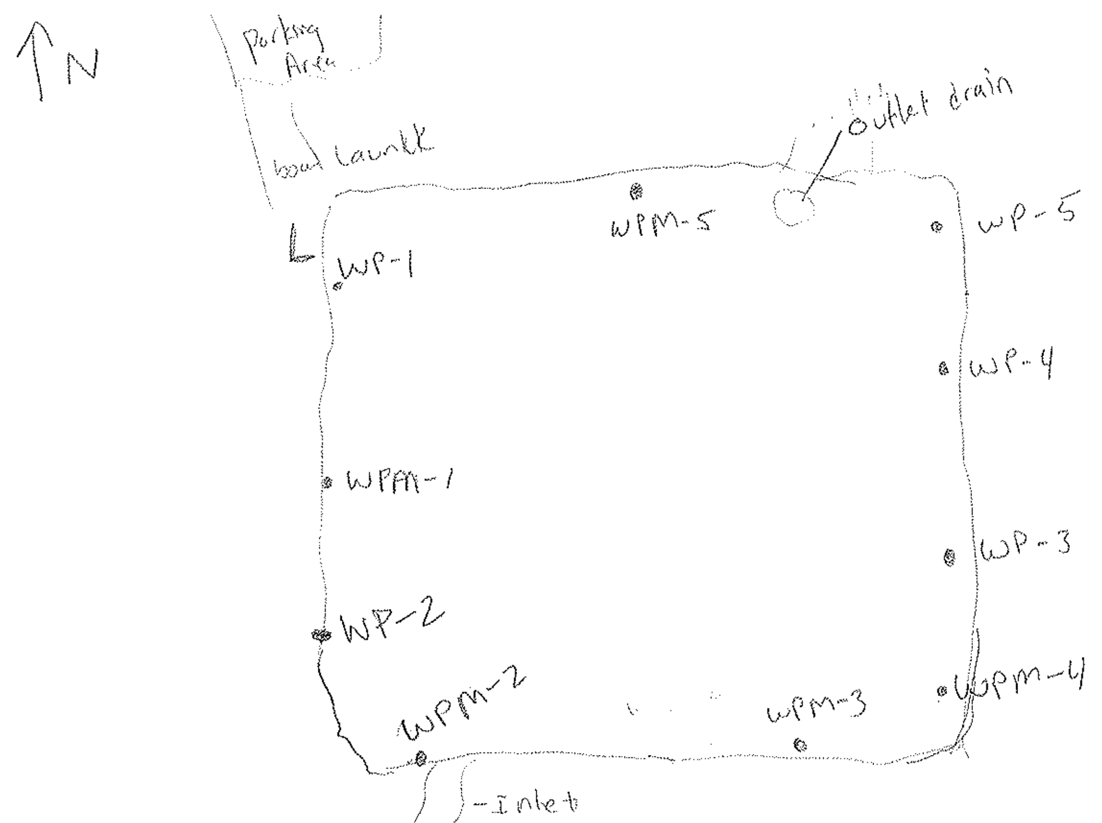
LAKE VERIFICATION FORM

LAKE NAME: Walker Pond **DATE OF VISIT:** 8/3/10 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **MODE OF ACCESS:** [✓ VEHICLE] HIKE-IN AIRCRAFT

TEAM ID (CIRCLE): 1 2 3 4 5 6 7 8 9 10 OTHER: _____

ARROW INDICATES NORTH **MARK SITE:** L = LAUNCH X = INDEX



LAKE VERIFICATION INFORMATION

LAKE SHAPE COMPARES TO MAP? ☑ YES ☐ NO

LAKE VERIFIED BY (✓ all that apply) : ☐ GPS ☑ LOCAL CONTACT ☐ SIGNS ☐ ROADS ☐ TOPO. MAP

☐ Other (Describe Here):

☐ NOT VERIFIED (Explain in Comments)

COORDINATES	LATITUDE (dd mm ss) North	LONGITUDE (ddd mm ss) West	TYPE OF GPS FIX	SIGNAL QUALITY	GEOMETRIC QUALITY	Are GPS Coordinates w/i ±1 min. of map?	
Map:	___"___'___"	___"___'___"					
Launch Site:	___"___'___"	___"___'___"	☐ 2D ☐ 3D	______	______	☐ YES	☐ NO
Index Site:	___"___'___"	___"___'___"	☐ 2D ☐ 3D	______	______	☐ YES	☐ NO

LAKE SAMPLED? ☑ YES ☐ NO

REASON NOT SAMPLED (EXPLAIN BELOW): ☐ NOT VISITED ☐ NON-TARGET ☐ INACCESSIBLE ☐ OTHER

Explanation: Sampled with Gill net and kick net.

CHECK HERE IF EXPLANATION IS CONTINUED ON BACK. ☐

DESCRIBE LAUNCH SITE, LAKE DIRECTIONS, AND ADD COMMENTS ON BACK

REVIEWED BY (INITIAL): ________

LAKE ID: ___ ___ ___ ___ ___ **L** **LAKE VERIFICATION FORM (continued)** **VISIT #: 1 2**

DIRECTIONS TO LAKE & LAUNCH SITE

LAUNCH SITE DESCRIPTION

GENERAL COMMENTS

EXPLANATION FOR NOT SAMPLING THE LAKE (continued from front)

REVIEWED BY (INITIAL):________

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES

LAKE NAME: Walker Pond **DATE OF VISIT:** 8 / 3 / 10 **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 **OTHER:** ___

	NEW STATION ID (if needed):	WP-1	WPM 1	WP-2	WPM-2	WPM -3	WPM-4	WP 3	WP-4	WP 5	WPM -5
RIPARIAN ZONE	**STATION ID:**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
VEGETATION TYPE N=NONE, D=DECID., C=CONIF., M=MIXED	CANOPY LAYER (> 5 M)	D	D	D	M	M	M	M	C	M	C
	UNDERSTORY (0.5 TO 5 M)	D	D	D	M	M	M	M	C	M	C
AREAL COVERAGE CATEGORIES 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (> 75%)											
CANOPY LAYER (> 5 M HEIGHT)	TREES ≥ 0.3 M DBH	0	0	0	0	1	1	0	1	1	1
	TREES < 0.3 M DBH	1	1	1	1	2	2	2	0	1	1
UNDERSTORY (HEIGHT=0.5 TO 5 M)	WOODY SHRUBS & SAPLINGS	2	2	2	1	2	2	2	1	1	1
	TALL HERBS, FORBS, & GRASSES	1	1	1	1	1	1	1	1	1	1
GROUND COVER (< 0.5 M HEIGHT)	WOODY SHRUBS & SEEDLINGS	2	2	2	1	2	3	2	1	1	1
	HERBS, FORBS, & GRASSES	3	3	3	4	3	2	3	3	4	4
	STANDING WATER OR INUNDATED VEGETATION	1	2	1	1	3	2	1	0	1	1
	BARREN OR BUILDINGS	0	0	0	0	0	0	0	3	2	2
SHORELINE SUBSTRATE ZONE	BEDROCK (> 4000 MM; BIGGER THAN A CAR)	0	0	0	0	0	0	0	0	0	0
	BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	0	0	0	0	0	0	1	0	1	0
	COBBLE/GRAVEL (2 - 250 MM; LADYBUG - BASKETBALL SIZE)	1	0	0	0	0	0	1	1	1	1
	LOOSE SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	1	0	0	0	0	0	1	3	2	2
	OTHER FINE SOIL/SEDIMENT (< 0.06 MM; NOT GRITTY)	0	0	0	0	1	0	0	0	0	0
	VEGETATED	4	4	4	4	4	4	4	3	3	3
	OTHER (EXPLAIN IN COMMENTS)	—	—	—	—	—	—	—	—	—	—
BANK FEATURES (WITHIN PLOT)	ANGLE: V = NEAR VERTICAL/UNDERCUT, S = 30-75°, G = <30°	G	G	G	G	G	S	S	S	S	S
	VERTICAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	0	0	0	0	0	0	0	0	6	0
	HORIZONTAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK	0	0	0	0	0	0	0	0	0	0
HUMAN INFLUENCE 0 = ABSENT CHECK (✓) = PRESENT WITHIN PLOT B = OBSERVED ADJACENT TO OR BEHIND PLOT											
	BUILDINGS	0	0	0	0	0	0	0	0	0	0
	COMMERCIAL	0	0	0	0	0	0	0	0	0	0
	PARK FACILITIES	0	0	0	0	0	0	0	0	0	0
	DOCKS/BOATS	✓	B	0	0	0	0	0	0	0	0
	WALLS, DIKES, OR REVETMENTS	B	0	0	0	0	0	0	B	✓	✓
	LITTER, TRASH DUMP, OR LANDFILL	0	0	0	0	0	0	0	0	0	0
	ROADS OR RAILROAD	✓	B	0	0	0	0	0	0	✓	✓
	ROW CROPS	0	0	0	0	0	0	0	0	0	0
	PASTURE OR HAYFIELD	0	0	0	0	0	0	0	0	0	0
	ORCHARD	0	0	0	0	0	0	0	0	0	0
	LAWN	0	0	0	0	0	0	0	0	0	0
	OTHER (EXPLAIN IN COMMENTS)	0	0	0	0	0	0	✓	✓	B	0

Logged in past (recently). on east side of Pond.

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; **U** = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE COMMENTS FORM.

REVIEWED BY (INITIAL): ______

Mostly vegetated w/ grasses/forbs and a few trees

LAKE ID: ___ ___ ___ ___ ___ L **PHYSICAL HABITAT CHARACTERIZATION FORM (continued)** VISIT #: 1 2

NEW STATION ID (If needed):	WP-1	WPM-1	WP-2	WPM-2	WPM-3	WPM-4	WP-3	WP-4	WP-5	WPM-5
LITTORAL ZONE **STATION ID:**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
STATION DEPTH (M) AT 10 M OFFSHORE	71.50	71.50	71.50	71.5	71.5	71.5	71.5	71.5	71.5	71.5
SURFACE FILM TYPE (S=SCUM, A=ALGAL MAT, P=OILY, N=NONE/OTHER)	N	N	N	N	N	N	N	A	A	A
BOTTOM SUBSTRATE: AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY (>75%)										
BEDROCK (>4000 MM; LARGER THAN A CAR)	0	0	0	0	0	0	0	0	0	0
BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)	1	0	0	0	0	0	0	0	0	0
COBBLE (64 - 250 MM; TENNIS BALL - BASKETBALL SIZE)	1	0	0	0	0	0	1	1	1	0
GRAVEL (2 TO 64 MM; LADYBUG TO TENNIS BALL SIZE)	2	1	1	2	0	1	1	2	1	1
SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)	3	2	2	3	1	2	2	4	3	2
SILT, CLAY, OR MUCK (< 0.06 MM; NOT GRITTY)	1	3	4	3	4	3	3	1	3	4
WOODY DEBRIS	0	0	0	0	0	0	2	0	0	0
COLOR (BL=BLACK, GY=GRAY, BR=BROWN, RD=RED, N=NONE OR OTHER)	BR	BR	BR	BR	BL	BL	BL	BR	BR	BL
ODOR (S=H_2S, A=ANOXIC, P=OIL, C=CHEMICAL, N=NONE)	N	A	A	N	N	N	N	N	N	N
MACROPHYTES AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY(>75%)										
SUBMERGENT	2	2	2	2	1	1	1	1	1	1
EMERGENT	0	0	0	0	0	0	0	0	0	0
FLOATING	1	1	1	1	1	1	1	1	1	1
TOTAL WEED COVER	2	2	2	2	1	1	1	1	1	1
DO MACROPHYTES EXTEND LAKEWARD? (Y OR N)?	Y	Y	N	Y	N	N	N	N	N	N
FISH COVER 0=ABSENT 1=PRESENT BUT SPARSE 2=PRESENT IN MODERATE TO VERY HEAVY DENSITY										
AQUATIC WEEDS	2	2	2	2	1	1	1	1	1	1
SNAGS > 0.3 M DIAMETER	0	0	0	0	0	0	0	0	0	0
BRUSH OR WOODY DEBRIS < 0.3 M DIAMETER	0	0	0	1	1	1	2	0	0	0
INUNDATED LIVE TREES > 0.3 M DIAMETER	0	0	0	0	0	0	0	0	0	0
OVERHANGING VEGETATION < 1 M ABOVE SURFACE	1	1	1	1	1	1	2	0	1	1
ROCK LEDGES OR SHARP DROPOFFS	0	0	0	0	0	0	0	1	0	0
BOULDERS	0	0	0	0	0	0	0	0	0	0
HUMAN STRUCTURES (E.G., DOCKS, LANDINGS, PILINGS, RIPRAP, ETC.)	1	0	0	0	0	0	0	0	0	0
LITTORAL FISH HABITAT CLASSIFICATION										
DISTURBANCE (H=HUMAN N=NATURAL M=MIXED)	M	N	N	N	N	N	N	N	N	N
COVER CLASS (C=COVER, O=OPEN, M=MIXED)	M	M	M	M	M	M	M	M	M	M
COVER TYPE (A=ARTIFICIAL F=FILL V=VEG. W=WOODY B=BOULDERS M=MIXED N=NONE)	V/A	V	V	V	V	V	W	V	V	V
SUBSTRATE (M=MUD/MUCK, S=SAND/GRAVEL, C=COBBLE/BOULDER, B=BEDROCK)	S	M	S/M	S/M	M/S	M/S	M/S	S	M/S	M/S
GEAR (G=GILL NET, T=TRAP NET, S=SEINE, 0=NONE)	G KN	G KN	G KN	G KN	G KN	G KN	G KN	G KN	G KN	G KN
GEAR LOCATION (DIST. & DIR. TO NEAREST REPRES. MACROHABITAT)	—	—	—	—	—	—	—			

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE PHYSICAL CHARACTERIZATION HABITAT COMMENTS FORM.

REVIEWED BY (INITIAL): ________

G = Gill net
KN = Kick net

Habitat Assessment Datasheet

Plot ID: PPC-PEF-8 Easting: Northing: Date: 7/27/10

Average Vegetation Height
- ☐ 0 – 0.15 m (up to about 6" – just over ankle height)
- ☐ 0.15 – 1.0 m
- ☒ Over 1.0 m (over waist high) immediate riparian

Notes riparian trees and shrubs extend ~20 ft up bank; vegetation is 0.15 - 1.0 m wildflowers + grasses?

Vegetation Type – check all that apply
- ☐ Predominantly grass
- ☐ Predominantly wildflower
- ☒ Predominantly shrub riparian zone understory
- ☐ Predominantly trees
- ☐ Predominantly open
- ☐ Other

Notes

Species Diversity
- ☐ Low diversity (1 to 4 overwhelmingly dominant species)
- ☒ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
- ☐ High diversity (more than 15 species common, such as in restored prairies)

Notes

Land Use (e.g., grassland, scrub, urban, etc.)

Notes private property; beyond slope is hayfield (mowed)

Shrub Index (percent cover)
- ☐ none
- ☐ 1 – 15% (sparse, scattered shrubs)
- ☐ 15 – 50% (significant shrub presence)
- ☒ >50% (shrubland) immediate riparian

Notes beyond mowed, riparian zone, sparse shrubs

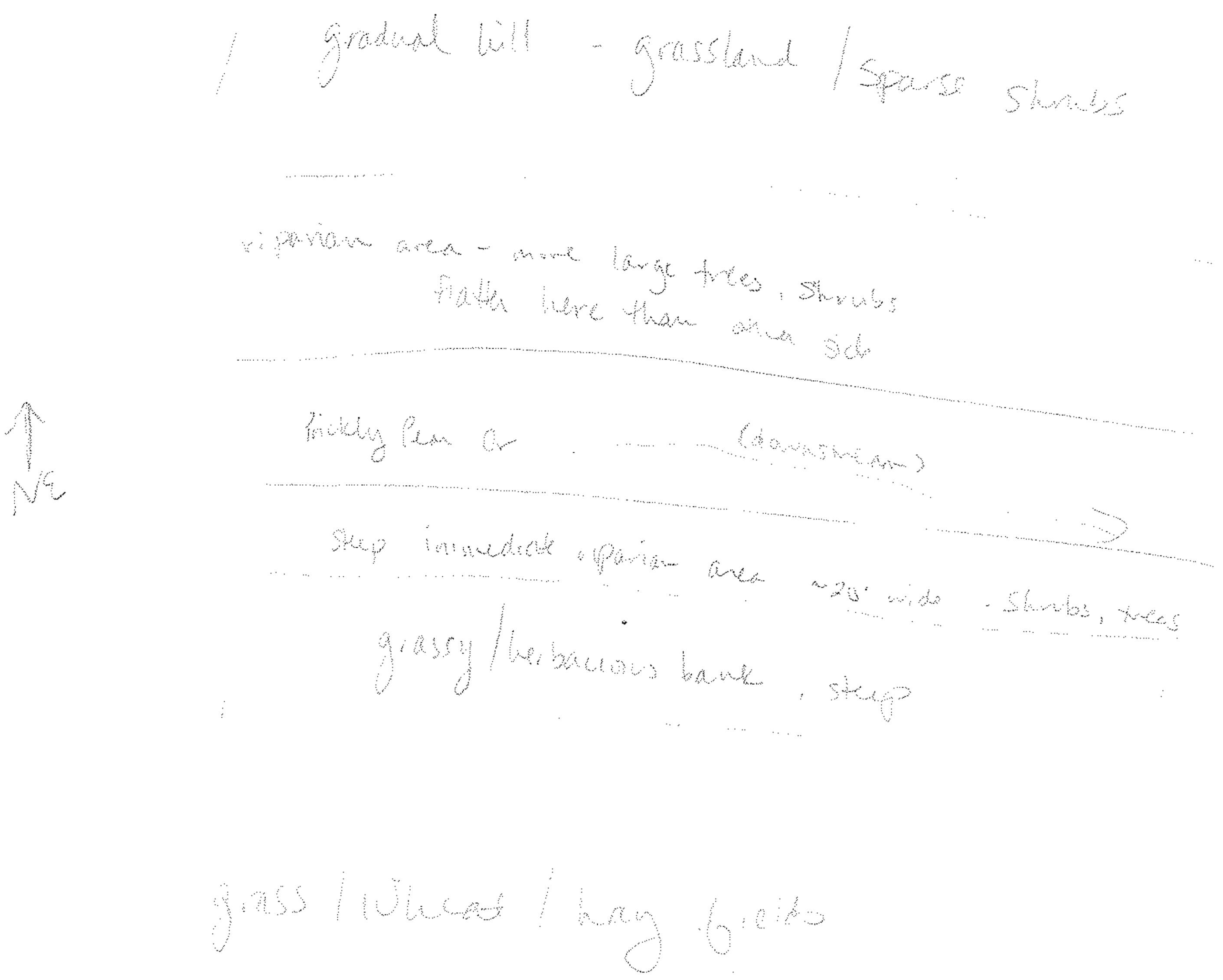
Tree Index
- ☐ none
- ☐ A couple or few scattered trees
- ☐ A couple small patches of trees
- ☐ Savannah- type grassland
- ☒ Riparian trees

Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):

mowed area (hayfield) around site

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



Habitat Assessment Datasheet

Plot ID: RC-R2-2 Easting: Northing: Date: 7/27/10

Average Vegetation Height

- ☐ 0 – 0.15 m (up to about 6" – just over ankle height)
- ☐ 0.15 – 1.0 m
- ☒ Over 1.0 m (over waist high)

Notes

Vegetation Type – check all that apply

- ☐ Predominantly grass
- ☐ Predominantly wildflower
- ☒ Predominantly shrub
- ☐ Predominantly trees
- ☐ Predominantly open
- ☐ Other

Notes some grasses along edges + underneath shrubs

Species Diversity

- ☐ Low diversity (1 to 4 overwhelmingly dominant species)
- ☒ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
- ☐ High diversity (more than 15 species common, such as in restored prairies)

Notes lots of willows but a few other shrub species (2 or 3) + grasses/herbs

Land Use (e.g., grassland, scrub, urban, etc.)

Notes was industrial, now near dump site ; near slag pile

Shrub Index (percent cover)

- ☐ none
- ☐ 1 – 15% (sparse, scattered shrubs)
- ☐ 15 – 50% (significant shrub presence)
- ☑ >50% (shrubland)

Notes

Tree Index

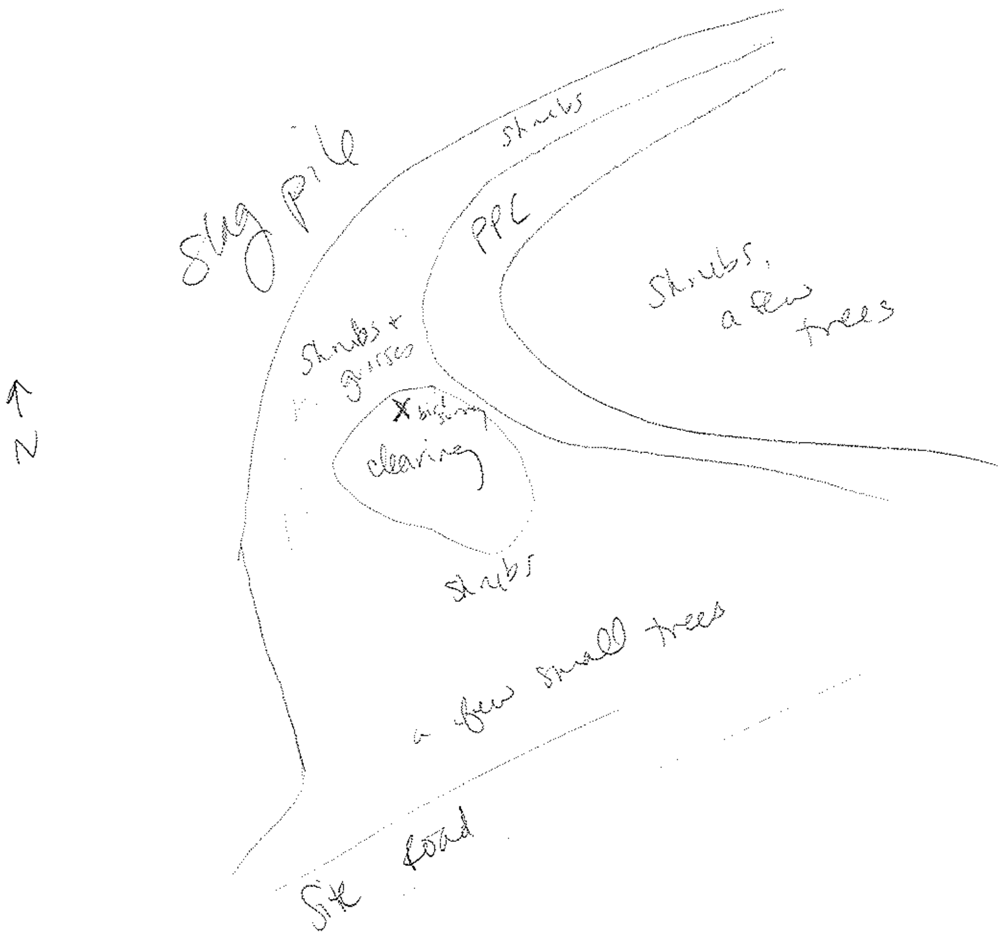
- ☐ none
- ☒ A couple or few scattered trees
- ☐ A couple small patches of trees
- ☐ Savannah- type grassland
- ☐ Riparian trees

Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):

Very disturbed area - adjacent to slag pile + road that goes through site

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



Habitat Assessment Datasheet

Plot ID: LL-BK-4 Easting: Northing: Date: 7/28/10

Average Vegetation Height

- ☒ 0 – 0.15 m (up to about 6" – just over ankle height)
- ☐ 0.15 – 1.0 m
- ☐ Over 1.0 m (over waist high)

Notes sparse grasses in Tiro Park, a few shrubs ~ 1.5m tall

Vegetation Type – check all that apply

- ☒ Predominantly grass
- ☐ Predominantly wildflower
- ☐ Predominantly shrub
- ☐ Predominantly trees
- ☒ Predominantly open
- ☐ Other

Notes

Species Diversity

- ☒ Low diversity (1 to 4 overwhelmingly dominant species)
- ☐ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
- ☐ High diversity (more than 15 species common, such as in restored prairies)

Notes 1 shrub spp, a couple of grasses, + 1 herbaceous

Land Use (e.g., grassland, scrub, urban, etc.)

Notes grass / shrub

Shrub Index (percent cover)

- ☐ none
- ☒ 1 – 15% (sparse, scattered shrubs)
- ☐ 15 – 50% (significant shrub presence)
- ☐ >50% (shrubland)

Notes

Tree Index

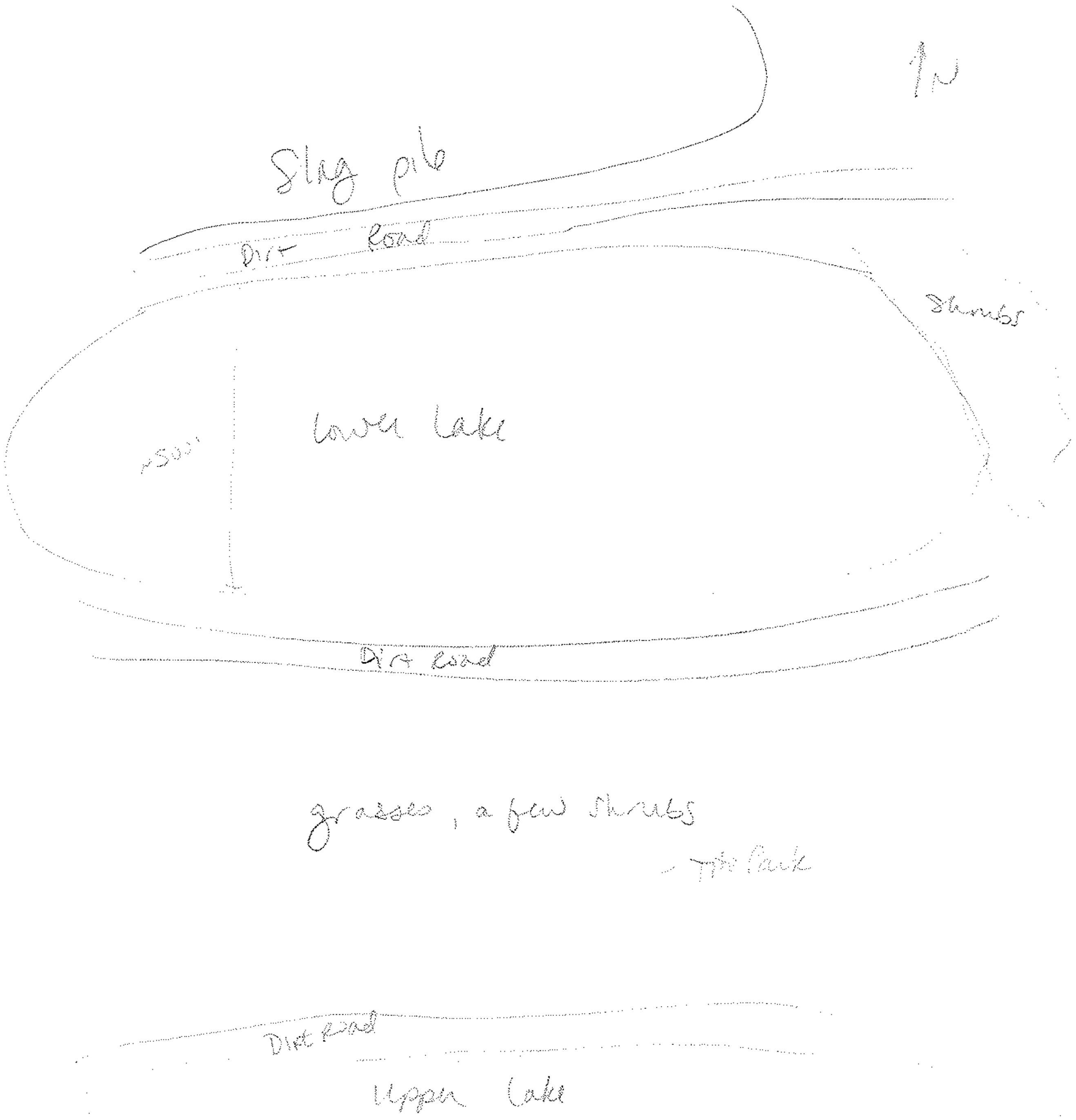
- ☒ none
- ☐ A couple or few scattered trees
- ☐ A couple small patches of trees
- ☐ Savannah- type grassland
- ☐ Riparian trees

Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?): noisy

Disturbed - road along lake edge; very near facility + [illegible] site

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



Habitat Assessment Datasheet

Plot ID: UOS-SS14 Easting: Northing: Date: 7/28/10

Average Vegetation Height

- ☐ 0 – 0.15 m (up to about 6" – just over ankle height)
- ☐ 0.15 – 1.0 m
- ☒ Over 1.0 m (over waist high)

Notes

Vegetation Type – check all that apply

- ☒ Predominantly grass
- ☐ Predominantly wildflower
- ☒ Predominantly shrub - willows around edge
- ☐ Predominantly trees
- ☐ Predominantly open
- ☐ Other

Notes mostly cattails, a few other riparian plants; grasses

Species Diversity

- ☐ Low diversity (1 to 4 overwhelmingly dominant species)
- ☒ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
- ☐ High diversity (more than 15 species common, such as in restored prairies)

Notes

Land Use (e.g., grassland, scrub, urban, etc.)

Notes near facility, but actual lake doesn't have use (I don't think)

Shrub Index (percent cover)

- ☐ none
- ☐ 1 – 15% (sparse, scattered shrubs)
- ☒ 15 – 50% (significant shrub presence) in significant area
- ☐ >50% (shrubland)

Notes

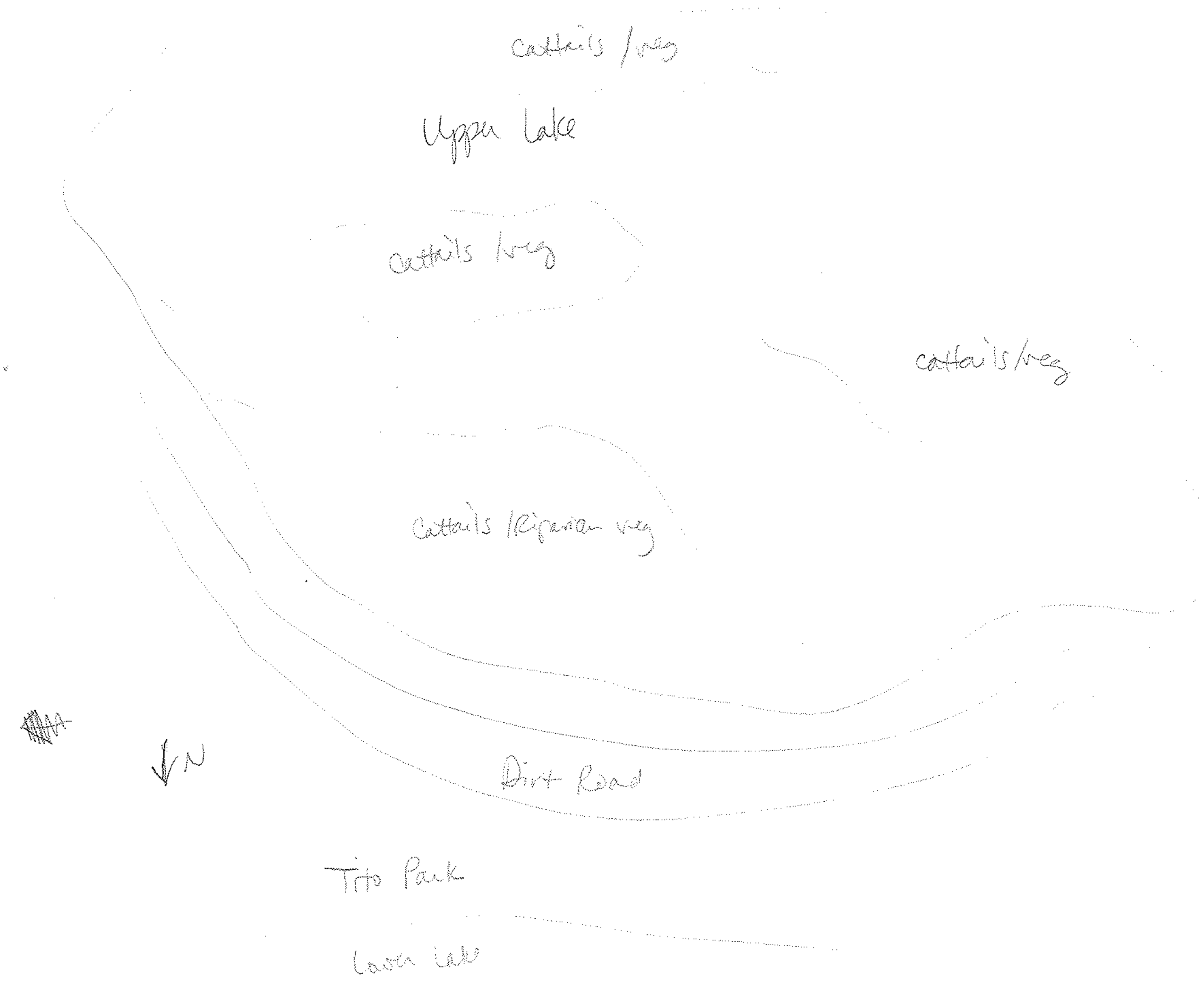
Tree Index

- ☐ none
- ☒ A couple or few scattered trees
- ☐ A couple small patches of trees
- ☐ Savannah- type grassland
- ☐ Riparian trees

Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



lake
→ not to scale...
large w/ lots
of islands
of vegetation

Habitat Assessment Datasheet

Plot ID: Marsh E of upper lake
Easting:
Northing:
Date: 7/29/10

Average Vegetation Height

- ☐ 0 – 0.15 m (up to about 6" – just over ankle height)
- ☐ 0.15 – 1.0 m
- ☒ Over 1.0 m (over waist high)

Notes cattail marsh

Vegetation Type – check all that apply

- ☐ Predominantly grass
- ☐ Predominantly wildflower
- ☐ Predominantly shrub
- ☐ Predominantly trees
- ☐ Predominantly open
- ☒ Other cattails

Notes a few shrubs, but mostly cattails

Species Diversity

- ☑ Low diversity (1 to 4 overwhelmingly dominant species)
- ☐ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
- ☐ High diversity (more than 15 species common, such as in restored prairies)

Notes cattails + 1-2 shrub spp

Land Use (e.g., grassland, scrub, urban, etc.)

Notes wetland

Shrub Index (percent cover)

- ☐ none
- ☒ 1 – 15% (sparse, scattered shrubs)
- ☐ 15 – 50% (significant shrub presence)
- ☐ >50% (shrubland)

Notes

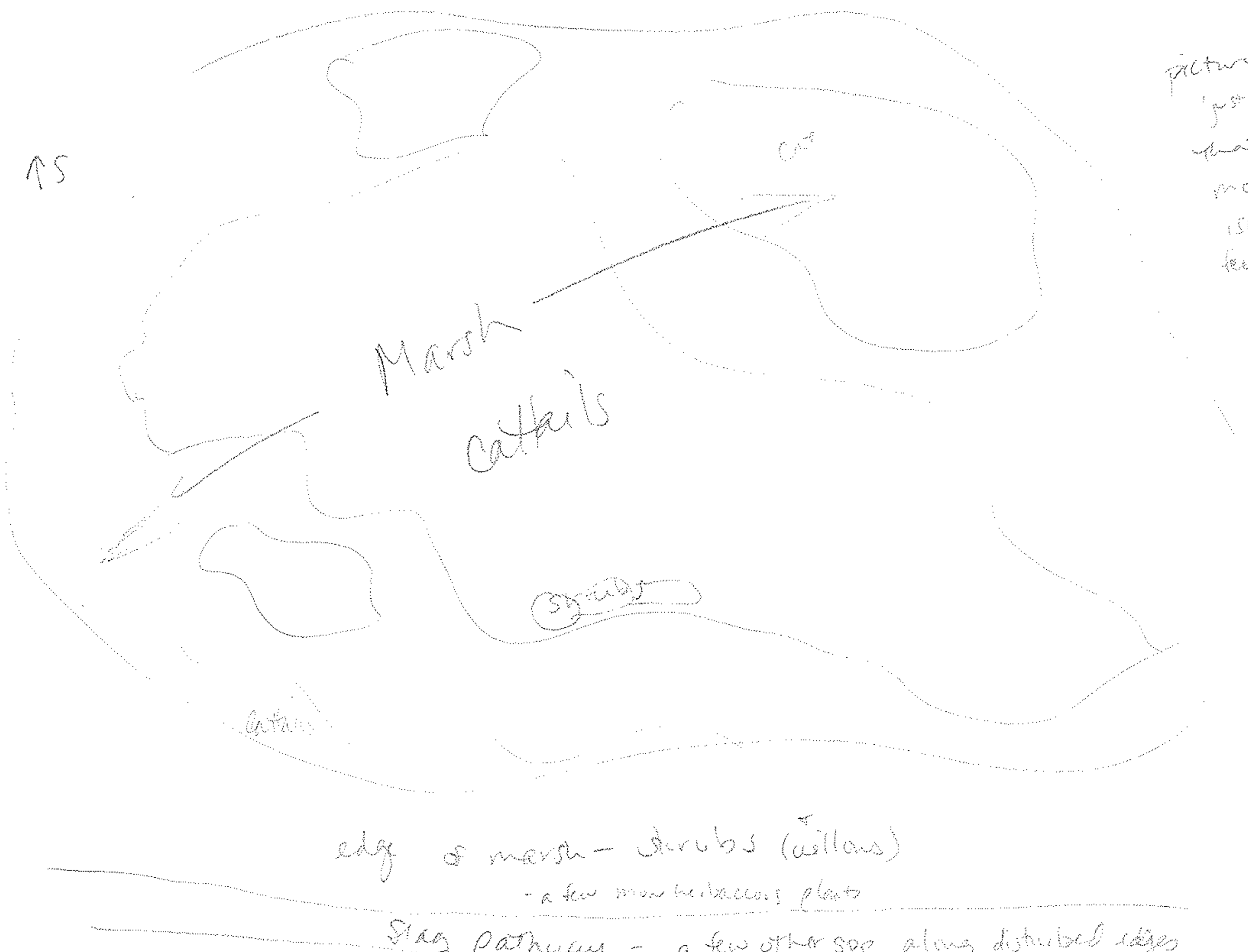
Tree Index

- ☐ none
- ☒ A couple or few scattered trees
- ☐ A couple small patches of trees
- ☐ Savannah- type grassland
- ☐ Riparian trees

Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



picture not ^actual or^ to scale - just demonstrates that marsh mostly cattail islands with a few open spots

edge of marsh - shrubs (willows) - a few more herbaceous plants

Slag pathway = a few other spp along disturbed edges (raspberry, a few herbaceous flowering plants)

Habitat Assessment Datasheet

Plot ID: Wilson Ditch Easting: Northing: Date: 7/31/10

Average Vegetation Height

☐ 0 – 0.15 m (up to about 6" – just over ankle height)
☑ 0.15 – 1.0 m
☐ Over 1.0 m (over waist high)
Notes mostly grasses ~.75m high; some autumn olive ~3m tall

Vegetation Type – check all that apply

☒ Predominantly grass
☐ Predominantly wildflower
☐ Predominantly shrub
☐ Predominantly trees
☐ Predominantly open
☐ Other
Notes some herbaceous plants, a few autumn olive

Species Diversity

☐ Low diversity (1 to 4 overwhelmingly dominant species)
☒ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
☐ High diversity (more than 15 species common, such as in restored prairies)
Notes

Land Use (e.g., grassland, scrub, urban, etc.)

Notes S side of Ditch is horse/dog arena; N side is grassland; W residential, E, plant

Shrub Index (percent cover)

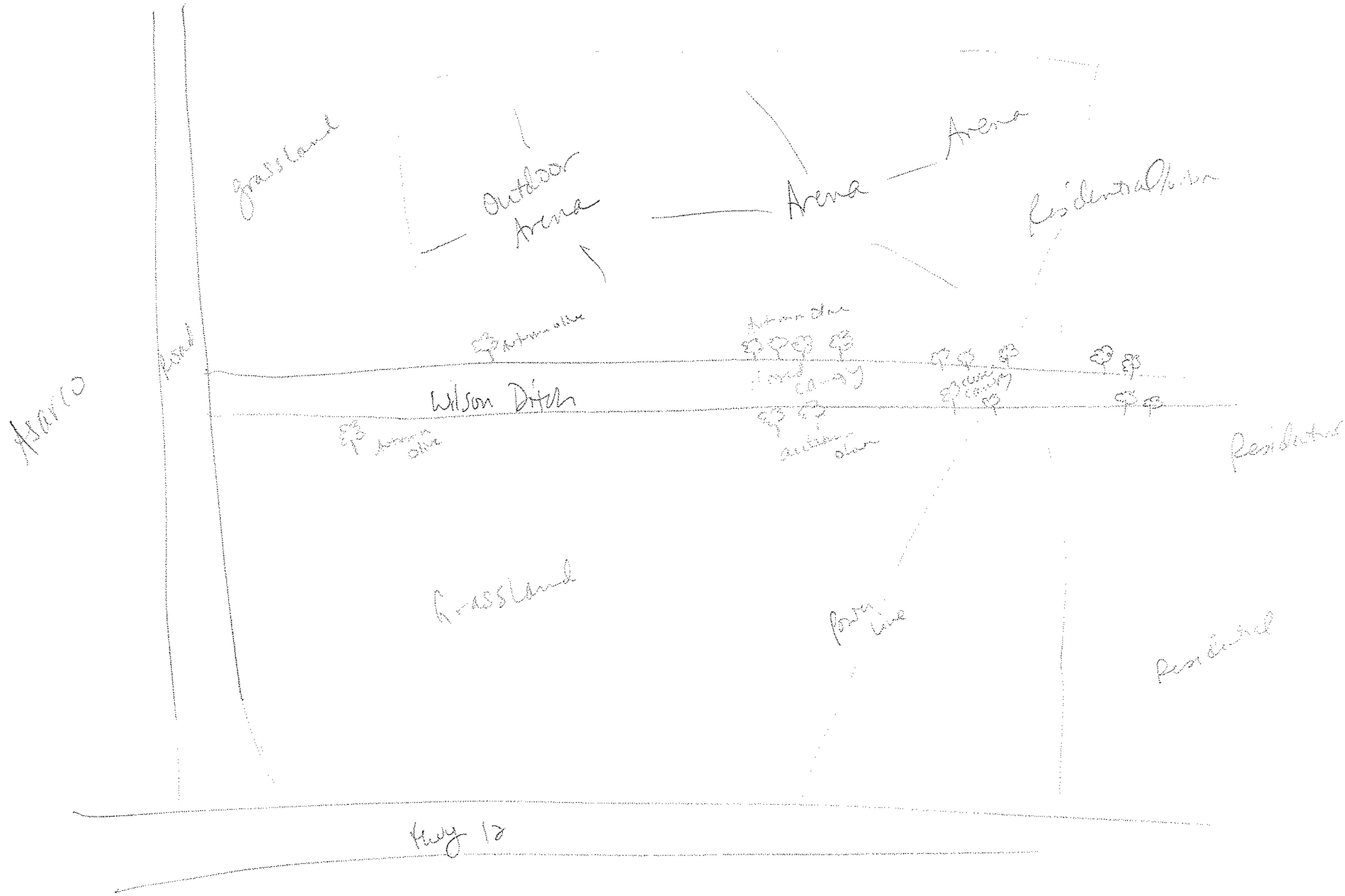
☐ none
☒ 1 – 15% (sparse, scattered shrubs)
☐ 15 – 50% (significant shrub presence)
☐ >50% (shrubland)
Notes

Tree Index

☐ none
☐ A couple or few scattered trees
☒ A couple small patches of trees
☐ Savannah- type grassland
☐ Riparian trees
Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):
lots of human use everywhere except potentially the N side of the Ditch (grassland)

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



Habitat Assessment Datasheet

Plot ID: RC Rd5 Rt4 Easting: Northing: Date: 8/1/10

Average Vegetation Height
- ☐ 0 – 0.15 m (up to about 6" – just over ankle height)
- ☐ 0.15 – 1.0 m
- ☒ Over 1.0 m (over waist high)

Notes

Vegetation Type – check all that apply
- ☒ Predominantly grass
- ☐ Predominantly wildflower
- ☒ Predominantly shrub
- ☒ Predominantly trees
- ☐ Predominantly open
- ☐ Other

Notes Grass, trees, + shrubs approximately equally distributed

Species Diversity
- ☐ Low diversity (1 to 4 overwhelmingly dominant species)
- ☒ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
- ☐ High diversity (more than 15 species common, such as in restored prairies)

Notes

Land Use (e.g., grassland, scrub, urban, etc.)

Notes Park - saw a fisherman + a dog-walker

Shrub Index (percent cover)
- ☐ none
- ☐ 1 – 15% (sparse, scattered shrubs)
- ☒ 15 – 50% (significant shrub presence)
- ☐ >50% (shrubland)

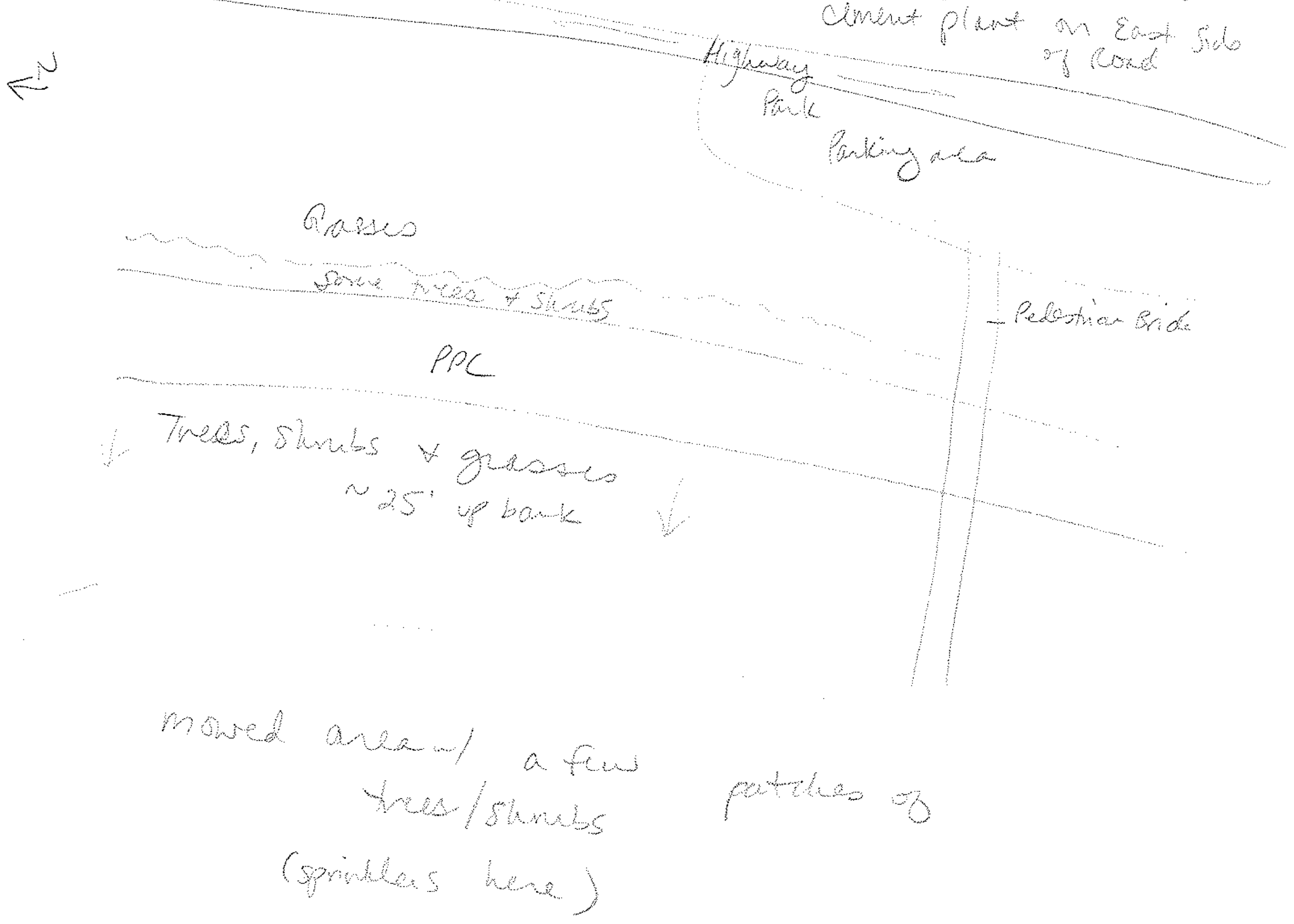
Notes

Tree Index
- ☐ none
- ☐ A couple or few scattered trees
- ☐ A couple small patches of trees
- ☐ Savannah- type grassland
- ☒ Riparian trees

Notes

Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



Habitat Assessment Datasheet

Plot ID: Walker Pond/Marsh Easting: Northing: Date: 8/3/10

Average Vegetation Height

☒ ~5% 0 – 0.15 m (up to about 6" – just over ankle height)
☒ 0.15 – 1.0 m ~50%
☒ Over 1.0 m (over waist high) ~5%
Notes sections of Shrubs alternate w/ sections of cattails, grasses/herbaceous veg

Vegetation Type – check all that apply

☒ Predominantly grass 20%
☒ Predominantly wildflower 30%
☒ Predominantly shrub 50%
☐ Predominantly trees
☐ Predominantly open
☐ Other ______
Notes ______

Species Diversity

☐ Low diversity (1 to 4 overwhelmingly dominant species)
☒ Moderate diversity (5 – 15 common species, such as a mix of flowering plants and grasses)
☐ High diversity (more than 15 species common, such as in restored prairies)
Notes ______

Land Use (e.g., grassland, scrub, urban, etc.)
Notes pond/marsh area used by visitors of (small) resort

Shrub Index (percent cover)

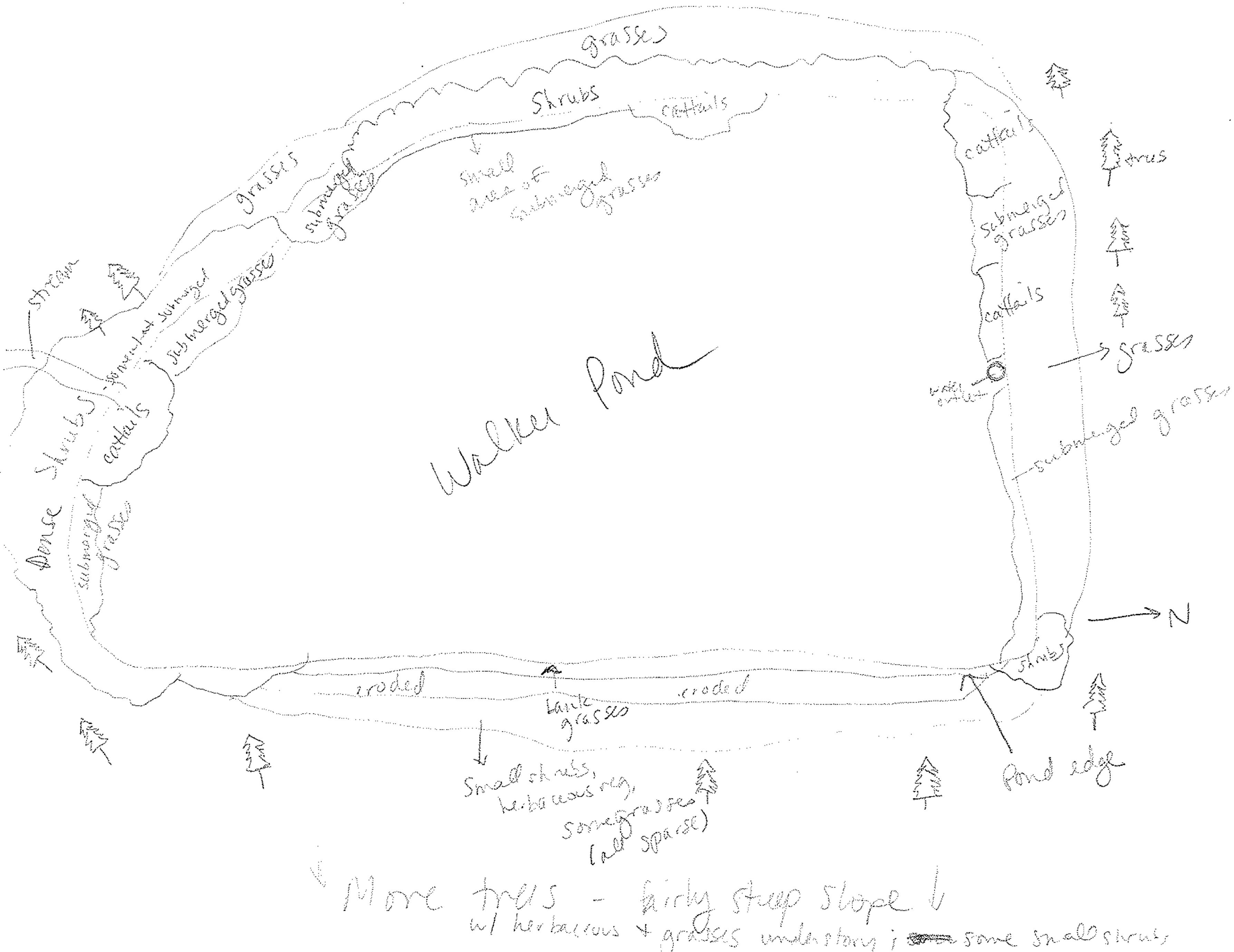
☐ none
☐ 1 – 15% (sparse, scattered shrubs)
☒ 15 – 50% (significant shrub presence)
☐ >50% (shrubland)
Notes ______

Tree Index

☒ none in immediate riparian area, but ~10-15' beyond riparian area, the site is surrounded by scattered evergreens ~50' tall
☐ A couple or few scattered trees
☐ A couple small patches of trees
☐ Savannah- type grassland
☐ Riparian trees
Notes ______

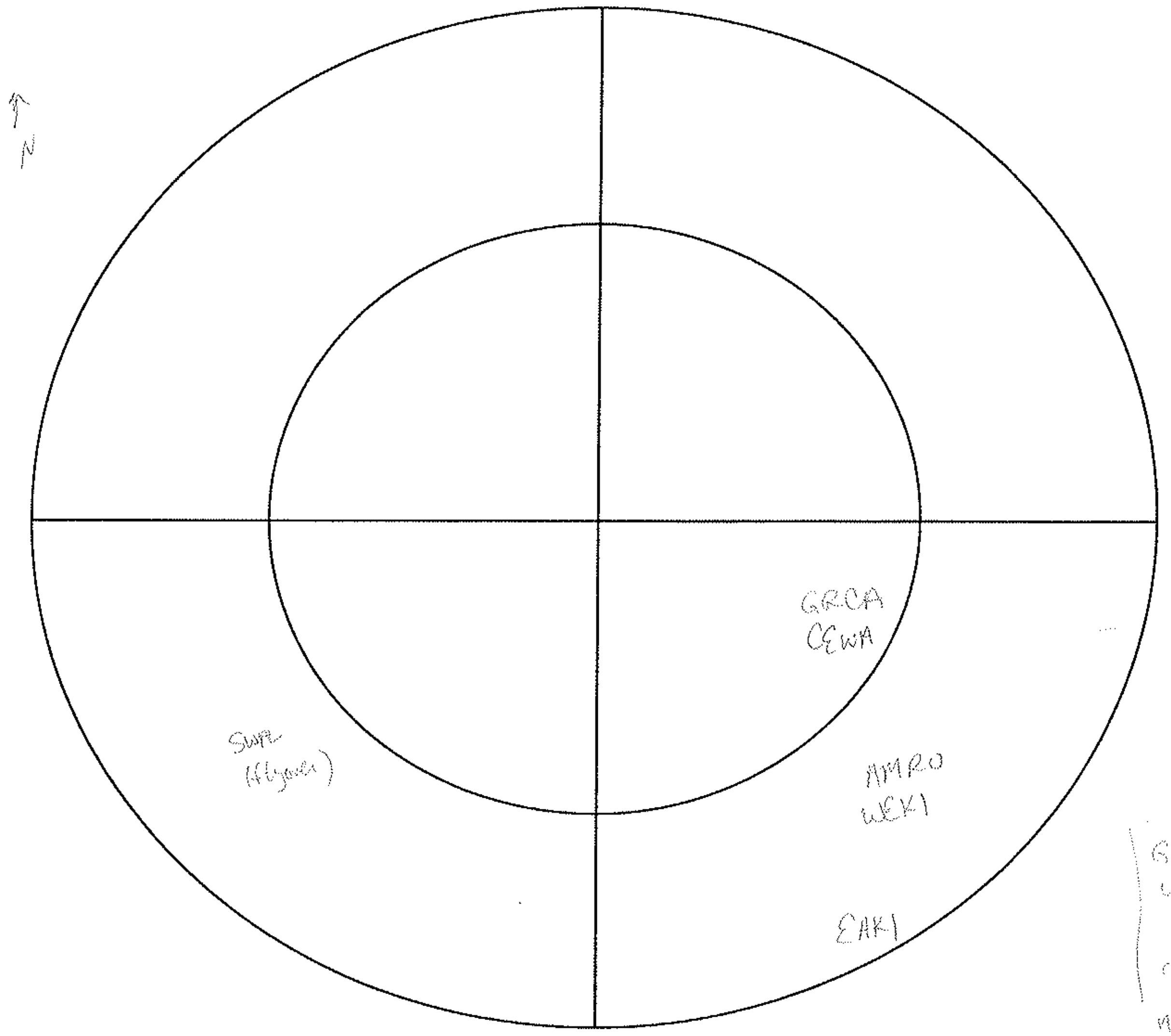
Notes (grazing, mowing, urban use, disturbance, logs, snags, etc.?):
The east side of the pond is eroded for ~50'. Trees on East + West edges are being thinned

Provide a sketch or several sketches of the site, including various aspects of topography, large rocks, downed woody debris, etc.



Bird Point Count Survey

Plot ID: APL-R2-2 Easting: Northing: Date: 7/27/10
Habitat: Riparian Temp(F): 75 Wind Spd: 0 Wind from: –
Plot Radius: ~100 ft Cloud Cover: 3 Noise Index: 3 Start Time: 6:27 pm – 6:32
Comments: Right next to stream, also noise from nearby facility



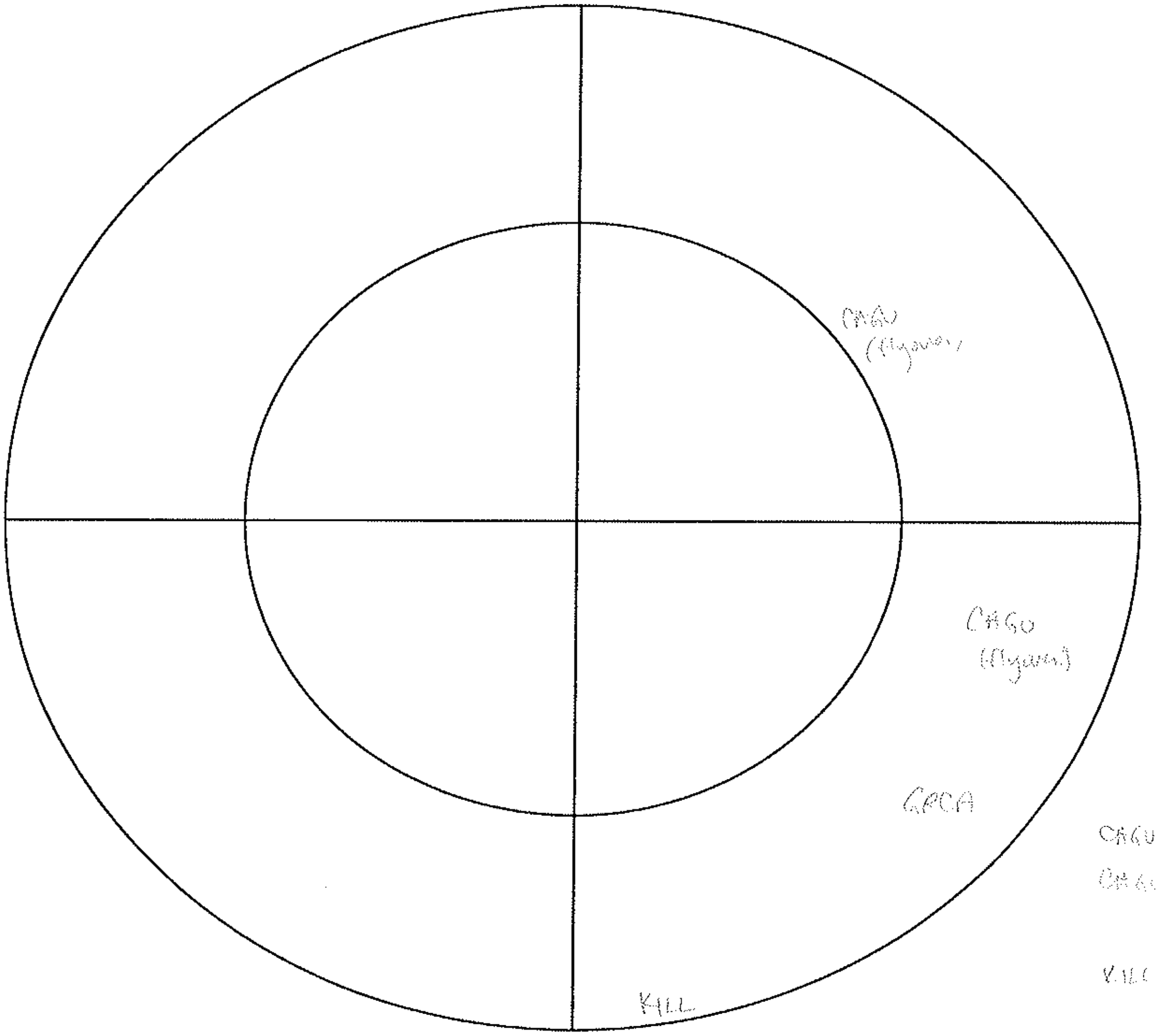
GRCA = Gray catbird
WEKI: western Kingbird
CEWA = Cedar waxwing
AMRO: American Robin
EAKI: Eastern Kingbird
SWAL: unkn swallow

List additional species detected before or after survey:
CHSP

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: PPC - R2-2
Easting:
Northing:
Date: 7/~~[illegible]~~ 28/10
Habitat: Riparian
Temp(F): ~~[illegible]~~ 55°
Wind Spd: 1
Wind from: E
Plot Radius: ~100ft
Cloud Cover: ~~[illegible]~~ 1
Noise Index: ~~[illegible]~~ 3
Start Time: 7:17 AM - 7:27 AM
Comments:



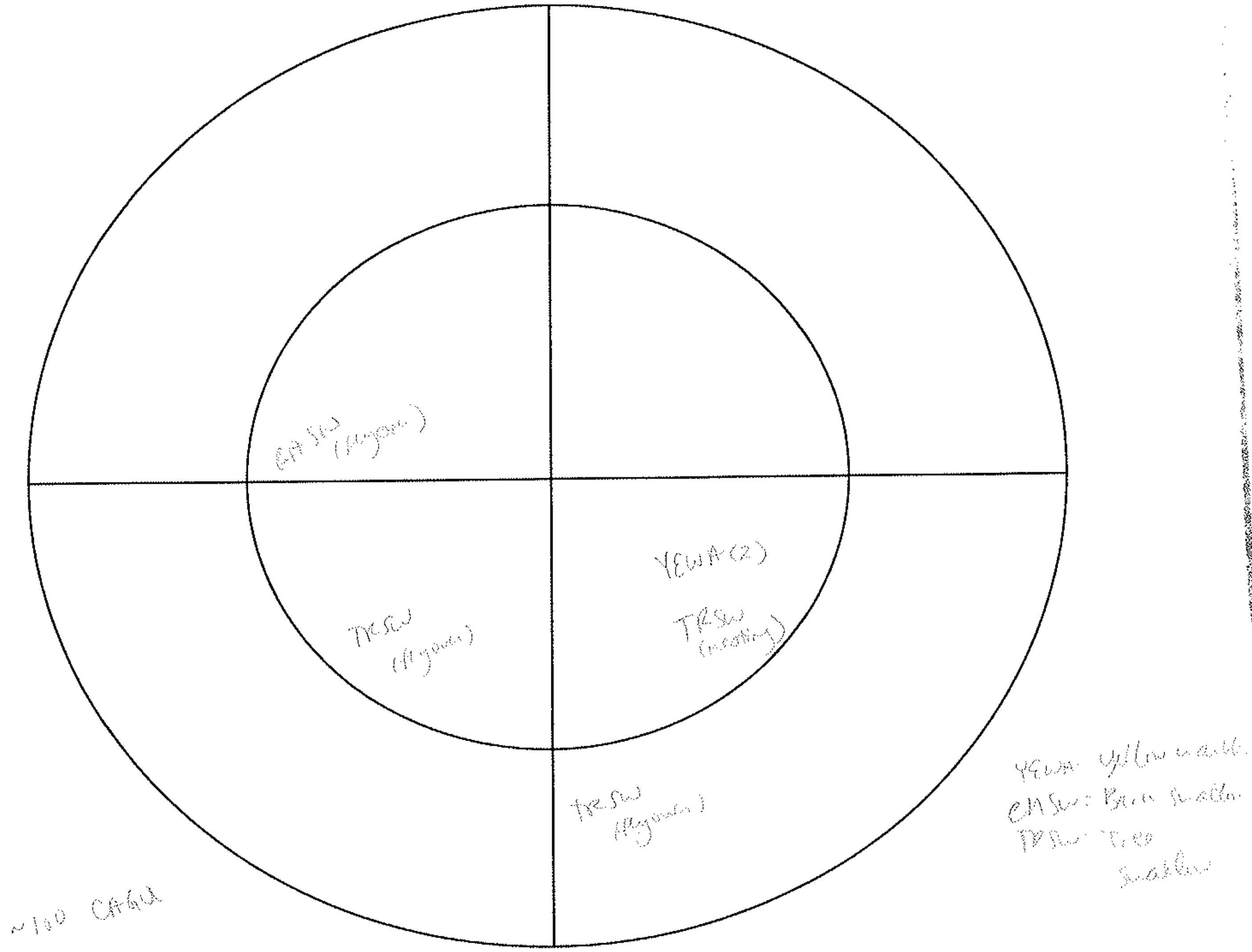
CAGU = California Gull
CAGO = Canada Goose
KILL = Killdeer

List additional species detected before or after survey:

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: LL-BK-4
Easting:
Northing:
Date: 7/28/10
Habitat: Lake/riparian/shore
Temp(F): 65°
Wind Spd: 1
Wind from: SE
Plot Radius: ~300'
Cloud Cover: 1
Noise Index: 3
Start Time: 7:49 AM 8:00
Comments: Loud noise from nearby facility



List additional species detected before or after survey: 7 CAGO, 1 KILL

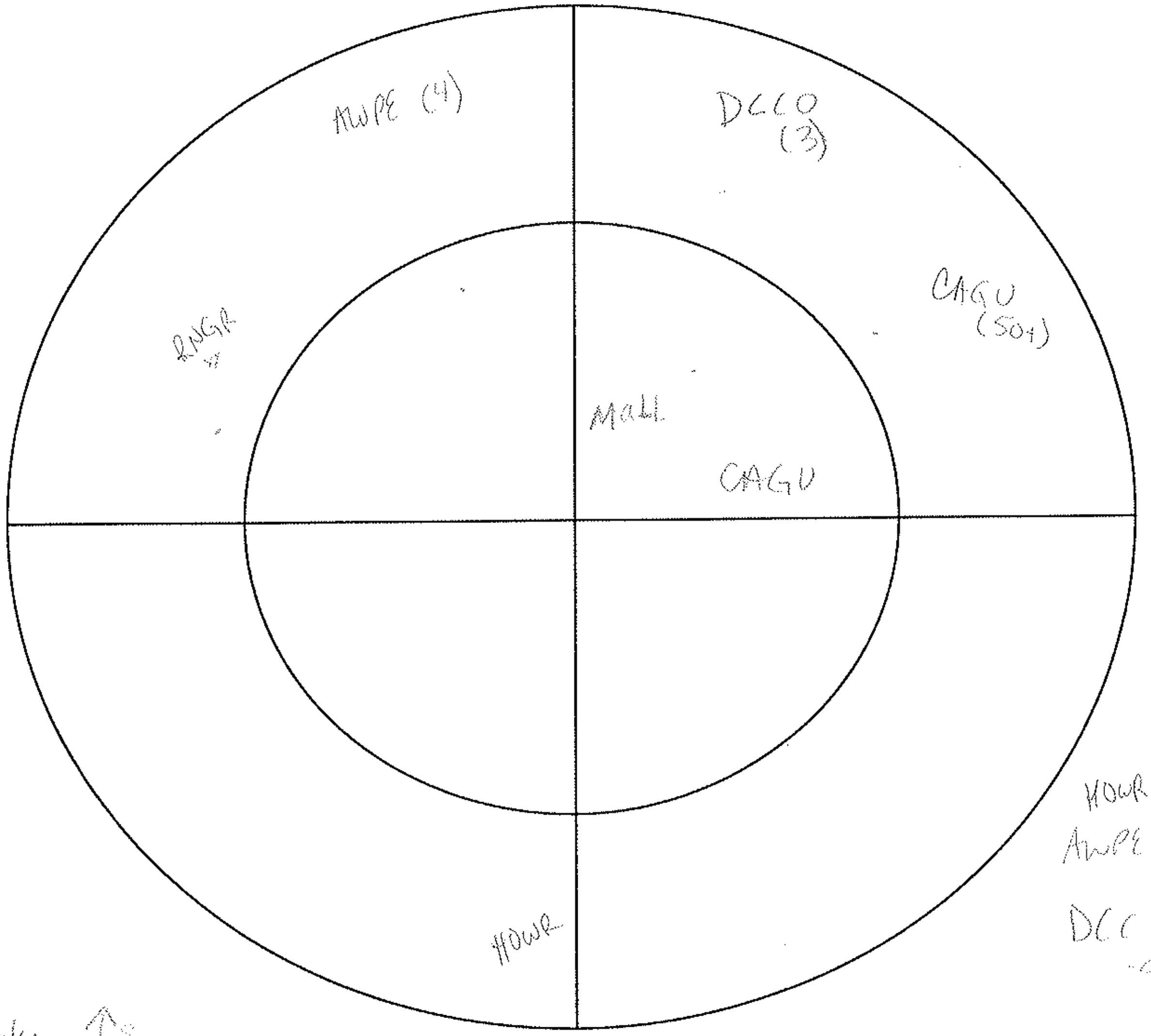
Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: UOS-SSM
Easting:
Northing:
Date: 7/28/10
Habitat: Lake Riparian
Temp(F): 65
Wind Spd: 1
Wind from: S
Plot Radius: ~400'
Cloud Cover: 1
Noise Index: 3
Start Time: 8:10 - 8:38 am
Comments:



RNGR - Red-necked Grebe

HOWR = housewren

AWPE = american white pelican

DCCO - double-crested cormorant

Lake ↑S

List additional species detected before or after survey:
GBHE, BEKI, BASW

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

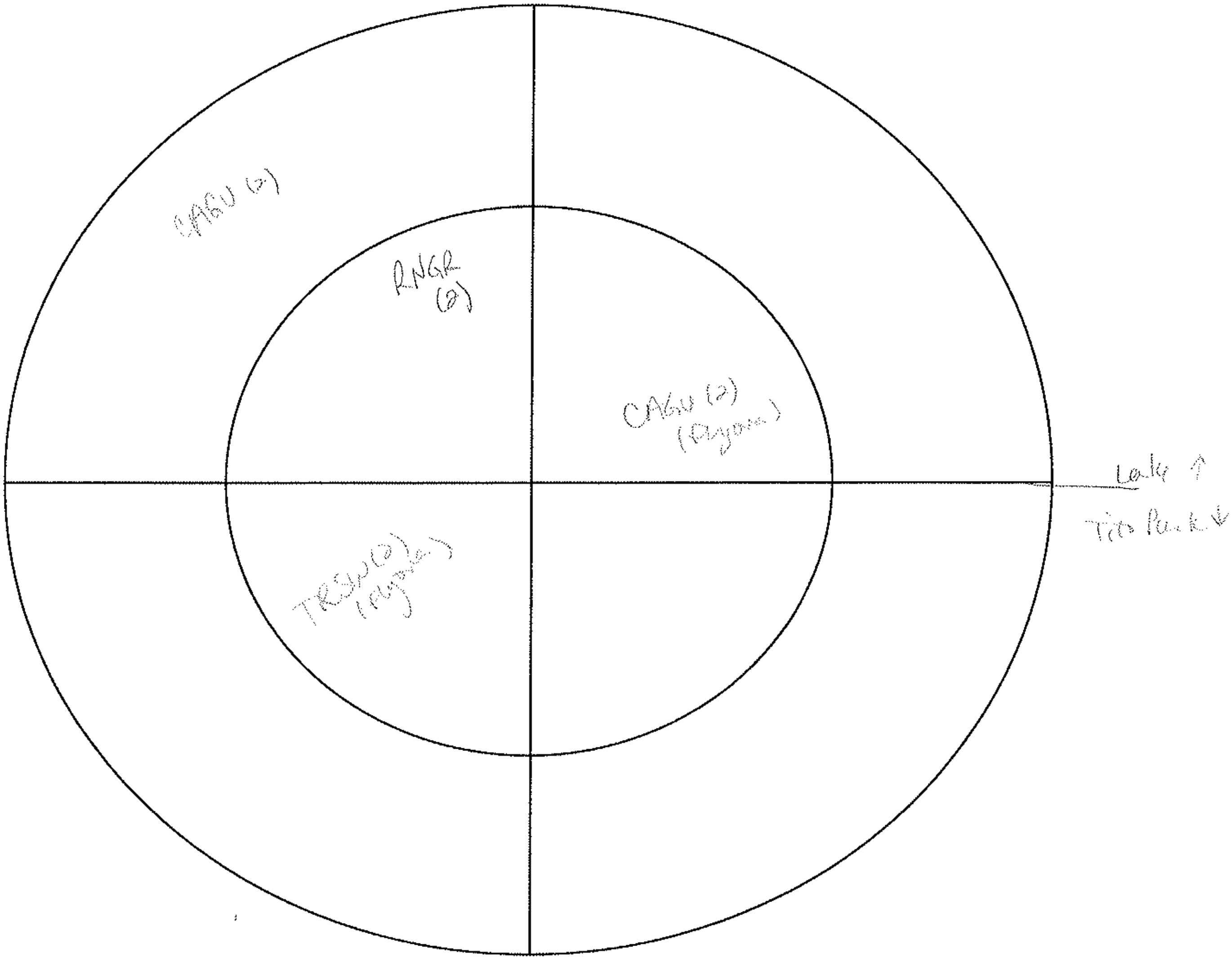
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

BEKI = belted kingfisher

Bird Point Count Survey

Plot ID: Tito Park + Lonoke Lake
Easting:
Northing:
Date: 7/30/10
Habitat: lake + open shrubland
Temp(F): 80°
Wind Spd: 1
Wind from:
Plot Radius: ~200 m
Cloud Cover: 4
Noise Index: 3
Start Time: 7:18 PM - 7:38 PM
Comments:



List additional species detected before or after survey:

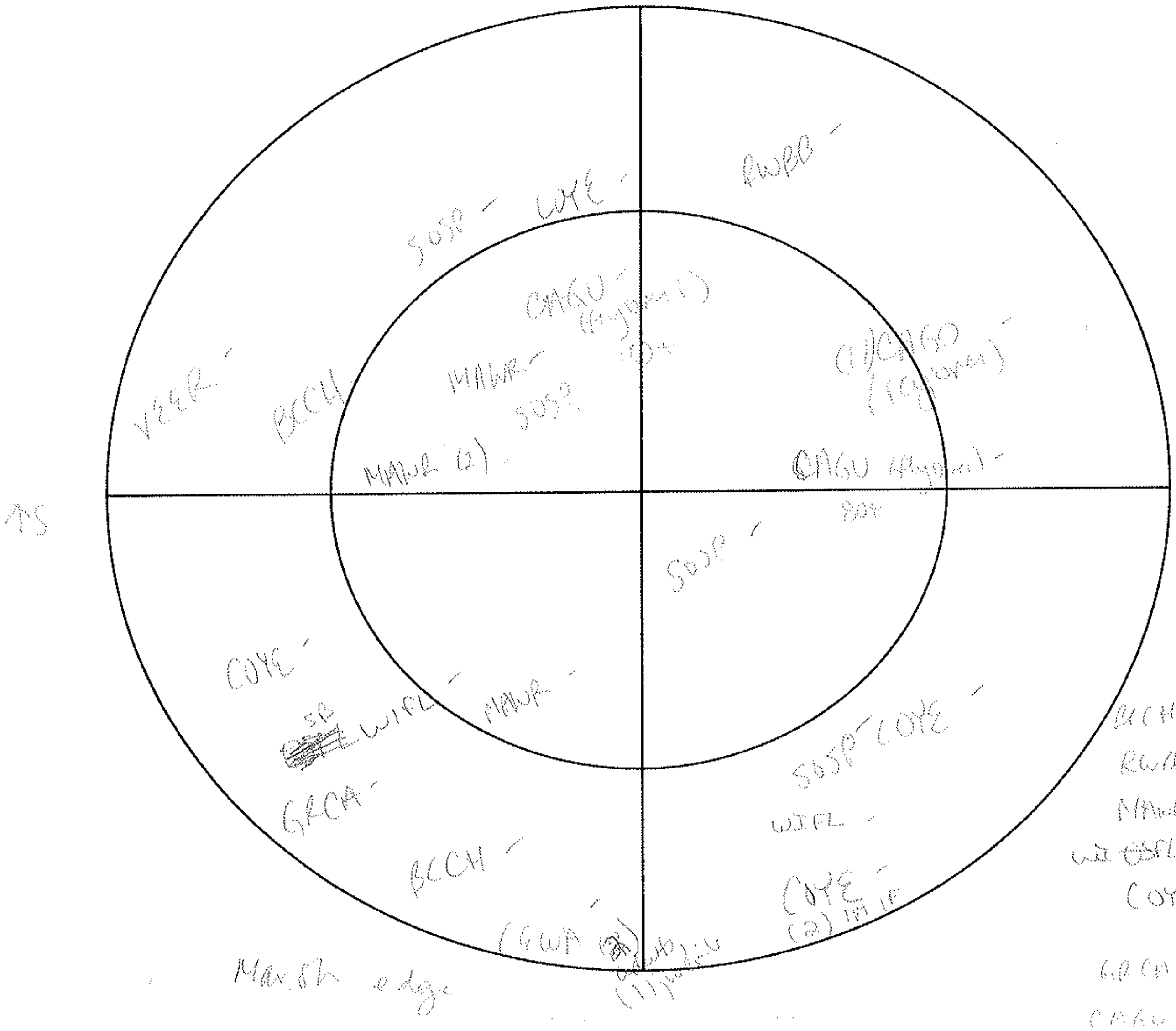
Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: Marsh East of upper lake
Easting:
Northing:
Date: 7/29/10
Habitat: marsh wetland
Temp(F): 65°
Wind Spd: 1
Wind from:
Plot Radius: 50'
Cloud Cover: 0
Noise Index: 3
Start Time: 7:15 AM - 7:50 AM
Comments: Cattails tall & difficult to see over; species heard on N edge may be from riparian zone of PRC.



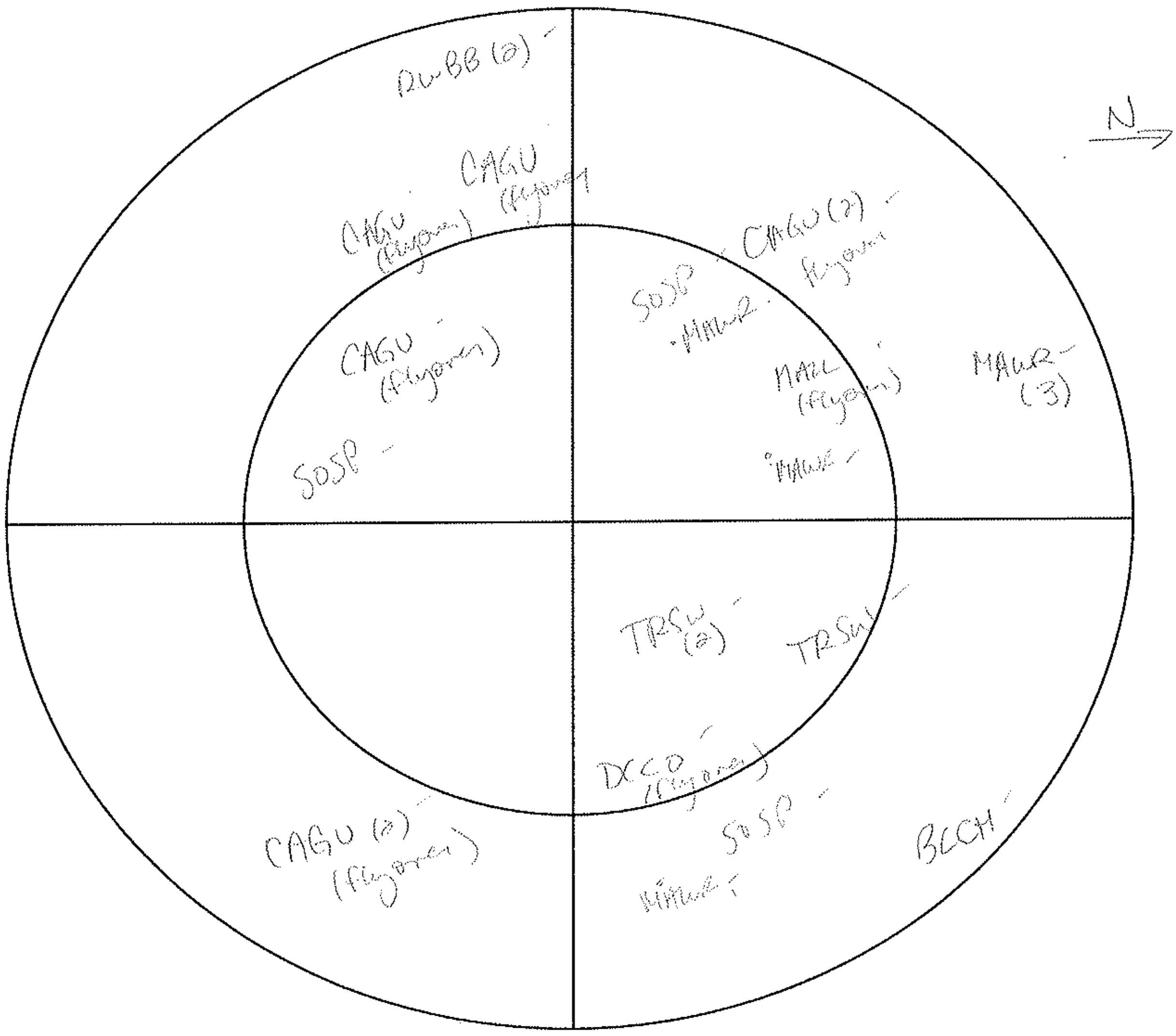
BCCH - black-capped chickadee
RWBB: red-winged blackbird
MAWR: Marsh wren
WI ~~OSFL~~ - ~~olive-sided~~ willow flycatcher
COYE: Common yellowthroat
GRCA: gray catbird
CAGU: California gull
VEER veery
WIFL: willow flycatcher

List additional species detected before or after survey:
lots of Gulls

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: Marsh
Easting:
Northing:
Date: 7/29/10
Habitat: Marsh
Temp(F): 83'
Wind Spd: 4
Wind from: SW
Plot Radius: 100'
Cloud Cover: 1
Noise Index: 2
Start Time: 7:05 PM - 7:20 PM
Comments:



List additional species detected before or after survey:
CEWA, EAKI, TRSW (6)

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

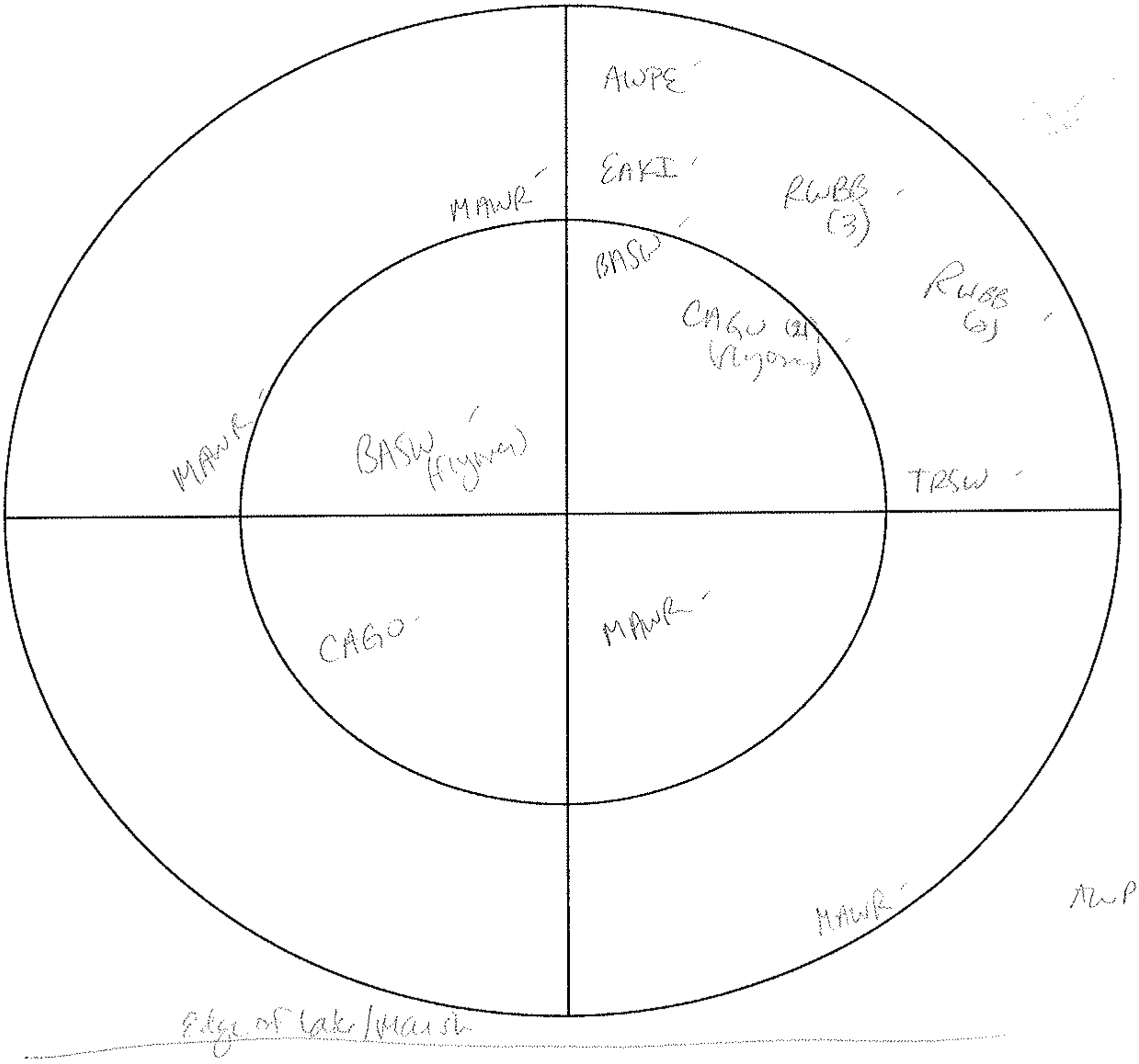
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

EAKI - Eastern Kingbird
CEWA = Cedar Waxwing

Bird Point Count Survey

Plot ID: N Side of upper lake
Easting:
Northing:
Date: 7/30/10
Habitat: Marsh/Lake
Temp(F): 83°
Wind Spd: 2
Wind from: SE
Plot Radius: ~300 ft
Cloud Cover: 4
Noise Index: 3
Start Time: 6:43 PM - 7:15 PM
Comments:



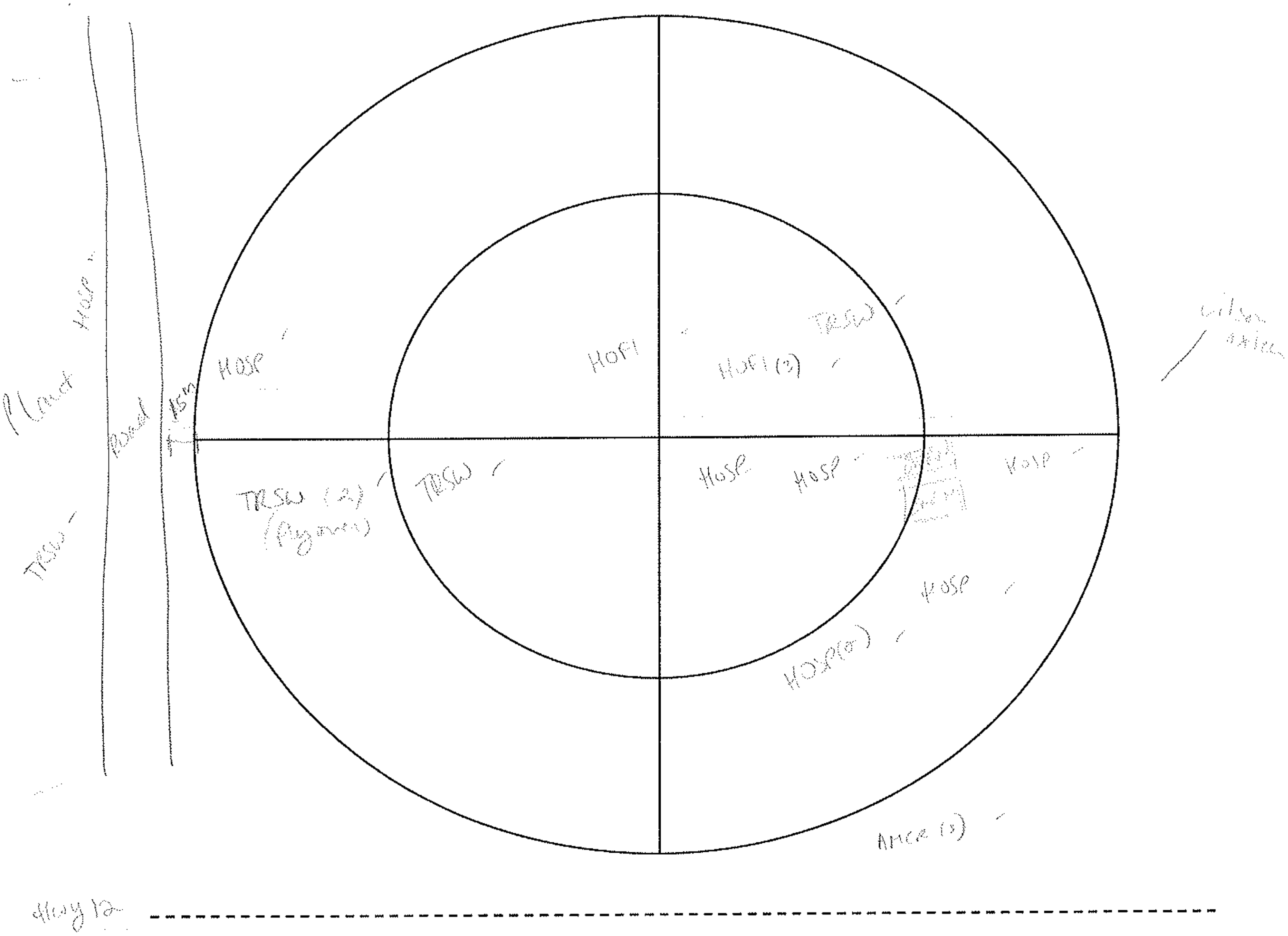
AWPE: Amer white pelican

List additional species detected before or after survey:

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: Wilson Ditch
Easting:
Northing:
Date: 7/31/10
Habitat: Riparian/Grass
Temp(F): 62°
Wind Spd: 2
Wind from: S
Plot Radius: 100'
Cloud Cover: 2
Noise Index: 2
Start Time: 7:30 AM - 7:55
Comments: walked east along ditch starting near road (~15m away from road)

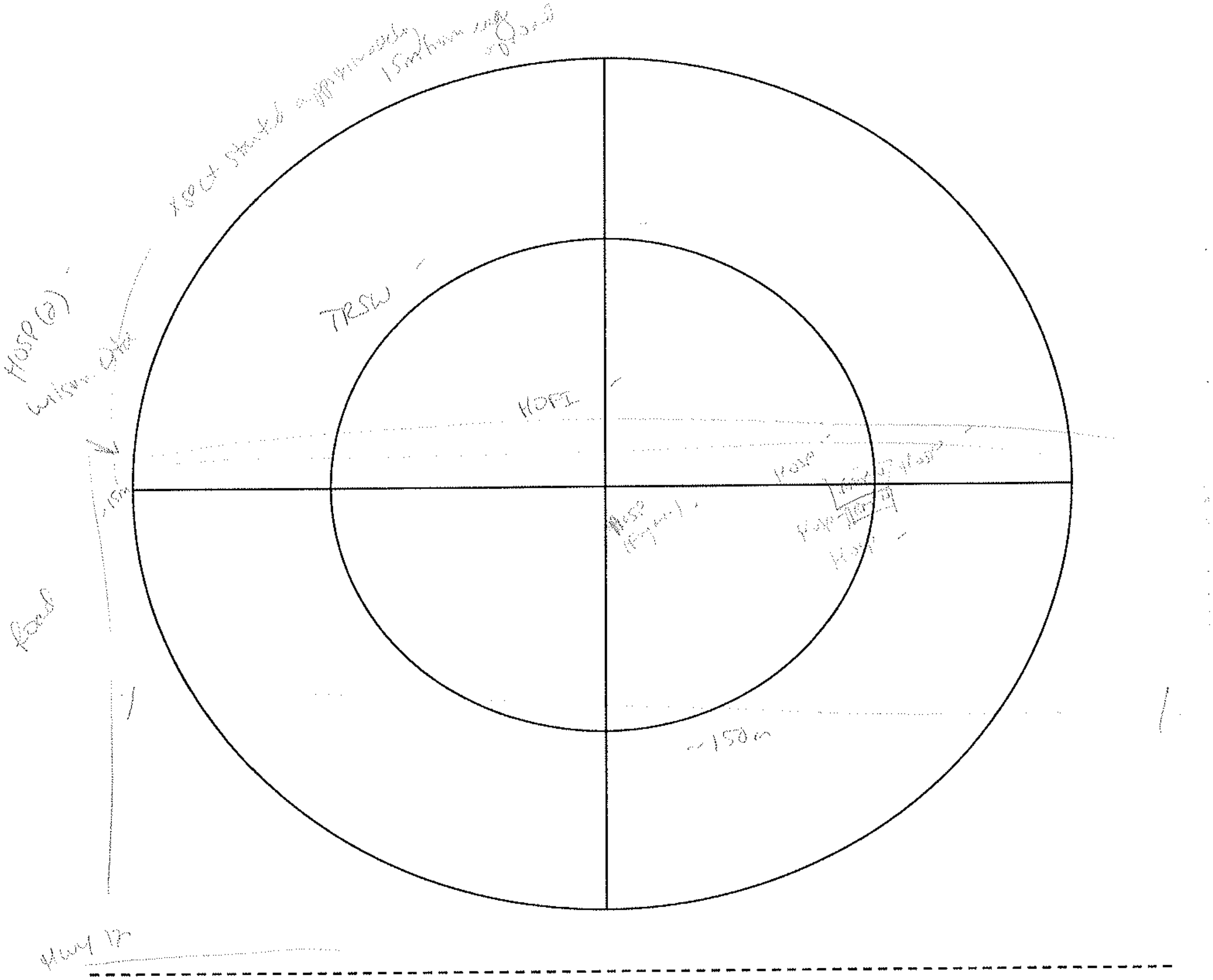


List additional species detected before or after survey:

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: Wilson Ditch
Easting:
Northing:
Date: 7/31/10
Habitat: Riparian / Grassland
Temp(F): ~~85~~ 56 75
Wind Spd: 2
Wind from: N
Plot Radius: 100'
Cloud Cover: 4
Noise Index: 3
Start Time: 5:04 PM - 5:22 PM
Comments:



List additional species detected before or after survey:

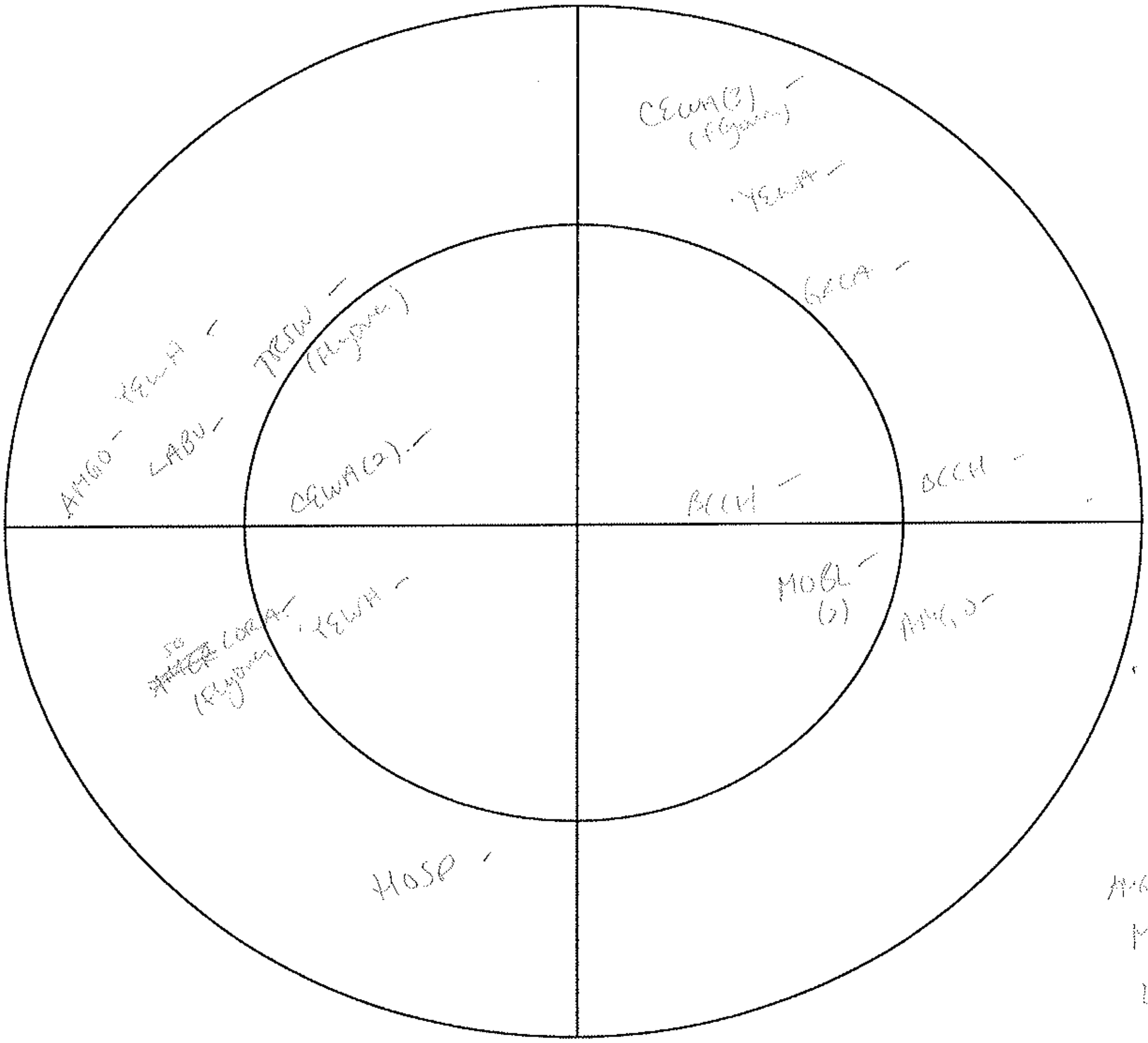
Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

PPC Plot ID: PPC Ref Site
Easting:
Northing:
Date: 8/1/10
Habitat: Riparian/Grassland
Temp(F): 68°
Wind Spd: 1
Wind from: –
Plot Radius: ~~75'~~ 150' m
Cloud Cover: 1
Noise Index: 2
Start Time: 6:50 AM – 7:00 AM
Comments:



↑ riparian

grassland ↓

AMGO: Amer. Goldfi
MOBL: Mountain Bluebird
LABU: Lark Bunting

List additional species detected before or after survey:

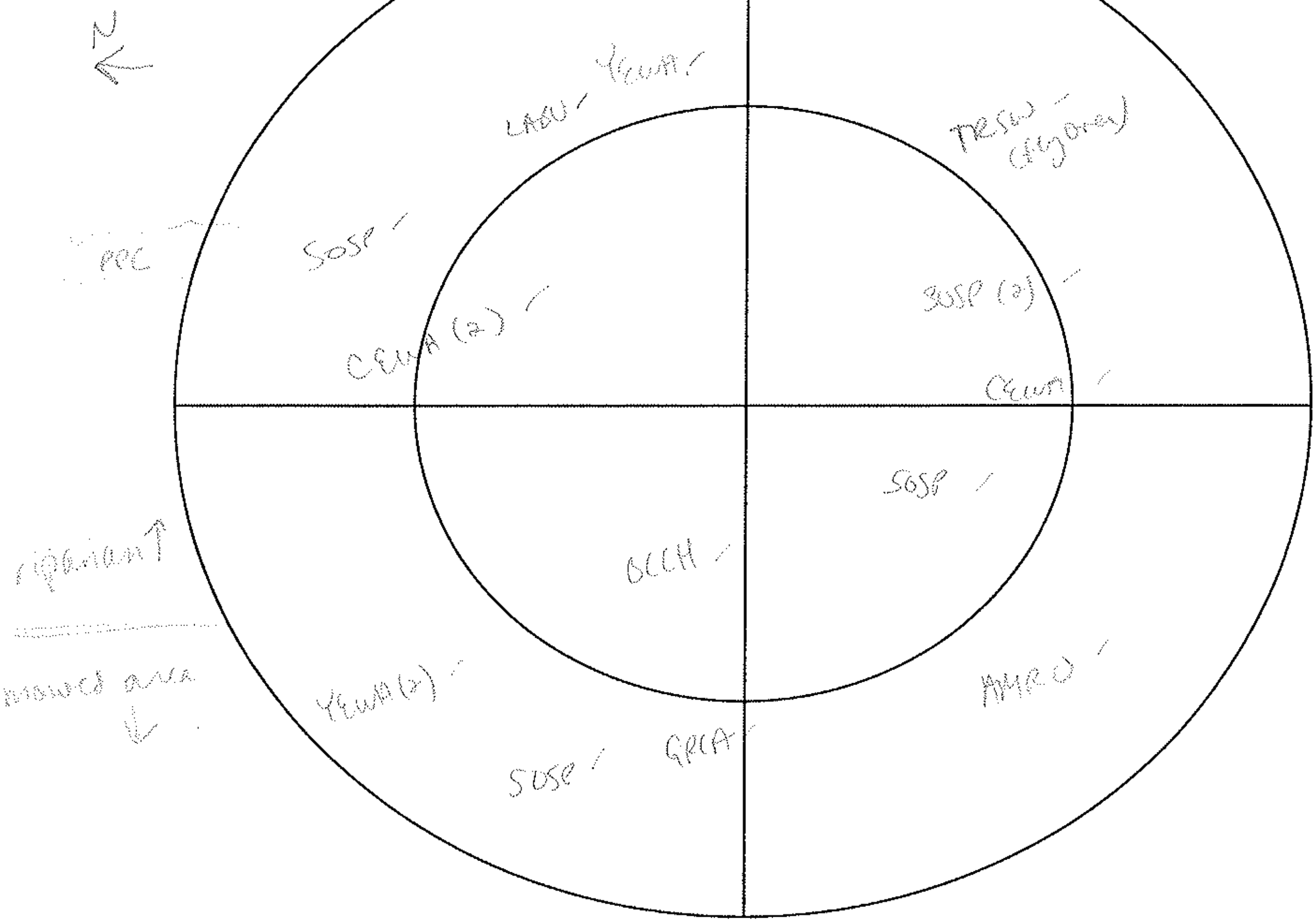
Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

PM on Back →

Bird Point Count Survey

1000 mowed grass

Plot ID: PPC Ost Site 4
Easting:
Northing:
Date: 6/1/10
Habitat: Riparian Hardwoods
Temp(F): 57°
Wind Spd: ~~2~~ 1
Wind from:
Plot Radius: 75'
Cloud Cover: 1
Noise Index: 3
Start Time: 7 53 am - 8:36 Am
Comments: noisy - across street from cement plant



List additional species detected before or after survey:

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

[illegible]

Plot ID : PPC rab Site 4

Habitat Riparian, Forested corridor

Plot radius: 75'

Temp : 86°

Cloud Cover: 1

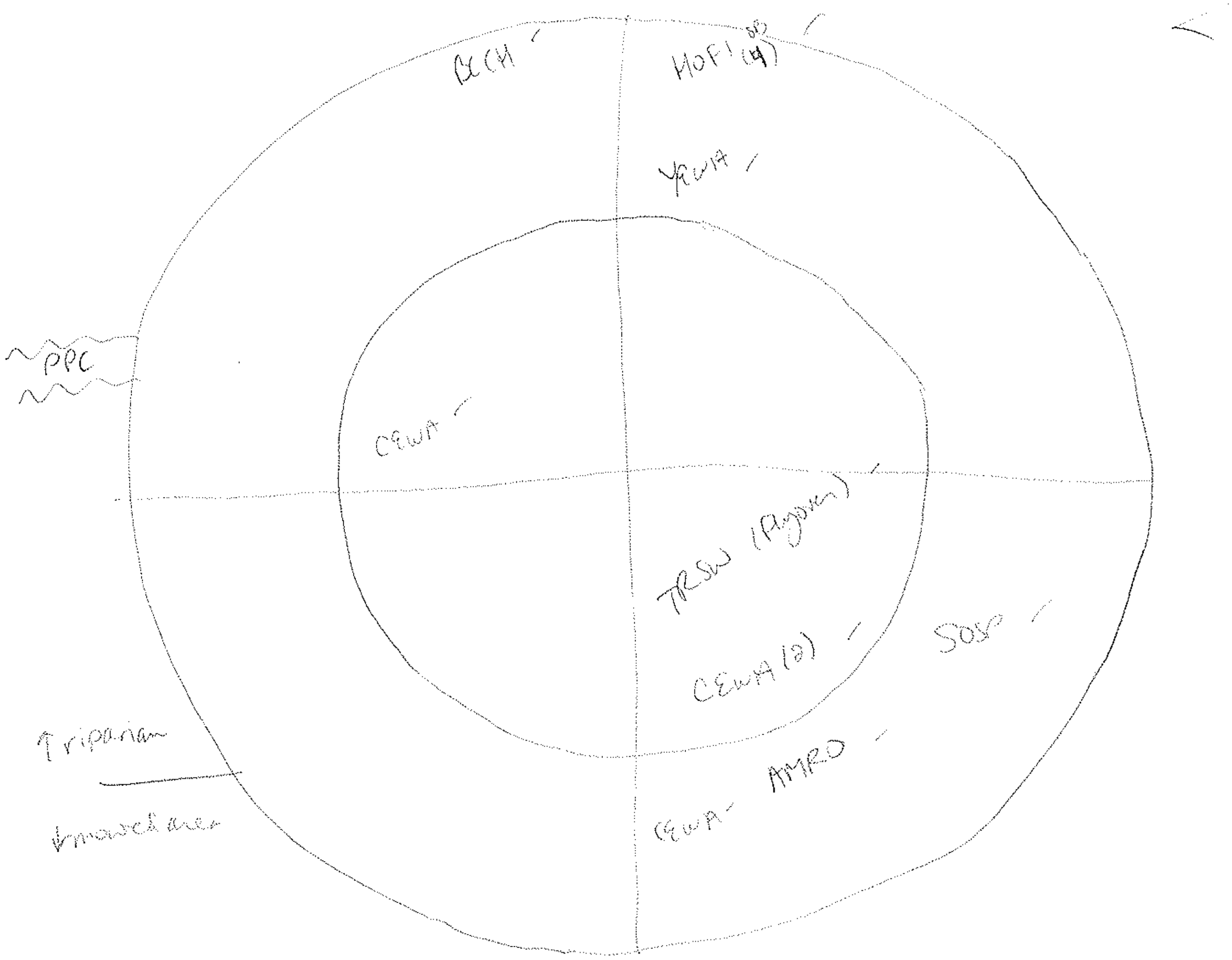
Wind Spd: 3

Noise Index: 3

Date: 8/1/10

Wind From: NE

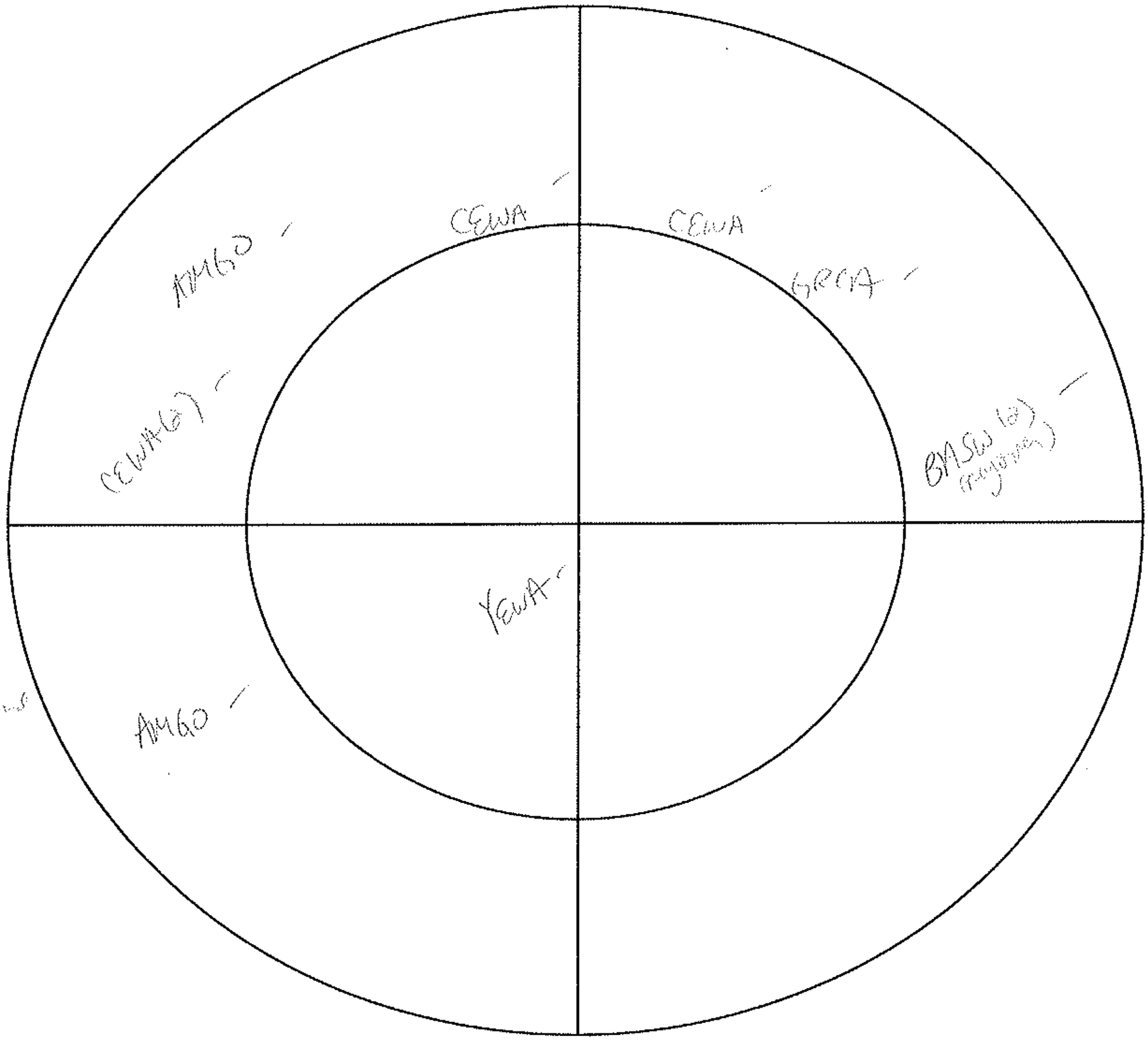
Start Time: 7:00 PM -7:28 PM



Spp seen before/after survey Osprey on other side of Hwy

Bird Point Count Survey

Plot ID: PPC Ref Site 1
Easting:
Northing:
Date: 8/1/10
Habitat: Riparian/Grassland
Temp(F): 86°
Wind Spd: 2
Wind from: NE
Plot Radius: 150'
Cloud Cover: 1
Noise Index: 2
Start Time: 6:28PM - 6:45PM
Comments:



Riparian
grassland

List additional species detected before or after survey:

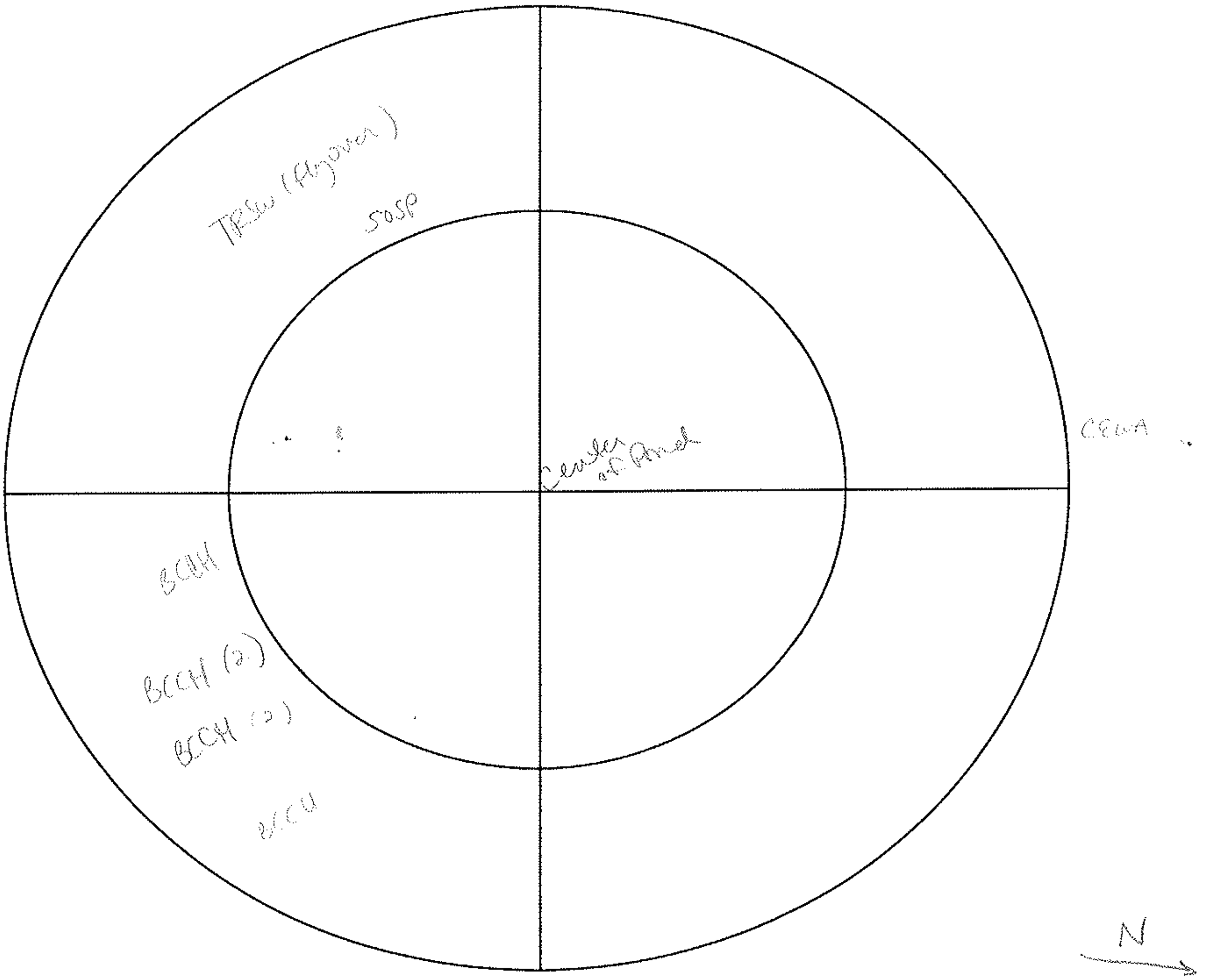
Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: Walker Pond/Marsh
Easting:
Northing:
Date: 8/3/10
Habitat: Pond/Marsh Edge
Temp(F): 83°
Wind Spd: 3 to 4
Wind from: NW
Plot Radius: 100'
Cloud Cover: 1
Noise Index: ~~2~~-3
Start Time: 5:04 PM - 5:34 PM
Comments: Circled the pond; wind & noise @ times.

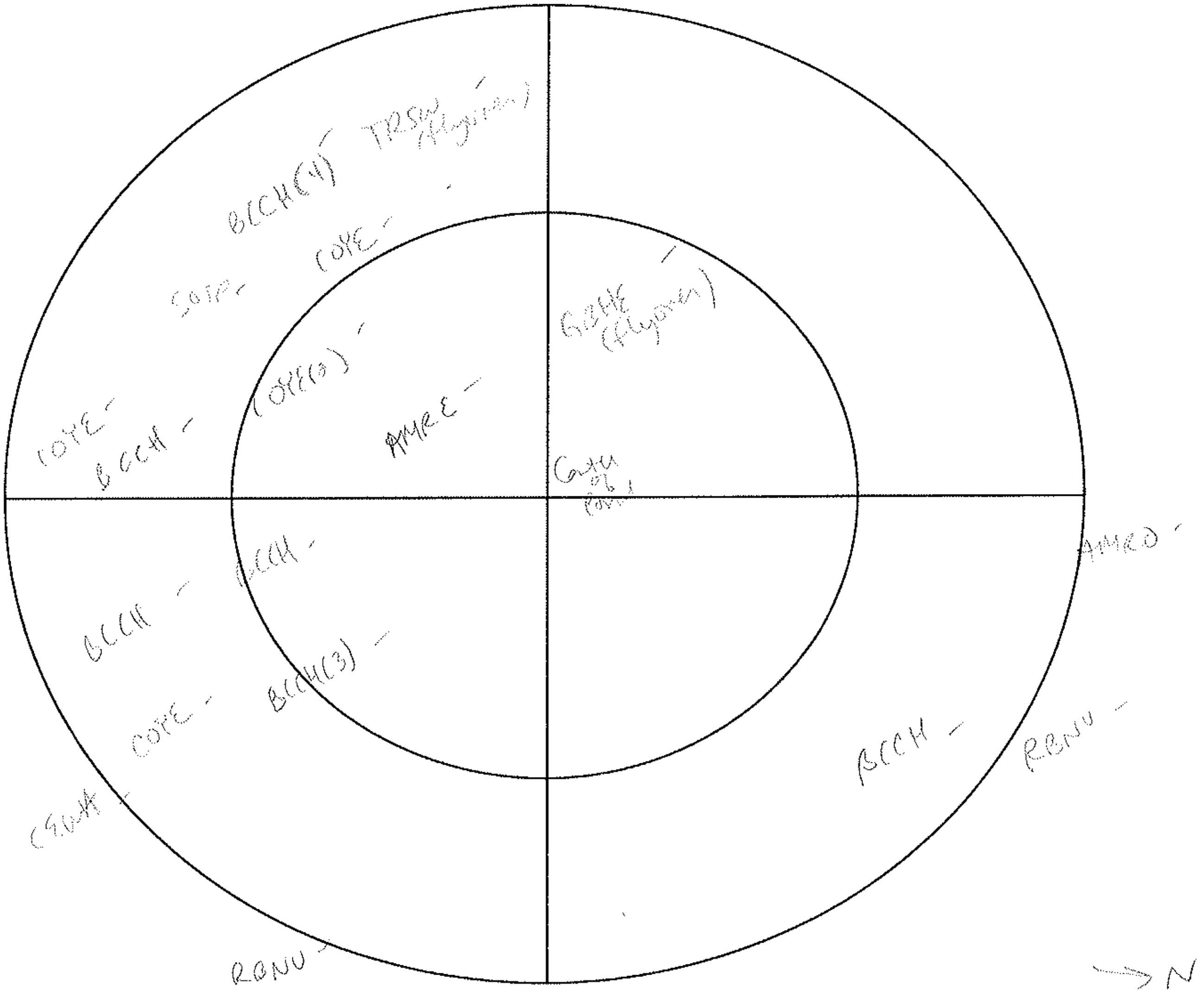


List additional species detected before or after survey:
BCCH heard around entire site, CEWA heard in NW corner of pond earlier

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper
Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%
Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

Bird Point Count Survey

Plot ID: Walker Pond/Marsh
Easting:
Northing:
Date: 8/4/10
Habitat: Pond/Marsh Edge
Temp(F): 58°
Wind Spd: 2
Wind from: E
Plot Radius: 100'
Cloud Cover: 4
Noise Index: 2
Start Time: 6:35AM – 7:35AM
Comments: ____



List additional species detected before or after survey:

____

Wind Speed: **0** = smoke rises vertically; **1** = rising smoke drifts; **2** = tree leaves rustle/can feel wind on your face; **3** = leaves and twigs move/light-weight flag extends; **4** = think branches move/raises dust and paper

Cloud Cover: **1** = 0-25%; **2** = 25-50%; **3** = 50-75%; **4** = 75-100%

Noise Index: **1** = quiet, low or no wind; **2** = fair conditions, some wind or noise; **3** = difficulty hearing at times, loud noise or distractions

RBNU = Red breasted Nuthatch

Small Yale Pond

7/26

- Ash Grove Wildlife Project

N 46° 33.223	46.55371°
W 111° 54.633	111.91056

- Reference Site, but NOT SUITABLE for upland sampling
- waypoint 27

- Across from Ash Grove Cement Factory

N 46° 32.613′	46.54354
W 111° 55.458	111.92431

- waypoint 28

- No Trespassing

N 46° 32.365′	N 46.53942°
W 111° 55.789	W 111.92982°

- waypoint 029
- Good Potential Soil (upland) Site
- Need Permission

- Possible most upstream reference site downstream of bridge crossing after turning on road near school.

- N 46° 32.071	46.53455
W 111° 56.147	111.93578

- waypoint 30
- Potential Upland Soil Site

- Further upstream - potential most upstream site.
- Potential upland soil site

N 46° 29.788′	46.49647°
W 111° 57.503	111.95839

- waypoint 31
- Pullout on left driving upstream
- Adjacent to Interstate 15

7/27

- PPC-REF-8

- N46° 33.879'	N 46.56466
W 111° 54.870'	W 111°. 91450

- Waypoint 32
- located on Ranch w/ cool buildings. Drive past house - park when you can see the next house in front of you. Flagged just downstream on waters edge.
- Yellow flag w/ pink + black flagging

- PPC-REF-6

N46° 33.407'	N46. 55678
W 111° 54.604'	W 111. 91007

- Waypoint 33
- Private property??
- Park after guard rail overlooking creek at Adopt A Highway - Ash Grove Employees Sign.
- Cross over barbed wire fence

- PPC-REF-7

N46° 33.711'	N 46.56186
W 111° 54.900	W 111. 91500

- Waypoint 34

- walked upstream from PPC-REF-8 along railroad tracks. Dropped down into stream under fence at large meander

- PPC-REF-5

N 46° 33.215	46. 55358
W 111° 54.644	111. 91072

- Waypoint 35
- Located at Ash Grove Wildlife Habitat Project parking area
- Old beaver dam (blown out) upstream of flagging

- PPC-REF-4

N 46° 32.626′	46.54375
W 111° 55.473′	111.92453

waypoint 36

- Flagged just upstream of foot bridge on river left (looking downstream) bank
- located at Ash Grove Sunderland Park located across from cement plant.

- PPC-REF-3

N 46° 32.396′	46.53995
W 111° 55.653	111.92756

waypoint 37

- walked up from culvert crossing
: Flagged on river left. Also flagged tree.

- PPC-REF-2

N 46° 32.069	46.53447°
W 111° 56.141′	111.93565°

- Just downstream of bridge crossing on McClelland Crk Road - Flagged on river left bank.

PPC-REF-1

N 46° 31.503′	N 46.52505
W 111° 56.748′	W 111.94580

waypoint 39

Go over highway and take left on Rotary
- Just upstream of grey house developmnt

27 July 10

PPC-RZ -4 CCP-RV-4

Down slag causeway E of Upper Lake
Deployed 2 coverboards
No earthworms

PPC-RZ-4 CCP-RV-5

Near E end of Lower lake, flagged tree at entrance, go thru willows along slag path to stream
deployed 2 coverboards + 3 pitfall traps
No earthworms

PC-RZ-4 CCP-RV-2

Along SE corner of slag pile near stream.
deployed 2 coverboards
found some earthworms, will decide how many it is feasible to get.
~1/2 ea for 3 people → ~8 worms (g)

26 July 2010

Deployed 2-3 cover boards at all sites in Tito Park.
Deployed 2 sets of 3 pitfall traps

Deployed 2 cover boards at each of 4 sites around Lower Lake Riparian zone

Deployed 2 cover boards at each of 3 sites around Upper Lake.

CAC
26 July ~~2007~~ 10

AM
SB, JM, DM, TV, RD - met at site, H&S briefing
site tour

CC, GD - PM H&S briefing

PM
DM, SB, CC - ID'ed soil sampling / terr invert
sites around Lower Lake, Tito
Park, Upper Lake (except UL-BK1)

GD - & deployed cover boards & pitfall
traps

JM, TV - PM visiting potential reference sites

CC - Carrie Clayton
SB - Stephanie Baker
JM - Jason Mullen
GD - Grant DeJong
DM - David Mayfield
TV - Tim Verslycke
DR - Dave Rouse
RD - Robin DeHate

CAC
27 July ~~2007~~ 10 - UPSTREAM REFERENCE
PPC - raining, but
warm

0630
AM SB - bird/veg survey @ PPC-REF-8
raining, few birds.
decided to revisit under
better weather cond.

TV, JM - ID'ed sites @ US PPC site

0730
AM
CC, GD, SB, RD, DM - Sampled benthic
inverts @ PPC-REF-8
finished @ 0920

CAC
DR, CC, GD, SB, ~~RD~~, DM - sampled benthic
inverts @ PPC-REF-6
finished @ 1100

RD CAC CAC
DR, CC, GD, ~~SB~~, ~~DM~~ - Sampled benthic
inverts @ PPC-REF-4
finished @ 1220

CAC
~~D~~ JM, SB, TV, DM - electrofished US & DS
of PPC-REF-4
started @ 1140, finished @ 1220
6 brown trout sampled

JM, SB, GD - aquatic habitat survey
@ PPC-REF-4
finished @ 1250

BREAK

JM, OC, SB - sampled benthic invert
@ PPC-REF-2 (BI)
finished @ 1612

GD, DM - IDed PPC-DS sites & deployed
cover boards, sampled
earthworms @ PPC-RZ-2

JM, CC, SB - sampled BI @ PPC-REF-1
finished @ 1722

DR, JM, GD, ~~SB~~ CC OAC - checked all cover
boards deployed 26 July
@ LL, Tito Park, UL
- 1 grasshopper found @ LL-BK-1
cover board

SB - PM bird/veg survey @ PPC-RZ-2

GD - deployed additional pitfall
traps @ ~~PPC~~ OR UL-BK-1 and
UOS-SS-21 or LL-BK-4 ?

Soil invertebrate trap locations / methods

~~UL-1~~ ~~UL~~	Gear	Date dep.	Additional Gear	Date Depl.
UL-BK-1	CB	AM 7.28. PM 10	PFT	7.20.10
UL-BK-2	CB	7.26.10		
UL-BK-3	CB	PM 7.26.10		
UL-BK-4	CB	PM 7.26.10		
LL-BK-1	CB	PM 7.26.10	PFT	PM 7.27.10
LL-BK-2	CB	PM 7.26.10		
LL-BK-3	CB	PM 7.26.10		
LL-BK-4	CB	PM 7.26.10	PFT	PM 7.27.10
UOS-SS8	CB	PM 7.26.10		
UOS-SS10	PFT	PM 7.26.10		
UOS-SS22	CB	PM 7.26.10		
UOS-SS14	PFT ~~CB~~	PM 7.26.10		
UOS-SS21	CB	PM 7.26.10		
OK UO~~S~~P-SS17	CB	AM 7.28.10		
UOP-SS12	CB	AM 7.28.10		
UOP-SS2	CB	AM 7.28.10		
~~UOP-SS4~~	~~CB~~	~~AM 7.28.10~~	OAC	
UOP-SS9	CB, PFT	AM 7.28.10		
UOP-SS20	PFT	AM 7.28.10		

cont. 15

28 July 2010

JM, TV - ID downstream PPC locations not found 27 July

DM, GD - ID soil perimeter samples & LL-BK-1, deployed CB/PFT @ all locations

SB - AM Bird survey @ PPC-RZ-2, N. end Upper Lake, Lower Lake, Tito

0930 -1130 PPC-22 Sunny, hot

DM, DR, SB, GD, CC - Sampled BI @ PPC-22 finished @ 1017

SB, JM, DR - Electrofished @ PPC-22 started @ 1020, finished 1100

11:45-1245 PPC-05 Sunny, hot, very high & fast-moving water

GD, DR, DM, SB - sampled BI @ PPC-05 finished @ 12:45

SB, CC, JM, TV, electrofished @ PPC-05 started @ 11:50 finished 12:30

SOIL INVERT TRAPS (cont. fr. 13)

			Additional		Notes.
	Gear	Depl date	Gear	Depl. date	
PPC-RZ-1	PFT?				
PPC-RZ-2	OB	PM 7.27.10			
PPC-RZ-3	PFT?				
PPC-RZ-4	CB, PFT or	PM 7.27.10			
PPC-RZ-5	CB ~~PFT~~	PM 7.27.10			Pound few earthworms 7.27.10

BIRD SURVEYS / VEG SURVEYS

	AM BIRD	PM BIRD	VEG	area
PPC REF-8	.		X	'DS boundary PPC-REF
PPC-RT-2	X	X	X	middle of PPC
Lower lake	X	X	X	
Tito Park	X	X	X	
Upper ~~Park~~ Lake N CAC	X	X	X	
~~Upper Lake S~~ CAC				
Marsh.	X	X	X	
WD/UOP	X		X	
UL REF				
~~STRE~~ CAC				
U/M REF				

28 July '2010 (cont)

~~0230~~ CAC

1430 PPC-102, 103

GD, DM, DR - sampled BI @ PPC 102
finished @ 1600

CE, JM, SB, TV - electrofished @
PPC-102, 103. finished @ 1600

1600

GD, DM, DR, TV, CE - sampled BI @
PPC-103, finished @ 1645

JM, SB, GD - Habitat Survey from
PPC-05 → PPC-103

1700

DM, TV, DR - Sampled BI @ PPC-7
~~JMT~~ CAC

29 July 2010 - sunny, hot

0630 - SB-bird Survey/veg survey ULM
- JM, GD-earthworm Sampling @ PPC-RZ-2
- CC, DM, TV-Checked CB, PFT @ all TFD Park, UL, and UL-BK-3 & 4 sites, PPC-RZ Sites

0900 - JM, SB seine @ ULM-1 (ULM-29) (near PPC-RZ-4). set minnow traps
~NO FISH
3 one 2
- GD, CC sampled BI @ ULM1
finished @ 1014
↓ captured frog en route to ULM-2 on road btw. creek & marsh
1030 - JM, SB Seine @ ULM-2 (ULM-25)
~~(near~~ one, set 3 minnow traps
NO FISH
- GD, CC, SB sampled BI @ ULM-2
- JM habitat assesment ULM-1, ULM-2

1430 - GD, DM, SB, CC sampled BI @ ULM-3 (near ULM-24)
- JM habitat assessment.
YOY Forage fish caught along edge of marsh
1600 - same as above @ ULM-4
- no fish caught.

1745 - Same as above @ ULM-5
- large school of FF caught

2000 - set 5 minnow traps @ UL-24 one, UL-27B
24A

30 July 2010 — Sunny, hot, late afternoon thunderstorm

0830 - GD check SI samples @ UL, LL, Tito Park, PPC-RZ
- SB, CE, DM check UL minnow traps - FHM, WS, leeches, dragonfly, beetles caught
- JM, DM set gill net

0930 - DM, JM, GD, SB sampled BI @ UL ~~24~~ OAC 21A

030 - GD, DM set PFT @ UL-BK-1, check VOP samples
- SB, JM, CC sample BI @ UL-21B

130 - SB, JM, CC Sample BI @ UL-24

1330 - DM, JM check gillnet - 1 RBT
SB, GD, CE, sample BI @ UL-23
JM check ULM-2 MT - captured FHM, DACE

1500 - JM, DM, GD, SB sample BI @ UL-25
- DM, SB sampled other Aq. Invert @ BI 23
- set minnow traps in LL

1700 - JM, GD habitat assessment & ponar off shore of each BI site
- SB, DM, CE sampled other aquatic @ ULM-1

1900
~~1730~~ - beaver observed @ UL

31 July 2010 - Sunny, hot, afternoon storm

0715 JM, CE - aquatic habitat assess.
SB - bird/veg survey
GD, DM - check ~~VOP~~ OAK UL, TP, LL SI traps.

0830 SB, CE check LL minnow traps
4 FHM, BI captured
DM, JM check UL gill net
- 1 lg sucker, 1 lg BI
many med. suckers
kept to replace piscivores w/ benthivore

1000 SB, JM, DM sampled BI @ UL22

1200 lunch

1300 SB, JM, DM, GD sampled BI @ UL25

1345 " " " " " BI @ UL24.

1443 " " " " " BI @ UL-21.

1600 DM, JM checked gillnet - 1 ~~Brook~~ Brown trout
1 RBT

1700 SB m bird & veg survey @ wilson ditch.

GD, CE checked soil suitability @ UL-BK-1. no EW observed along transect

01 August 2001

0630 - 0830 SB bird survey PPC US

0800 - 1130 JM, DM, CC set gill net in UL
& sampled OA in UUM.

GD checked soil suitability
for EW samples

0945 - 1030 JM, DM, CC shocked @ PPC-24
GD, SB sample BI & OA @
PPC 24

1130 - 1230 all sampled BI, OA, FF (40s)
@ WD

1330 - 1530 GD, CC checked all SI traps
SB, DM sampled EW @ ULM-27
JM fished

LL - have 2 samples complete
TP - orthoptera*, lepidoptera*, coleoptera, tricoptera,*
(v15) aranea - not enough in either/
not enough combined
- could catch grasshoppers
- should remove caddisfly -
- grasshoppers/moths probably not
exposed.
- beetles/spiders are only true -
exposed bugs

UL - hymenoptera, araneae, coleoptera
lepidoptera, ephemeroptera*
* should come out
- not enough in either, not enough
combined
- will sample and colony in PM
- will move PFT from LL → UL

RZ - have 1 sample complete fr PPC-RZ-4
@2 - gastropoda, coleoptera, hymenoptera
@5 - hymenoptera, coleoptera
both very light
- could hit and colony again @ 4

VOP -
@17/20 east side - hemiptera, hymenoptera, aranea
orthoptera*, coleoptera, collembola,
acari
- light
@ 9 - aranea, hymenoptera
- very light
@ 13 - hymenoptera (4)
@ 2 - coleoptera, hymenoptera, chilopoda,
aranea
- also very light

1530 - 1700 GD relocated PFT from UL to
LL

1700 JM, DM checked gillnet - only suckers, none taken

GD repaired PFT, took ant colony sample @ WL-BL-1

02 August 20~~08~~ 10 CAC

0800 - 1030 DM, CC shipped samples

0900 - 1030 JM attempted hook and line capture of game fish @ UL - none caught
SB birded
GD checked all UOS, LL, UL, PPC RZ SI samples

1030 - 1215 - are looked for EW @ US end of PPC, none found
- met w Dave R. & Karen
- of USWP, found thatch ant colony

1215 - 1330 GD, DM & Dave, Karen sweep netted @ PPC (by thatch ant colony ~~and~~ CAC.

1430 - 1600 GD, DM, DR sweep netted in fito park and around UOP sites, checked those SI traps.

1715 - 1730 disinfected all gear (SB, JM, CC)

03 August 2010

Awaited Decision on Reference site — walker Pond

Contacted owner an MT FWP to gain access and approval.

DR, KN, SB, GD

1000 – 1040 Sampled B1 @ WP-1
set gill net N46° 33' 42.0" W112° 15' 51.0"

cac
~~1004~~ 1040 - 1100 same personel
sampled B1 @ WPM-1
N 46° 33' 41.5"
W 112° 16' 00.0"

1100 - 11 29 Same sampled B1 @ WP-2
N 46° 33' 41.2"
W 112° 16' 00.2"

1130 - 1159 Same Sampled B1 @ WPM-2
N 46° 33' 41.4"
W 112° 13' 59.7"

1200 - 1230 same Sampled B1 @ WPM-3
N 46° 33' 38.5'
W 112° 15' 59.1"

1130 checked gill net - no large fish - 2 ≈ 10.5"

1130 - 1230 JM habitat assessment

1330 GO, SB, CC, DM Sampled @ WPM-5 N 46° 33' 41.2" W 112° 15' 57.0"

[illegible] ishing

1340 GO, SB, DM, CC Sampled B1 @ ~~WPM~~5 cac
N 46° 33' 40.6"
W 112° 15 55.9"

1405 GO, SB, DM, CC sampled @ WP-4
N - 46° 33' 40.5"
W - 112° 15' 56.0"
- DM, DR captured frog @ WP-4

1430 GO, SB, DM, DR, CC Sampled @ WP 3
N - 46° 33' 39.6"
W - 112° 15' 55.6"

1500 GO, SB, DM, DR, CC Sampled @ WPM-4
N - 46° 33' 39.1"
W - 112° 15' 57.6"

1530 - 1630 all Sampled EW @ walker - EW 1, 2, 3

16:30 – 1715 checked gill net & processed 5 GF.

Appendix B

Chemistry and Toxicity Data Evaluated for the BERA

List of Tables

References

US EPA (Region VIII). 2005. "Supplemental Ecological Risk Assessment for the East Helena Smelter Site, Montana." Prepared by Syracuse Research Corp., January 25.

Table B-1. BERA Sample Locations

		Coordinates (NAD83 State Plant Feet)		Coordinates (UTM Zone 12N Meters)		Environmental Media Collected at Station															
CSM Unit	Sample/Location ID	X	Y	X	Y	SW	PW	PZ	SD	SDTOX	BI	OI	AM	FF	GF	PF	AP	SL	EW	SI	AFI
Canyon Ferry Reservor (reference)	CFR_1	8777657.113	4690050.61	2767350.9	30815884.46	X	X		X	X				X			X				
Canyon Ferry Reservor (reference)	CFR_2	7318217.635	3922300.187	2307111.989	25684168.41	X	X		X	X	X										
Lower Lake	LL_1	5442686.827	3437775.48	1718385.897	20636342.54	X	X		X	X											
Lower Lake	LL_2	2721799.442	1718717.161	859332.9541	10318121.95	X			X												
Lower Lake	LL_3	2722317.771	1718466.406	859492.42	10318048.55	X			X												
Lower Lake	LL-21	5444828.972	3437614.504	1719039.804	20636306.03	X			X		X			X							
Lower Lake	LL-22	9528328.16	6012995.69	3008298.896	36112672.29	X			X		X	X		X							
Lower Lake	LL-23	2721796.826	1718673.16	859332.4147	10318108.52	X			X												
Lower Lake	LL-24	5443072.061	3438368.915	1718499.844	20636525.68	X			X		X			X							
Lower Lake	LL-25	6803321.895	4296244.974	2147976.916	25795130.95	X			X		X	X		X							
Lower Lake	LL-BK-1	4081679.338	2578577.184	1288685.631	15477329.79													X		X	
Lower Lake	LL-BK-2	2722645.15	1718296.891	859593.205	10317998.8													X		X	
Lower Lake	LL-BK-3	4082962.491	2578603.191	1289076.606	15477345.24													X		X	
Lower Lake	LL-BK-4	2721805.897	1718315.505	859337.2767	10317999.55													X		X	
Lower Lake	Lower Lake	1360892.449	859253.6711	429664.8755	5159028.952	X															
Lower Ore Storage Area	LOS-SS1	1359193.911	859798.8948	429143.9346	5159185.187													X			
Lower Ore Storage Area	LOS-SS10	2718631.657	1720770.989	858355.3155	10318729.42													X			
Lower Ore Storage Area	LOS-SS11	1359512.454	860346.8484	429237.8193	5159354.081													X			
Lower Ore Storage Area	LOS-SS12	1359356.989	860585.1464	429189.0336	5159425.807													X			
Lower Ore Storage Area	LOS-SS13	1358979.348	860869.1959	429072.2566	5159510.176													X			
Lower Ore Storage Area	LOS-SS14	1359396.726	860784.2973	429199.9786	5159486.745													X			
Lower Ore Storage Area	LOS-SS15	5436162.224	3444254.351	1716359.096	20638279.16													X		X	X
Lower Ore Storage Area	LOS-SS16	6796326.799	4305106.531	2145792.73	25797791.09													X			
Lower Ore Storage Area	LOS-SS2	1359390.453	859759.532	429204.0748	5159174.341													X			
Lower Ore Storage Area	LOS-SS3	2717680.361	1720156.929	858068.9439	10318536.66													X			
Lower Ore Storage Area	LOS-SS5	2718861.353	1719909.967	858430.3793	10318468.31													X			
Lower Ore Storage Area	LOS-SS6	2718549.207	1720390.535	858332.414	10318612.96													X			
Lower Ore Storage Area	LOS-SS7	2718946.364	1720305.612	858453.9723	10318589.41													X			
Lower Ore Storage Area	LOS-SS8	4076489.138	2581429.681	1287086.841	15478168.85													X			
Lower Ore Storage Area	LOS-SS9	2718304.663	1720887.884	858254.9564	10318763.13													X			
Lower Ore Storage Area	SS-19	1359535.578	861222.2155	429239.7356	5159621.044													X			
Lower Ore Storage Area	SS-22	1359343.384	859664.5023	429190.2846	5159145.098													X			
Misc. Unpaved Area	UPS-SS1	1359781.887	859208.7972	429326.62	5159008.762													X			
Misc. Unpaved Area	UPS-SS10	1359655.873	861120.0491	429277.0026	5159590.607													X			
Misc. Unpaved Area	UPS-SS11	2720256.042	1721344.978	858847.0916	10318913.9													X			
Misc. Unpaved Area	UPS-SS12	2720974.927	1721158.024	859067.3164	10318861.13													X			
Misc. Unpaved Area	UPS-SS13	1360102.872	860258.6726	429418.306	5159330.665													X			
Misc. Unpaved Area	UPS-SS14	1360501.814	859957.813	429541.6746	5159241.297													X			
Misc. Unpaved Area	UPS-SS2	1359560.751	859437.7764	429257.8711	5159077.263													X			
Misc. Unpaved Area	UPS-SS3	1359998.816	859240.0202	429392.5607	5159019.552													X			
Misc. Unpaved Area	UPS-SS4	1359894.083	859680.3104	429358.0546	5159153.146													X			
Misc. Unpaved Area	UPS-SS5	1359727.414	859893.108	429306.0032	5159217.033													X			
Misc. Unpaved Area	UPS-SS7	1359728.607	860616.5745	429302.1251	5159437.565													X			
Misc. Unpaved Area	UPS-SS8	1359270.089	861170.8695	429159.1108	5159603.836													X			
Misc. Unpaved Area	UPS-SS9	2719075.637	1722734.219	858479.1377	10319330.45													X			
Misc. Unpaved Area	SS-21	1359851.662	860494.0603	429340.3527	5159400.942													X			
Misc. Unpaved Area	SS-28	1360156.739	859337.9202	429440.1244	5159050.319													X			
Misc. Unpaved Area	SS-29	1360113.883	859623.8485	429425.3846	5159137.224													X			
Misc. Unpaved Area	SS-30	1360562.682	860025.8225	429559.8295	5159262.384													X			
Misc. Unpaved Area	SS-31	1360244.117	860742.2316	429458.525	5159478.89													X			
Prickly Pear Creek	PPC_2	4084936.432	2573206.093	1289709.942	15475711.68	X	X		X												
Prickly Pear Creek	PPC_3	4080983.53	2586535.141	1288426.878	15479751.44	X	X		X												
Prickly Pear Creek	PPC_4	4080476.114	2589412.362	1288255.34	15480625.49	X	X		X												
Prickly Pear Creek	PPC_5	4080524.637	2589410.861	1288270.14	15480625.32	X	X		X												
Prickly Pear Creek	PPC-101	1361540.95	858889.5691	429864.6847	5158921.77	X															
Prickly Pear Creek	PPC-102	10892400.03	6872344.615	3438932.355	41271748.92	X		X	X	X	X	X			X	X					
Prickly Pear Creek	PPC-102 (SG-06)	1361474.912	859114.5716	429843.236	5158989.968	X															
Prickly Pear Creek	PPC-103	12252498.41	7734028.181	3868340.939	46431513.89	X		X	X	X	X	X			X	X					
Prickly Pear Creek	PPC-22	13615409.5	8582667.578	4298683.364	51587319.26				X	X	X	X		X		X					
Prickly Pear Creek	PPC-22 (SG-03A)	1361633.477	857815.1081	429899.1886	5158594.798	X															
Prickly Pear Creek	PPC-23	1361505.961	860842.6277	429842.5687	5159516.891				X												
Prickly Pear Creek	PPC-23 (SG-08)	1361510.38	860834.7123	429843.9621	5159514.504	X															

Table B-1. BERA Sample Locations

		Coordinates (NAD83 State Plant Feet)		Coordinates (UTM Zone 12N Meters)		Environmental Media Collected at Station															
CSM Unit	**Sample/Location ID**	**X**	**Y**	**X**	**Y**	**SW**	**PW**	**PZ**	**SD**	**SDTOX**	**BI**	**OI**	**AM**	**FF**	**GF**	**PF**	**AP**	**SL**	**EW**	**SI**	**AFI**
Prickly Pear Creek	PPC-24	10870039.21	6916562.124	3431857.134	41285096.11				X	X	X	X			X	X					
Prickly Pear Creek	PPC-3A	1361602.872	854620.4104	429908.592	5157620.821	X															
Prickly Pear Creek	PPC-5	6807299.403	4298177.923	2149177.997	25795743.47	X			X	X	X	X									
Prickly Pear Creek	PPC-5 (SG-07)	1361489.372	859664.7748	429844.4177	5159157.764	X															
Prickly Pear Creek	PPC-6	1361390.734	861313.7011	429804.6834	5159659.807	X															
Prickly Pear Creek	PPC-7	5442615.969	3446243.327	1718314.651	20638923.27	X			X	X	X										
Prickly Pear Creek	PPC-7 (SG-09)	1360742.968	861467.4005	429606.3318	5159702.86	X															
Prickly Pear Creek	PPC-8	2720465.377	1726473.424	858880.8331	10320478.37	X			X												
Prickly Pear Creek	PPC-8 (SG-10)	1360205.955	863289.1102	429431.9605	5160255.001	X															
Prickly Pear Creek	PPC-9A	1357939.92	865480.4472	428728.3846	5160909.675	X															
Prickly Pear Creek	PPC-RZ-1	1361511.47	860707.0447	429845.0428	5159475.595													X			
Prickly Pear Creek	PPC-RZ-2	5445479.976	3439155.195	1719229.208	20636779.47													X	X	X	
Prickly Pear Creek	PPC-RZ-3	1361642.7	857869.524	429901.6806	5158611.439													X			
Prickly Pear Creek	PPC-RZ-4	4084590.374	2574888.034	1289594.595	15476222.34													X		X	
Prickly Pear Creek	PPC-RZ-5	2722813.204	1717875.983	859646.8986	10317871.48													X		X	
Prickly Pear Creek	SG-11	1359372.182	864146.6879	429172.7836	5160511.518	X															
Prickly Pear Creek (reference)	PPC_1	3990330.943	2357938.504	1262136.67	15409539.47	X	X		X												
Prickly Pear Creek (reference)	REF-PPC-1	4059821.195	2517072.655	1282383.642	15458453.97	X			X		X										
Prickly Pear Creek (reference)	REF-PPC-2	5423683.349	3369580.566	1712993.27	20615444.13	X			X	X	X										
Prickly Pear Creek (reference)	REF-PPC-3	2716088.31	1688640.603	857768.4913	10308920.61	X			X												
Prickly Pear Creek (reference)	REF-PPC-4	13588562.92	8456808.827	4291238.171	51548797.98	X			X	X	X				X						
Prickly Pear Creek (reference)	REF-PPC-5	4087238.871	2547467.272	1290562.696	15467879.57	X			X	X											
Prickly Pear Creek (reference)	REF-PPC-6	5450379.806	3401312.12	1720944.661	20625273	X			X	X	X										
Prickly Pear Creek (reference)	REF-PPC-7	2722833.872	1704360.743	859732.4485	10313751.93	X			X												
Prickly Pear Creek (reference)	REF-PPC-8	4084755.308	2559687.227	1289734.003	15471589.84	X			X		X										
Prickly Pear Creek/Upper Lake Marsh	AP-01	1361521.035	858247.1287	429862.381	5158725.826								X								
Prickly Pear Creek/Upper Lake Marsh	AP-02	1361533.737	858257.4494	429866.1924	5158729.047								X								
Prickly Pear Creek/Upper Lake Marsh	AP-03	1361532.149	858247.9226	429865.7642	5158726.134								X								
Prickly Pear Creek/Upper Lake Marsh	AP-04	1361521.432	858258.6403	429862.4345	5158729.338								X								
Railcar Staging Area	RCSA-1	6794918.928	4308142.999	2145345.783	25798708.41													X			
Railcar Staging Area	RCSA-2	8155129.301	5171428.959	2574779.108	30958962.48													X			
Railcar Staging Area	RCSA-3	1358758.016	862009.8892	428998.1024	5159856.582													X			
Railcar Staging Area	RCSA-4	1358880.479	861749.4651	429036.9583	5159777.918													X			
Railcar Staging Area	RCSA-5	8150243.033	5172605.76	2573282.786	30959292.54													X			
Railcar Staging Area	RCSA-6	1357981.004	862196.9896	428760.1581	5159909.058													X			
Railcar Staging Area	RCSA-7	1357655.986	862269.9377	428660.6589	5159929.388													X			
Railcar Staging Area	RCSA-8	6786856.215	4311692.91	2142867.308	25799743.21													X			
Site Perimeter	UOP-SS1	1359182.056	861547.1445	429130.0705	5159718.015													X			
Site Perimeter	UOP-SS10	1359785.457	858949.5013	429329.2285	5158929.745													X			
Site Perimeter	UOP-SS11	1359924.607	858418.6899	429374.7564	5158768.761													X			
Site Perimeter	UOP-SS12	5438810.595	3447261.237	1717148.737	20639211.24													X		X	X
Site Perimeter	UOP-SS13	1360177.128	861718.522	429432.3814	5159776.088													X			
Site Perimeter	UOP-SS14	1360504.171	861640.7905	429532.5257	5159754.312													X			
Site Perimeter	UOP-SS15	2721823.611	1722768.165	859316.57	10319356.91													X			
Site Perimeter	UOP-SS16	2722177.999	1723082.903	859422.7485	10319454.92													X			
Site Perimeter	UOP-SS17	2722738.318	1722677.919	859595.918	10319334.76													X			
Site Perimeter	UOP-SS17 (east)	2722871.083	1722676.297	859636.3966	10319335.04															X	X
Site Perimeter	UOP-SS18	1361339.29	861468.6675	429788.094	5159706.742													X			
Site Perimeter	UOP-SS19	1361655.67	860622.0187	429889.4958	5159450.523													X			
Site Perimeter	UOP-SS2	2718193.178	1722508.894	858211.4696	10319256.59													X			
Site Perimeter	UOP-SS20	5446547.527	3437118.642	1719566.557	20636164.96													X		X	X
Site Perimeter	UOP-SS21	1361669.112	858821.4501	429904.1502	5158901.758													X			
Site Perimeter	UOP-SS3	1358961.747	860938.6902	429066.4839	5159531.256													X			
Site Perimeter	UOP-SS4	2717702.433	1721168.336	858069.7417	10318845.09													X			
Site Perimeter	UOP-SS5	1358700.323	860275.1961	428990.6875	5159327.478													X			
Site Perimeter	UOP-SS6	1358708.043	860065.4356	428994.2705	5159263.585													X			
Site Perimeter	UOP-SS7	1358838.759	859759.3816	429035.9095	5159171.06													X			
Site Perimeter	UOP-SS8	1359188.714	859632.6276	429143.3251	5159134.475													X			
Site Perimeter	UOP-SS9	5437462.214	3437032.228	1716797.701	20636085.35													X		X	X
Site Perimeter	SS-23	1359611.537	859067.8469	429275.5208	5158964.8													X			
Tito Park	UOS-SS1	2720066.968	1717595.692	858811.4415	10317769.95													X			
Tito Park	UOS-SS10	5442418.562	3436241.686	1718313.118	20635873.44													X		X	X

Table B-1. BERA Sample Locations

		Coordinates (NAD83 State Plant Feet)		Coordinates (UTM Zone 12N Meters)		Environmental Media Collected at Station															
CSM Unit	Sample/Location ID	X	Y	X	Y	SW	PW	PZ	SD	SDTOX	BI	OI	AM	FF	GF	PF	AP	SL	EW	SI	AFI
Tito Park	UOS-SS11	1360761.86	859196.1932	429625.4068	5159010.666													X			
Tito Park	UOS-SS12	2721195.72	1717878.251	859153.8481	10317862.69													X		X	
Tito Park	UOS-SS13	1360745.674	858898.0893	429622.2208	5158919.704													X			
Tito Park	UOS-SS14	5443587.561	3435673.59	1718672.781	20635707.12													X		X	X
Tito Park	UOS-SS15	1360902.657	859046.9405	429669.1992	5158965.997													X			
Tito Park	UOS-SS16	1361052.841	859041.1504	429715.0118	5158965.113													X			
Tito Park	UOS-SS17	4083609.67	2576925.769	1289283.712	15476837.73													X		X	X
Tito Park	UOS-SS18	1361051.509	858912.0004	429715.363	5158925.738													X			
Tito Park	UOS-SS19	1361196.626	858895.3714	429759.6949	5158921.52													X			
Tito Park	UOS-SS2	5440014.341	3435750.511	1717583.15	20635709.62													X		X	X
Tito Park	UOS-SS20	2722566.889	1717890.686	859571.7312	10317874.52													X		X	
Tito Park	UOS-SS21	4082292.6	2577524.432	1288878.736	15477012.49													X		X	X
Tito Park	UOS-SS22	5442680.518	3435687.174	1718396.218	20635705.95													X		X	X
Tito Park	UOS-SS3	2720321.05	1718162.53	858885.5665	10317944.22													X			
Tito Park	UOS-SS4	2720615.465	1718138.398	858975.4507	10317938.59													X			
Tito Park	UOS-SS5	1360313.778	859214.4563	429488.7164	5159013.606													X			
Tito Park	UOS-SS6	1360467.512	859209.4848	429535.6065	5159012.992													X			
Tito Park	UOS-SS7	1360476.594	859362.2089	429537.4795	5159059.598													X			
Tito Park	UOS-SS8	5442441.055	3436833.527	1718316.504	20636053.97													X		X	X
Tito Park	UOS-SS9	4081382.707	2577191.573	1288603.337	15476905.69													X		X	X
Tito Park	SS-24	1360693.08	859041.2843	429605.3498	5158963.044													X		X	
Upper Lake/Marsh	UL_comp	1360714.772	858685.399	429614.0484	5158854.691												X				
Upper Lake/Marsh	UL-21	4082153.489	2576261.556	1288843.737	15476626.72	X			X		X	X		X	X	X					
Upper Lake/Marsh	UL-22	2720196.308	1716840.925	858855.2921	10317540.64	X			X												
Upper Lake/Marsh	UL-23	13602442.48	8585428.559	4294714.603	51588084.83	X			X		X	X			X	X					
Upper Lake/Marsh	UL-24	6801830.543	4293823.597	2147536.524	25794384.13	X			X		X	X									
Upper Lake/Marsh	UL-25	5440855.542	3432062.994	1717861.184	20634590.53	X			X		X	X									
Upper Lake/Marsh	UL-BK-1	2719992.493	1715454.192	858801.2969	10317116.74													X		X	
Upper Lake/Marsh	UL-BK-2	2720314.073	1717559.329	858886.9765	10317760.31													X		X	
Upper Lake/Marsh	UL-BK-3	2720809.684	1717974.318	859035.6142	10317889.71													X		X	
Upper Lake/Marsh	UL-BK-4	2722182.258	1717800.642	859455.017	10317844.82													X		X	
Upper Lake/Marsh	ULM_1	5440514.584	3431387.039	1717761.218	20634382.49	X			X		X						X				
Upper Lake/Marsh	ULM_10	6801830.543	4293823.597	2147536.524	25794384.13	X	X		X	X	X										
Upper Lake/Marsh	ULM_11	4082153.489	2576261.556	1288843.737	15476626.72	X			X								X				
Upper Lake/Marsh	ULM_12	5444279.168	3435003.222	1718887.525	20635506.84	X	X		X	X											
Upper Lake/Marsh	ULM_2	4081566.482	2573110.583	1288683.283	15475662.81	X			X								X				
Upper Lake/Marsh	ULM_3	5440730.663	3433665.243	1717813.724	20635078.19	X	X		X	X											
Upper Lake/Marsh	ULM_4	5442143.481	3433637.229	1718244.54	20635077.94	X	X		X	X											
Upper Lake/Marsh	ULM_5	4083291.731	2574594.906	1289200.465	15476125.38	X			X								X				
Upper Lake/Marsh	ULM_6	5444805.646	3433531.535	1719056.633	20635061.33	X	X		X	X											
Upper Lake/Marsh	ULM_7	5441409.569	3432235.76	1718029.048	20634646.44	X	X		X	X											
Upper Lake/Marsh	ULM_8	4082112.559	2574150.086	1288843.642	15475982.87	X			X								X				
Upper Lake/Marsh	ULM_9	4083204.436	2574257.212	1289175.836	15476021.93	X			X								X				
Upper Lake/Marsh	ULM-1	9530682.521	6007734.997	3009047.391	36111082.55	X			X		X			X	X						
Upper Lake/Marsh	ULM-2	8163084.181	5145828.941	2577353.996	30951205.78	X			X		X	X		X							
Upper Lake/Marsh	ULM-3	6802688.472	4289171.734	2147825.311	25792971.19	X			X		X	X		X							
Upper Lake/Marsh	ULM-4	5442471.909	3432290.192	1718352.549	20634669.26	X			X		X	X									
Upper Lake/Marsh	ULM-5	6804030.1	4291901.774	2148218.255	25793811.22	X			X		X	X		X							
Upper Lake/Marsh	ULM-6	2722165.879	1716633.198	859456.8693	10317488.87	X			X												
Upper Lake/Marsh	ULM-7	5445242.701	3430327.73	1719208.64	20634087.32	X			X									X	X		
Upper Lake/Marsh	ULM-8	2721088.402	1715039.246	859137.782	10316996.68	X			X												
Upper Lake/Marsh	ULM-9	2721569.26	1714932.388	859284.9822	10316966.93	X			X												
Upper Lake/Marsh	Upper Lake	1360714.434	858703.8439	429613.8373	5158860.312	X															
Walker Creek (reference)	Walker Pond	1273152.305	854684.7255	402946.3147	5157121.295								X								
Walker Creek (reference)	WP-1	10185091.83	6840402.753	3223514.74	41257861.24	X			X		X				X						
Walker Creek (reference)	WP-2	3819238.586	2565014.828	1208766.747	15471655.44	X			X		X										
Walker Creek (reference)	WP-3	3820033.752	2564450.594	1209012.454	15471488.12	X			X		X										
Walker Creek (reference)	WP-4	3819998.947	2564747.248	1209000.102	15471578.34	X			X		X										
Walker Creek (reference)	WP-5	3819905.202	2564870.918	1208970.799	15471615.49	X			X		X										
Walker Creek (reference)	WPM-1	3819207.276	2564983.109	1208757.389	15471645.59	X			X		X										
Walker Creek (reference)	WPM-2	3819138.278	2564952.722	1208736.534	15471635.92	X			X		X										
Walker Creek (reference)	WPM-3	3819295.059	2564049.966	1208789.63	15471361.65	X			X		X										

Table B-1. BERA Sample Locations

		Coordinates (NAD83 State Plant Feet)		Coordinates (UTM Zone 12N Meters)		Environmental Media Collected at Station															
CSM Unit	**Sample/Location ID**	**X**	**Y**	**X**	**Y**	**SW**	**PW**	**PZ**	**SD**	**SDTOX**	**BI**	**OI**	**AM**	**FF**	**GF**	**PF**	**AP**	**SL**	**EW**	**SI**	**AFI**
Walker Creek (reference)	WPM-4	3819721.428	2564155.26	1208918.983	15471396.25	X			X		X										
Walker Creek (reference)	WPM-5	3819795.995	2564984.192	1208936.844	15471649.38	X			X		X										
Walker Creek (reference)	WPS-1	3818794.256	2564614.747	1208633.65	15471530.87													X	X		
Walker Creek (reference)	WPS-2	3818961.647	2564225.873	1208686.961	15471413.31													X	X		
Walker Creek (reference)	WPS-3	3819058.481	2564189.626	1208716.692	15471402.83													X	X		
Walker Creek (reference)	WPS-4	1273202.836	855077.1774	402959.4127	5157241.224													X			
Walker Creek (reference)	WPS-5	1272983.54	854851.5041	402893.8897	5157171.143													X			
Walker Creek (reference)	WPS-6	1273378.724	854928.7225	403013.9013	5157197.004													X			
Walker Creek (reference)	GF-18	1273097.858	854995.8504	402927.8898	5157215.816										X						
Walker Creek (reference)	GF-19	1273117.304	854997.4061	402933.8082	5157216.405										X						
Walker Creek (reference)	GF-20	1273118.081	855015.2958	402933.9402	5157221.863										X						
Walker Creek (reference)	GF-21	1273135.971	855007.5176	402939.4393	5157219.597										X						
Walker Creek (reference)	GF-22	1273135.971	854991.1836	402939.5353	5157214.618										X						
Wilson Ditch	WD-1	1360131.61	858899.8835	429435.0331	5158916.651	X															
Wilson Ditch	WD-2	6794541.259	4305815.704	2145244.308	25797996.79	X			X		X	X		X							
Wilson Ditch	WD-25	2710547.089	1729801.877	855838.0415	10321434.8	X			X												
Wilson Ditch	WD-26	2706662.367	1732745.749	854636.6439	10322309.37	X			X												
Wilson Ditch	WD-3	2711643.692	1725785.488	856195.8553	10320216.95	X			X												
Wilson Ditch	WD-4	2715469.245	1723493.093	857375.3951	10319540.62	X			X												

Abbreviations:
SW = Surface Water
PW = Porewater
PZ = Piezometer
SD = Sediment
SDTOX = Sediment Toxicity Test
BI = Benthic Invertebrate
OI = Other Aquatic Invertebrates (e.g., snails, crustaceans, leaches)

AM = Amphibian
FF = Forage Fish
GF = Game Fish
PF = Piscivorous Fish
AP = Aquatic Plant
SL = Soil
EW = Earthworm
SI = Soil Invertebrates

AFI = Aerial/Foliar Invertebrates

Table B-2. Surface Water Chemistry Data (Conventional Parameters)

CSM Unit	Sample Date	Location Sample ID	Temperature (C°)	pH (s.u.)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	Specific Conductivity (umhos/cm)	Bicarbonate (mg/L as HO_3)	Total Alkalinity (mg/L as $CaCO_3$)	Hardness mg/L as CaCO	Dissolved					Sulfate SO_4 (mg/L)
												Ca (mg/L)	Cl (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	
Canyon Ferry (Ref)	10/1/03	CFR_1	nr	nr	nr	nr	nr	nr	nr	nr	194.0 E	34.5	nr	14.1	nr	4.89	27.3
Canyon Ferry (Ref)	10/1/03	CFR_2	nr	nr	nr	nr	nr	nr	nr	nr	193.0 E	41.4	nr	18.5	nr	5.61	31.9
Lower Lake	9/30/03	LL_1	nr	nr	nr	nr	nr	nr	nr	nr	180.0 E	63.9	nr	7.47	nr	21.6	393
Lower Lake	9/30/03	LL_2	nr	nr	nr	nr	nr	nr	nr	nr	203.0 E	67.6	nr	7.63	nr	21.8	396
Lower Lake	9/30/03	LL_3	nr	nr	nr	nr	nr	nr	nr	nr	207.0 E	69.8	nr	8	nr	22.7	405
Lower Lake	5/10/2000	Lower Lake	12.70	7.80	5209	nr	9.03	6625	78	64	608.0 E	228	349	9.4	1241	77	3459
Lower Lake	10/31/2000	Lower Lake	7.70	7.80	5191	9.5	8.03	6690	24	20	457.0 E	171	300 J	7.3	1472	77	3214
Lower Lake	5/3/2001	Lower Lake	11.90	8.80	4536	8.3	6.7	5350	77	63	254.8 E	91	331	6.7	1216	67	2715
Lower Lake	11/16/2001	Lower Lake	5.30	8.01	3999	17	8.6	3940	44	36	278.5 E	98	274	8.2	1079	72	2370
Lower Lake	5/15/2002	Lower Lake	14.30	8.60	3202	15	9.9	4390	57	47	280.9 E	98	242	8.8	856	45	1871
Lower Lake	11/7/2002	Lower Lake	2.90	8.60	2436	33	6.09	3070	57	47	229.4 E	79	160	7.8	642	31	1451
Lower Lake	4/30/2003	Lower Lake	9.60	7.03	1826	21	10.4	2620	76	62	203.6 E	70	107	7	494	25	1152
Lower Lake	10/22/2003	Lower Lake	11.50	7.40	1550	3.9	12.37	2310	90	90	211.0 E	71	82	8.2	386	22	871
Lower Lake	4/27/2004	Lower Lake	15.20	7.62	1230	19	10.2	163 R	130	110	192.7 E	64	62	8	293	20	750
Lower Lake	11/4/2004	Lower Lake	5.00	6.98	964	< 10	10.19	1507	130	100	161.2 E	53	50	7	246	14	403
Lower Lake	6/9/2005	Lower Lake	15.10	8.52	738	10	6.97	1148	130 J	110 J	157.8 E	50	31	8	184 J	11 J	332
Lower Lake	11/21/2005	Lower Lake	1.63	7.33	798	11	10.43	1115	130	110	147.8 E	46	30	8	200	nr	394
Lower Lake	5/12/2006	Lower Lake	13.60	8.75	733	20	7.3	1097	130	110	127.8 E	38	25	8	196	10	312
Lower Lake	6/6/2007	Lower Lake	17.72	8.77	570	< 10	7.87	884	130	110	113.7 E	34	17	7	148	8	303
Lower Lake	10/31/2007	Lower Lake	7.30	8.65	568	< 10	10.46	896	160	130	132.8 E	40	19	8	130	7	253
Lower Lake	4/30/2008	Lower Lake	10.17	7.93	523	< 10	9.01	822	140	120	154.4 E	47	15	9	116	6	240
Lower Lake	10/24/2008	Lower Lake	6.50	7.86	493	< 10	10.2	740	150	130	125.3 E	37	14	8	111	7	220
Lower Lake	5/1/2009	Lower Lake	8.28	8.09	422	< 10	9.15	654	150	120	139.4 E	41	10	9	79	6	190
Lower Lake	10/29/2009	Lower Lake	5.41	8.68	364	< 10	8.85	541	120	110	121.9 E	34	9	9	75	6	160
Lower Lake	7/8/2010	Lower Lake	18.75	7.19	328	< 10	6.96	512	130	110	103.7 E	30	7	7	54	4	130
Lower Lake	8/3/2010	LL-25	21.6	8.58	336	<10	6.17	499	nm	110	105.3 E	29	7	8	55	5	130
Lower Lake	8/3/2010	LL-22	21.9	8.7	336	<10	6.06	499	nm	110	107.8 E	30	8	8	54	5	130
Lower Lake	8/3/2010	LL-21	21.8	8.76	339	<10	6.06	500	nm	110	105.3 E	29	7	8	53	5	130
Lower Lake	8/3/2010	LL-24	21.7	8.64	337	<10	6.6	500	nm	110	102.8 E	28	7	8	51	5	130
Lower Lake	8/3/2010	LL-23	22.09	8.88	341	<10	6.6	500	nm	110	102.8 E	28	7	8	54	5	130
Prickly Pear Creek	10/1/2003	PPC_2	7.81	7.75	147	nr	10.61	229.9	nr	nr	119.0 E	32.5	nr	8.05	nr	2.73	17.9
Prickly Pear Creek	10/1/2003	PPC_3	9.05	7.89	150	nr	10.64	235	nr	nr	108.0 E	34	nr	8.03	nr	3.34	19.6
Prickly Pear Creek	10/1/2003	PPC_4	8.93	8.11	150	nr	11.04	234.9	nr	nr	115.0 E	33.8	nr	8.28	nr	3.41	19.4
Prickly Pear Creek	10/1/2003	PPC_5	9.06	7.72	165	nr	9.94	258.3	nr	nr	139.0 E	41	nr	9.47	nr	3.46	15.8
Prickly Pear Creek	5/10/2000	PPC-101	10.70	8.50	161	nr	10.2	253	89	73	86.3 E	25	3.1	5.8	12	< 5	42
Prickly Pear Creek	5/10/2000	PPC-102	10.70	8.50	176	nr	10.4	251	95	78	86.3 E	25	3.4	5.8	13	< 5	38
Prickly Pear Creek	5/10/2000	PPC-103	10.80	8.40	161	nr	10.4	247	89	73	86.7 E	25	3	5.9	13	< 5	38
Prickly Pear Creek	5/10/2000	PPC-3A	10.70	8.70	174	nr	11.9	254	90	74	86.3 E	25	3	5.8	12	< 5	41
Prickly Pear Creek	5/10/2000	PPC-5	10.60	8.40	165	nr	11.4	253	98	80	86.7 E	25	3.2	5.9	13	< 5	42
Prickly Pear Creek	5/10/2000	PPC-7	10.40	8.30	174	nr	11.6	261	94	77	86.3 E	25	3.5	5.8	13	< 5	39
Prickly Pear Creek	5/10/2000	PPC-8	9.80	8.04	164	nr	12.07	296	98	80	88.8 E	26	3.5	5.8	13	< 5	41
Prickly Pear Creek	10/31/2000	PPC-101	6.80	8.20	189	2.8	11.8	285	107	88	100.0 E	29	5.5 J	6.7	19	< 5	57
Prickly Pear Creek	10/31/2000	PPC-102	8.30	8.20	196	3.9	11.9	285	98	80	104.5 E	30	5.6 J	7.2	20	< 5	51
Prickly Pear Creek	10/31/2000	PPC-103	7.40	8.30	182	3	11.9	281	110	90	100.4 E	29	5.1 J	6.8	18	< 5	52
Prickly Pear Creek	10/31/2000	PPC-3A	8.10	8.40	172	3	10.1	279	126	103	97.1 E	28	5.1 J	6.6	17	< 5	51
Prickly Pear Creek	10/31/2000	PPC-5	8.30	7.90	189	1.3	10.2	284	104	85	100.4 E	29	4.8 J	6.8	18	< 5	47
Prickly Pear Creek	10/31/2000	PPC-7	6.30	7.30	196	< 1	10.7	313	109	89	100.0 E	29	5.4 J	6.7	17	< 5	54
Prickly Pear Creek	10/31/2000	PPC-8	7.10	7.40	190	< 1	11.6	282	104	85	103.3 E	30	4.7 J	6.9	18	< 5	53
Prickly Pear Creek	5/3/2001	PPC-101	8.90	9.30	143	9.4	8.9	167	61	50	55.2 E	18	2.4 J	< 5	6.7	< 5	37
Prickly Pear Creek	5/3/2001	PPC-102	8.90	7.50	139	8.3	9.2	167	55	45	50.2 E	16	2.5 J	< 5	5.8	< 5	42
Prickly Pear Creek	5/3/2001	PPC-103	8.10	7.30	140	7.2	9.1	170	55	45	55.2 E	18	1.7 J	< 5	6.8	< 5	33
Prickly Pear Creek	5/3/2001	PPC-3A	10.60	6.20	149	7.8	6.8	181	56	46	55.2 E	18	2.8 J	< 5	6.5	< 5	40
Prickly Pear Creek	5/3/2001	PPC-5	7.40	7.00	147	8.5	6.8	168	54	44	55.2 E	18	2.6 J	< 5	6.7	< 5	42
Prickly Pear Creek	5/3/2001	PPC-7	6.70	6.20	150	8.8	6.7	171	54	44	55.2 E	18	3.3 J	< 5	6.9	< 5	44
Prickly Pear Creek	5/3/2001	PPC-8	5.30	6.60	147	9.3	6.8	171	54	44	55.2 E	18	2.6 J	< 5	6.8	< 5	41
Prickly Pear Creek	11/16/2001	PPC-101	5.70	8.20	189	5.4 J	11.6	314	128	105	105.0 E	30	4.6	7.3	18	< 5	50
Prickly Pear Creek	11/16/2001	PPC-102	6.10	8.30	195	2.3 J	11.5	312	122	100	107.0 E	31	4.6	7.2	18	< 5	47
Prickly Pear Creek	11/16/2001	PPC-103	6.10	8.30	193	2.1 J	11.6	314	106	87	107.9 E	31	4.2	7.4	18	< 5	47
Prickly Pear Creek	11/16/2001	PPC-3A	6.50	6.60	186	1.8 J	11.9	316	102	84	104.5 E	30	5.1	7.2	18	< 5	48
Prickly Pear Creek	11/16/2001	PPC-5	5.30	6.60	188	2.3 J	11.8	313	126	103	107.9 E	31	4.2	7.4	18	< 5	48
Prickly Pear Creek	11/16/2001	PPC-7	5.00	6.50	190	2.8 J	11.4	321	106	87	107.9 E	31	5	7.4	18	< 5	47
Prickly Pear Creek	11/16/2001	PPC-8	4.50	6.20	189	2.6 J	11.3	315	109	89	110.4 E	32	4.8	7.4	18	< 5	47
Prickly Pear Creek	5/15/2002	PPC-101	11.10	8.60	437	< 1	9.6	564	227	186	233.2 E	67	15	16	32	7.3	94
Prickly Pear Creek	5/15/2002	PPC-102	10.10	8.05	159	8.2	10.3	194	67	55	82.2 E	24	2.3	5.4	9.4	< 5	40

Table B-2. Surface Water Chemistry Data (Conventional Parameters)

												Dissolved					
CSM Unit	Sample Date	Location Sample ID	Temperature (C°)	pH (s.u.)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	Specific Conductivity (umhos/cm)	Bicarbonate (mg/L as HO_3)	Total Alkalinity (mg/L as $CaCO_3$)	Hardness mg/L as CaCO	Ca (mg/L)	Cl (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Sulfate SO_4 (mg/L)
Prickly Pear Creek	5/15/2002	PPC-103	10.00	8.09	160	15	10.4	199	65	53	81.7 E	24	2.3	5.3	8.9	< 5	37
Prickly Pear Creek	5/15/2002	PPC-3A	10.30	8.01	149	5	11.56	193	65	53	81.3 E	24	2.6	5.2	9.1	< 5	41
Prickly Pear Creek	5/15/2002	PPC-5	10.00	7.82	161	10	10.96	198	63	52	78.8 E	23	1.7	5.2	8.7	< 5	40
Prickly Pear Creek	5/15/2002	PPC-6A	10.40	9.60	163	11	12.8	198	65	53	82.2 E	24	2.1	5.4	9.4	< 5	42
Prickly Pear Creek	5/15/2002	PPC-7	9.90	7.98	170	11	11.91	207	66	54	81.7 E	24	2.8	5.3	9.4	< 5	43
Prickly Pear Creek	5/15/2002	PPC-8	8.80	8.01	171	12	11.61	201	66	54	81.7 E	24	2.4	5.3	9.5	< 5	41
Prickly Pear Creek	11/6/2002	PPC-101	12.20	7.50	408	< 1	5.2	512	223	183	200.0 E	57	11	14	29	6.8	80
Prickly Pear Creek	11/6/2002	PPC-102	3.00	7.20	200	1.2	6.8	293	105	86	106.2 E	31	4.5	7	16	< 5	57
Prickly Pear Creek	11/6/2002	PPC-103	3.10	7.10	199	1.1	6.8	285	107	88	103.7 E	30	4.5	7	15	< 5	56
Prickly Pear Creek	11/6/2002	PPC-5	3.20	7L	201	2.4	nr	285	110	90	110.0 E	32	4.8	7.3	16	< 5	51
Prickly Pear Creek	11/6/2002	PPC-6A	3.70	7.90	nr	nr	9	287	nr	nr	nr	nr	nr	nr	nr	nr	nr
Prickly Pear Creek	11/6/2002	PPC-7	3.50	7L	206	< 1	nr	290	109	89	110.0 E	32	5.5	7.3	16	< 5	58
Prickly Pear Creek	11/6/2002	PPC-8	3.10	6.9L	203	1.4	nr	291	107	88	110.4 E	32	4.6	7.4	16	< 5	53
Prickly Pear Creek	11/7/2002	PPC-3A	3.00	7.6L	189	< 1	nr	275	105	86	100.4 E	29	2.1	6.8	15	< 5	25
Prickly Pear Creek	4/30/2003	PPC-103	7.10	6.60	153	1.5	11.7	176	68	56	62.7 E	21	2.9	< 5	8.6	< 5	34
Prickly Pear Creek	4/30/2003	PPC-3A	6.90	6.6L	148	3.9	nr	164	63	52	62.7 E	21	2.6	< 5	8.2	< 5	29
Prickly Pear Creek	4/30/2003	PPC-5	6.80	6.5L	155	3.2	nr	165	65	53	62.7 E	21	2.7	< 5	8.4	< 5	32
Prickly Pear Creek	4/30/2003	PPC-7	6.20	6.6L	151	4.5	nr	166	63	52	62.7 E	21	3	< 5	8.3	< 5	30
Prickly Pear Creek	4/30/2003	PPC-8	5.90	6.4L	150	2.6	nr	163	66	54	62.7 E	21	2.7	< 5	8.4	< 5	28
Prickly Pear Creek	10/22/2003	PPC-103	9.70	7.77	211	4.2	10.13	325	100	100	120.3 E	35	3.3	8	17	< 5	55
Prickly Pear Creek	10/22/2003	PPC-3A	9.00	8L	209	6.5	nr	322	95	95	117.8 E	34	3.2	8	17	< 5	59
Prickly Pear Creek	10/22/2003	PPC-5	9.20	7.9L	218	4.8	nr	338	101	101	120.7 E	35	3.4	8.1	17	< 5	59
Prickly Pear Creek	10/22/2003	PPC-7	9.00	8L	227	7.2	nr	332	100	100	117.8 E	34	3.6	8	18	< 5	61
Prickly Pear Creek	10/22/2003	PPC-8	9.20	8L	223	3.3	nr	342	102	102	121.1 E	35	3.7	8.2	18	< 5	60
Prickly Pear Creek	4/29/2004	PPC-103	7.00	7.17	158	< 10	8.78	277	78	64	89.6 E	26	3	6	10	3	42
Prickly Pear Creek	4/29/2004	PPC-3A	7.50	7.14	160	< 10	8.3	276	81	66	87.1 E	25	5	6	10	3	43
Prickly Pear Creek	4/29/2004	PPC-5	6.90	7.10	161	< 10	8.81	287	78	64	87.1 E	25	3	6	10	3	43
Prickly Pear Creek	4/29/2004	PPC-7	6.40	6.26	170	< 10	8.81	290	81	66	87.1 E	25	3	6	10	3	43
Prickly Pear Creek	4/29/2004	PPC-8	6.10	6.83	170	< 10	9.02	289	81	66	87.1 E	25	2	6	11	3	42
Prickly Pear Creek	11/4/2004	PPC-103	3.40	6.82	177	< 10	11.64	290	100	82	103.7 E	30	7 UJ	7	15	3	39
Prickly Pear Creek	11/4/2004	PPC-3A	4.30	7.96	180	< 10	10.06	289	95	78	106.2 E	31	5 UJ	7	15	3	42
Prickly Pear Creek	11/4/2004	PPC-5	3.00	7.77	176	< 10	10.39	290	98	80	103.7 E	30	5 UJ	7	16	3	42
Prickly Pear Creek	11/4/2004	PPC-7	2.70	7.85	185	< 10	10.51	296	99	81	101.2 E	29	8 UJ	7	16	3	42
Prickly Pear Creek	11/4/2004	PPC-8	2.20	8.01	181	< 10	10.52	291	100	82	101.2 E	29	4 UJ	7	15	3	44
Prickly Pear Creek	6/9/2005	PPC-103	8.20	8.00	92	11	10.22	129	45 J	37 J	49.8 E	15	2	3	5 J	1 J	27
Prickly Pear Creek	6/9/2005	PPC-3A	8.20	7.9L	96	14	nr	125	38 J	31 J	52.3 E	16	1	3	5 J	1 J	26
Prickly Pear Creek	6/9/2005	PPC-5	8.10	7.5L	87	< 10	nr	122	44 J	36 J	49.8 E	15	2	3	5 J	1 J	24
Prickly Pear Creek	6/9/2005	PPC-7	8.00	7.4L	87	< 10	nr	122	45 J	37 J	52.3 E	16	1	3	5 J	1 J	24
Prickly Pear Creek	6/9/2005	PPC-8	7.80	7.4L	104	< 10	nr	134	44 J	36 J	49.8 E	15	2	3	5 J	1 J	24
Prickly Pear Creek	11/21/2005	PPC-103	3.17	7.64	205	< 10	10.8	296	98	80	120.3 E	35	12	8	16	2	57
Prickly Pear Creek	11/21/2005	PPC-3A	3.85	7.67	206	< 10	10.85	297	95	78	120.3 E	35	11	8	16	2	55
Prickly Pear Creek	11/21/2005	PPC-5	3.03	7.40	205	< 10	11.07	297	98	80	120.3 E	35	9	8	15	2	57
Prickly Pear Creek	11/21/2005	PPC-7	2.90	7.44	207	< 10	11	295	98	80	120.3 E	35	9	8	16	2	57
Prickly Pear Creek	11/21/2005	PPC-8	2.46	7.36	203	< 10	11.34	295	93	76	122.8 E	36	23	8	16	2	47
Prickly Pear Creek	5/12/2006	PPC-103	10.08	8.10	140	< 10	7.72	189	68	55	80.5 E	24	3	5	10	2	33
Prickly Pear Creek	5/12/2006	PPC-3A	9.17	7.71	130	< 10	7.98	183	64	52	78.0 E	23	3	5	8	2	32
Prickly Pear Creek	5/12/2006	PPC-5	9.65	7.72	134	< 10	8.3	181	70	57	84.6 E	24	4	6	9	2	32
Prickly Pear Creek	5/12/2006	PPC-7	9.45	7.44	134	< 10	9.05	170	70	57	80.5 E	24	3	5	9	2	32
Prickly Pear Creek	5/12/2006	PPC-8	9.41	7.40	136	< 10	9.15	191	70	57	80.5 E	24	3	5	9	2	30
Prickly Pear Creek	12/8/2006	PPC-103	0.33	7.41	218	< 10	12.21	301	99	81	121.2 E	37	5	7	14	2	60
Prickly Pear Creek	12/8/2006	PPC-3A	0.95	7.74	209	< 10	12.47	297	99	81	118.7 E	36	4	7	15	3	58
Prickly Pear Creek	12/8/2006	PPC-5	0.35	7.48	211	< 10	12.57	309	100	85	121.2 E	37	5	7	15	3	58
Prickly Pear Creek	12/8/2006	PPC-7	0.00	7.45	211	< 10	12.91	295	100	83	127.8 E	38	5	8	15	3	61
Prickly Pear Creek	12/8/2006	PPC-8	0.00	7.31	218	< 10	13.2	319	100	84	121.2 E	37	5	7	15	3	60
Prickly Pear Creek	6/6/2007	PPC-103	9.45	7.38	98	< 10	9.44	139	54	44	52.3 E	16	2	3	6	2	23
Prickly Pear Creek	6/6/2007	PPC-3A	9.59	7.75	103	< 10	10.27	136	51	42	49.8 E	15	1	3	6	2	24
Prickly Pear Creek	6/6/2007	PPC-5	10.45	7.33	99	< 10	9.97	133	51	42	52.3 E	16	2	3	6	2	23
Prickly Pear Creek	6/6/2007	PPC-7	10.54	6.81	102	< 10	9.92	140	54	44	52.3 E	16	2	3	6	2	24
Prickly Pear Creek	6/6/2007	PPC-8	10.63	7.24	106	< 10	9.91	140	51	42	52.3 E	16	2	3	6	2	24
Prickly Pear Creek	10/31/2007	PPC-103	5.10	7.64	208	< 10	8.86	332	120	100	120.3 E	35	5	8	17	3	53
Prickly Pear Creek	10/31/2007	PPC-3A	5.20	7.82	204	< 10	9.19	323	120	95	115.3 E	33	5	8	16	3	55
Prickly Pear Creek	10/31/2007	PPC-5	4.80	7.86	208	< 10	10.5	328	120	98	120.3 E	35	5	8	16	3	55
Prickly Pear Creek	10/31/2007	PPC-7	4.50	7.98	207	< 10	10.76	334	120	98	120.3 E	35	6	8	17	3	53
Prickly Pear Creek	10/31/2007	PPC-8	4.20	7.97	208	< 10	11.36	343	120	98	120.3 E	35	5	8	17	3	54

Table B-2. Surface Water Chemistry Data (Conventional Parameters)

												Dissolved					
CSM Unit	Sample Date	Location Sample ID	Temperature (C°)	pH (s.u.)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	Specific Conductivity (umhos/cm)	Bicarbonate (mg/L as HO_3)	Total Alkalinity (mg/L as $CaCO_3$)	Hardness mg/L as CaCO	Ca (mg/L)	Cl (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Sulfate SO_4 (mg/L)
Prickly Pear Creek	4/30/2008	PPC-103	8.06	7.86	173	< 10	11.74	258	91	74	108.7 E	32	4	7	12	2	43
Prickly Pear Creek	4/30/2008	PPC-3A	7.41	7.97	154	< 10	12.02	231	78	64	97.1 E	29	3	6	11	2	39
Prickly Pear Creek	4/30/2008	PPC-5	7.96	7.75	165	< 10	12.1	258	88	72	108.7 E	32	4	7	12	2	43
Prickly Pear Creek	4/30/2008	PPC-7	7.50	7.53	169	< 10	11.95	264	91	74	108.7 E	32	4	7	12	2	44
Prickly Pear Creek	4/30/2008	PPC-8	7.50	7.42	167	< 10	12.01	266	92	75	108.7 E	32	4	7	12	2	43
Prickly Pear Creek	10/24/2008	PPC-103	4.10	8L	174	< 10	nr	258	92	76	94.6 E	28	4	6	13	2	48
Prickly Pear Creek	10/24/2008	PPC-3A	4.70	8.2L	167	< 10	nr	253	90	74	92.1 E	27	4	6	13	2	46
Prickly Pear Creek	10/24/2008	PPC-5	4.10	8L	167	< 10	nr	258	91	75	94.6 E	28	4	6	13	3	48
Prickly Pear Creek	10/24/2008	PPC-7	4.10	8L	170	< 10	nr	259	91	75	94.6 E	28	4	6	12	2	48
Prickly Pear Creek	10/24/2008	PPC-8	4.00	8L	172	< 10	nr	260	91	75	97.1 E	29	4	6	13	2	48
Prickly Pear Creek	5/1/2009	PPC-103	3.70	7.21	144	< 10	11.4	217	75	62	78.0 E	23	3	5	9	2	38
Prickly Pear Creek	5/1/2009	PPC-103A	3.79	8.10	144	< 10	8.8	219	75	62	78.0 E	23	4	5	9	2	38
Prickly Pear Creek	5/1/2009	PPC-5	3.30	7.50	140	< 10	11.5	218	75	62	78.0 E	23	4	5	9	2	37
Prickly Pear Creek	5/1/2009	PPC-7	nr	7.9L	141	< 10	nr	220L	75	62	78.0 E	23	3	5	9	2	37
Prickly Pear Creek	5/1/2009	PPC-8	nr	7.7L	141	< 10	nr	223L	75	62	73.0 E	21	4	5	8	2	37
Prickly Pear Creek	5/15/2009	PPC-9A	7.03	7.57	nr	nr	12.65	170	nr	nr	nr	nr	nr	nr	nr	nr	nr
Prickly Pear Creek	5/15/2009	PPC-9A	8.80	7.90	nr	nr	9.47	164	nr	nr	nr	nr	nr	nr	nr	nr	nr
Prickly Pear Creek	10/29/2009	PPC-103	4.45	7.58	172	< 10	10.2	249	84	69	103.7 E	30	4	7	11	3	48
Prickly Pear Creek	10/29/2009	PPC-3A	4.46	8.30	175	< 10	11.8	244	83	68	101.2 E	29	4	7	11	2	48
Prickly Pear Creek	10/29/2009	PPC-5	4.38	6.30	173	< 10	6.7	243	85	70	101.2 E	29	4	7	11	2	48
Prickly Pear Creek	10/29/2009	PPC-7	4.02	8.90	166	< 10	12.6	243	84	69	101.2 E	29	4	7	11	2	48
Prickly Pear Creek	10/29/2009	PPC-8	3.78	8L	171	< 10	10.28	243	84	69	101.2 E	29	4	7	11	3	48
Prickly Pear Creek	7/8/2010	PPC-103	12.59	7.8L	120	30	nr	169	69	56	58.9 E	17	2	4	5	2	23
Prickly Pear Creek	7/8/2010	PPC-3A	12.09	7.90	123	16	9.05	168	69	56	58.9 E	17	2	4	6	2	24
Prickly Pear Creek	7/8/2010	PPC-5	11.99	8.10	118	< 10	10.4	168	70	57	58.9 E	17	2	4	5	2	23
Prickly Pear Creek	7/8/2010	PPC-7	11.72	8.20	119	< 10	8.08	169	70	57	66.4 E	20	2	4	5	2	24
Prickly Pear Creek	7/8/2010	PPC-8	11.61	7.7L	123	< 10	nr	169	71	58	58.9 E	17	2	4	6	2	23
Prickly Pear Creek	8/4/2010	PPC-22 (SG-03A)	16.14	7.55	159	<10	8.56	226	nm	74	92.1 E	27	3	6	9	2	32
Prickly Pear Creek	8/4/2010	PPC-102 (SG-06)	16.49	7.19	162	<10	6.97	224	nm	75	89.6 E	26	3	6	9	2	31
Prickly Pear Creek	8/4/2010	PPC-5 (SG-07)	15.63	7.24	159	<10	7.91	221	nm	76	92.1 E	27	3	6	9	2	31
Prickly Pear Creek	8/4/2010	PPC-23 (SG-08)	15.65	7.28	161	<10	7.97	229	nm	75	87.1 E	25	3	6	9	2	31
Prickly Pear Creek	8/4/2010	PPC-7 (SG-09)	nm	nm	162	<10	nm	nm	nm	76	83.0 E	25	3	5	8	2	31
Prickly Pear Creek	8/4/2010	PPC-8 (SG-10)	16	8.07	159	<10	nm	248	nm	76	80.5 E	24	3	5	8	2	31
Prickly Pear Creek	8/4/2010	SG-11	16.1	7.99	162	<10	8.4	253	nm	76	85.5 E	26	3	5	9	2	31
Prickly Pear Creek (Piezomete	8/5/2010	PPC-102	17.6	7.61	278	12	2.5	421	nm	130	107.1 E	33	5	6	33	3	71
Prickly Pear Creek (Piezomete	8/5/2010	PPC-103	17	7.86	373	<10	3.6	561	nm	150	114.6 E	36	8	6	60	6	120
Prickly Pear Creek (Ref)	10/1/2003	PPC_1	4.21	7.48	71	nr	11.3	111.2	nr	nr	58.1 E	17.2	nr	3.31	nr	1.51	5.4
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-8	14.3	7.65	155	<10	9.24	225	nm	73	80.5 E	24	3	5	8	2	34
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-7	14.7	7.74	161	<10	8.63	236	nm	74	83.0 E	25	3	5	8	2	34
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-6	15.2	7.78	165	<10	8.8	223	nm	71	80.5 E	24	3	5	9	2	34
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-5	14.5	7.69	170	<10	8.13	246	nm	74	83.0 E	25	4	5	9	2	39
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-4	15.1	7.9	166	<10	7.44	256	nm	69	83.0 E	25	4	5	10	2	38
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-3	16.1	8.21	167	<10	6.86	248	nm	73	89.6 E	26	4	6	10	2	38
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-2	16.8	8.36	165	<10	6.76	239	nm	69	89.6 E	26	4	6	10	2	38
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-1	17.4	8.4	163	<10	6.26	240	nm	71	80.5 E	24	4	5	9	2	37
Upper Lake/Marsh	9/30/2003	ULM_1	nr	nr	nr	nr	nr	nr	nr	nr	133.0 E	34	nr	13.2	nr	3.69	23.3
Upper Lake/Marsh	9/30/2003	ULM_10	nr	nr	nr	nr	nr	nr	nr	nr	111.0 E	35.1	nr	8.22	nr	3.07	19.6
Upper Lake/Marsh	9/30/2003	ULM_3	nr	nr	nr	nr	nr	nr	nr	nr	107.0 E	34.5	nr	8.08	nr	2.91	19.1
Upper Lake/Marsh	9/30/2003	ULM_4	nr	nr	nr	nr	nr	nr	nr	nr	114.0 E	33.8	nr	7.79	nr	2.87	19
Upper Lake/Marsh	9/30/2003	ULM_7	nr	nr	nr	nr	nr	nr	nr	nr	107.0 E	34.3	nr	7.81	nr	2.94	19.5
Upper Lake/Marsh	9/30/2003	ULM_11	nr	nr	nr	nr	nr	nr	nr	nr	112.0 E	33.8	nr	8.02	nr	2.73	18.6
Upper Lake/Marsh	9/30/2003	ULM_12	nr	nr	nr	nr	nr	nr	nr	nr	110.0 E	33.7	nr	8.42	nr	2.97	19
Upper Lake/Marsh	9/30/2003	ULM_2	nr	nr	nr	nr	nr	nr	nr	nr	127.0 E	36.6	nr	8.76	nr	2.48	17.6
Upper Lake/Marsh	9/30/2003	ULM_5	nr	nr	nr	nr	nr	nr	nr	nr	122.0 E	33.8	nr	7.92	nr	2.89	19.4
Upper Lake/Marsh	9/30/2003	ULM_6	nr	nr	nr	nr	nr	nr	nr	nr	115.0 E	33.5	nr	8.13	nr	2.97	19.2
Upper Lake/Marsh	9/30/2003	ULM_8	nr	nr	nr	nr	nr	nr	nr	nr	157.0 E	47	nr	11	nr	0.515	22.4
Upper Lake/Marsh	9/30/2003	ULM_9	nr	nr	nr	nr	nr	nr	nr	nr	111.0 E	33	nr	8.27	nr	0.971	20.5
Upper Lake/Marsh	11/7/2002	Upper Lake	1.60	8.10	231	76	nr	298	118	97	127.0 E	37	9.9	8.4	18	< 5	64
Upper Lake/Marsh	5/6/2009	Upper Lake	9.30	8.50	134	< 10	6.6	191	66	54	75.5 E	22	3	5	8	2	33
Upper Lake/Marsh	10/29/2009	Upper Lake	4.16	8.40	174	< 10	nr	247	86	70	103.7 E	30	4	7	11	3	48
Upper Lake/Marsh	8/3/2010	UL-21	18.6	8.12	159	15	7.69	230	nm	74	87.1 E	25	3	6	8	2	32
Upper Lake/Marsh	8/5/2010	UL-24	17.08	7.54	155	<10	8.41	208	93	76	92.1 E	27	4	6	9	2	34
Upper Lake/Marsh	8/5/2010	UL-23	16.07	7.01	161	<10	6.61	222	95	78	92.1 E	27	4	6	9	2	33
Upper Lake/Marsh	8/5/2010	UL-22	15.9	6.29	157	<10	9.62	220	95	78	92.1 E	27	4 J	6	9	2	34

Table B-2. Surface Water Chemistry Data (Conventional Parameters)

CSM Unit	Sample Date	Location Sample ID	Temperature (C°)	pH (s.u.)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	Specific Conductivity (umhos/cm)	Bicarbonate (mg/L as HO_3)	Total Alkalinity (mg/L as $CaCO_3$)	Hardness mg/L as CaCO	Dissolved					Sulfate
												Ca (mg/L)	Cl (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)
Upper Lake/Marsh	8/5/2010	UL-25	16.7	7.41	172	<10	11.7	228	110	92	107.1 E	33	4 J	6	10	2	35
Upper Lake/Marsh	8/5/2010	ULM-1	19.3	6.71	156	29	2.05	237	95	78	94.6 E	28	3	6	8	2	27
Upper Lake/Marsh	8/5/2010	ULM-2	16.5	7.06	160	<10	9.01	219	90	74	85.5 E	26	4 J	5	9	2	36
Upper Lake/Marsh	8/5/2010	ULM-3	15	6.75	161	<10	7.66	222	92	76	97.1 E	29	4 J	6	9	2	34
Upper Lake/Marsh	8/5/2010	ULM-4	18.5	8.35	138	<10	11.22	217	90	74	90.5 E	28	4 J	5	9	2	31
Upper Lake/Marsh	8/5/2010	ULM-5	18.7	8.04	142	<10	13.54	216	83	74	89.6 E	26	4 J	6	9	2	31
Upper Lake/Marsh	8/5/2010	ULM-6	16.9	6.7	143	<10	5.5	218	91	75	83.0 E	25	3 J	5	9	2	32
Upper Lake/Marsh	8/5/2010	ULM-7	18	7.54	163	<10	4.69	240	92	75	83.0 E	25	4	5	9	2	34
Upper Lake/Marsh	8/5/2010	ULM-8	18.5	7.37	153	<10	8.09	231	91	74	89.6 E	26	4	6	9	2	34
Upper Lake/Marsh	8/5/2010	ULM-9	18.3	8.32	162	<10	3.9	231	90	74	89.6 E	26	4	6	8	2	35
Walker Creek (Marsh)	8/11/2010	WPM-1	19.17	7.19	104	18	5.36	118	nm	50	48.0 E^a	11	5	<5	5	<5	7
Walker Creek (Marsh)	8/12/2010	WPM-2	13.14	6.38	101	24	7.48	117	nm	50	50.5 E^a	12	5	<5	6	<5	7
Walker Creek (Marsh)	8/12/2010	WPM-3	8.55	5.99	240	15500	6.52	278	nm	490	94.6 E	28	3	6	13	<5	30
Walker Creek (Marsh)	8/12/2010	WPM-4	12.9	6.34	103	28	5.73	117	nm	44	50.5 E^a	12	5	<5	6	<5	7
Walker Creek (Marsh)	8/12/2010	WPM-5	13.93	6.21	99	25	8.15	117	nm	40	48.0 E^a	11	5	<5	6	<5	7
Walker Creek (Mouth)	8/12/2010	WC-1	10.9	6.19	nm	nm	8.87	117	nm	nm	nm	nm	nm	nm	nm	nm	nm
Walker Creek (Pond)	8/11/2010	WP-1	12.98	6.27	103	<10	6.87	113	nm	44	50.5 E^a	12	5	<5	6	<5	7
Walker Creek (Pond)	8/11/2010	WP-2	14.18	6.67	103	20	9.17	110	nm	40	48.0 E^a	11	5	<5	5	<5	7
Walker Creek (Pond)	8/11/2010	WP-3	13.94	6.53	99	<10	8.82	118	nm	40	48.0 E^a	11	6	<5	6	<5	8
Walker Creek (Pond)	8/11/2010	WP-4	13.79	6.13	98	10	8.27	113	nm	42	48.0 E^a	11	6	<5	5	<5	8
Walker Creek (Pond)	8/11/2010	WP-5	14.56	6.59	97	<10	8.16	118	nm	40	50.5 E^a	12	6	<5	6	<5	8
Wilson Ditch	6/4/2001	WD-1	12.90	8.80	132	3	6.7	157	51	50	61.8 E	18	2.4	4.1	7.2	< 5	30
Wilson Ditch	6/4/2001	WD-2	12.30	8.8L	134	2.8	nr	151	50	55	61.4 E	18	2.4	4	7.5	< 5	29
Wilson Ditch	6/20/2002	WD-1	20.90	6.4L	116	2.6	nr	221	50	41	50.2 E	16	< 1	< 5	5.6	< 5	20
Wilson Ditch	6/20/2002	WD-2	18.90	6L	111	5.2	nr	141	51	42	50.2 E	16	1	< 5	5.4	< 5	22
Wilson Ditch	8/10/2010	WD-26	21.07	7.84	157	<10	6.7	216	nm	77	87.1 E	25	4	6	9	3	30
Wilson Ditch	8/10/2010	WD-25	19.64	7.33	158	<10	8.47	216	nm	78	92.1 E	27	4	6	9	2	32
Wilson Ditch	8/10/2010	WD-3	16.17	6.98	156	<10	8.94	212	nm	77	92.1 E	27	4	6	9	2	33
Wilson Ditch	8/10/2010	WD-4	16.13	6.97	154	<10	10.02	211	nm	77	94.6 E	28	4	6	9	2	32
Wilson Ditch	8/10/2010	WD-2	15.68	7.76	162	<10	10.85	210	nm	77	89.6 E	26	4	6	9	2	34

Notes:

nr = not reported

nm = not measured

U = not detected

J = estimated value

E = Estimated by the following equation for Hardness, mg equivalent/L $CaCO_3$ *= ([Ca,mg/L]*2.497) + ([Mg,mg/L]*4.116)*

(a) Values used 5 mg/L of Mg in hardness calculation as values for Mg were below reporting limits

Table B-3. Surface Water Chemistry Data (Dissolved Metals)

			Dissolved Metals																																								
	Sample	Location	Hardness	Al		Sb		As		As ^{III}		As ^{V}		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Canyon Ferry (Ref)	10/1/2003	CFR_1	144	200	U	60	U	12.3		nm		nm		80.6		5	U	1	U	1.2		50	U	25	U	88		10	U	15	U	nm		40	U	13.7		1.5		25	U	7.4		63.6	
Canyon Ferry (Ref)	10/1/2003	CFR_2	180	102		8.3		16.4		nm		nm		89.9		5	U	1	U	1.1		50	U	3.6		100	U	10	U	15	U	nm		40	U	15.8		-	R	25	U	9.6		64.6	
Lower Lake	9/30/2003	LL_1	190	200	U	393		200		nm		nm		40		5	U	6.9		0.84		50	U	20.2		122		17.5		199		nm		2.8		52.3		1.4		72.9		50	U	70.1	
Lower Lake	9/30/2003	LL_2	200	200	U	417		216		nm		nm		41.5		5	U	6.6		10	U	50	U	20.7		114		23.6		204		nm		3.7		50.5		10	U	71		50	U	84.8	
Lower Lake	9/30/2003	LL_3	207	200	U	428		214		nm		nm		42.8		5	U	6.8		10	U	50	U	21.3		172		22.7		207		nm		4.4		49.3		0.72		71.4		50	U	103	
Lower Lake	5/10/2000	Lower Lake	608.0	nm		nm		200		20	U	200		nm		nm		40		nm		nm		50		50	J	30		400		nm		nm		nm		nm		nm		nm		200	
Lower Lake	10/31/2000	Lower Lake	457.0	nm		nm		100		20	U	100		nm		nm		20		nm		nm		20		80	UJ	40		400		nm		nm		nm		nm		nm		nm		100	
Lower Lake	5/3/2001	Lower Lake	254.8	nm		nm		50		40		5	U	nm		nm		6		nm		nm		5		50	U	10		300		nm		nm		nm		nm		nm		nm		100	
Lower Lake	11/16/2001	Lower Lake	278.5	50	U	nm		100		40		60		nm		nm		10		nm		nm		20		20	U	5	U	300		nm		nm		nm		nm		nm		nm		50	
Lower Lake	5/15/2002	Lower Lake	280.9	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Lower Lake	11/7/2002	Lower Lake	229.4	nm		nm		200		nm		nm		nm		nm		1		nm		nm		20		20	U	5	U	200		nm		nm		nm		nm		nm		nm		20	U
Lower Lake	4/30/2003	Lower Lake	203.6	nm		nm		200		nm		nm		nm		nm		1	U	nm		nm		8		30		5	U	400		nm		nm		nm		nm		nm		nm		20	U
Lower Lake	10/22/2003	Lower Lake	211.0	nm		nm		200		nm		nm		nm		nm		10		nm		nm		26		350		76		250		nm		nm		nm		nm		nm		nm		88	
Lower Lake	4/27/2004	Lower Lake	192.7	nm		nm		83	J	nm		nm		nm		nm		7		nm		nm		18		190		20	J	180		nm		nm		nm		nm		nm		nm		30	
Lower Lake	11/4/2004	Lower Lake	161.2	nm		nm		124		1	U	110		nm		nm		2		nm		nm		10		70		8		270		nm		nm		nm		nm		nm		nm		20	
Lower Lake	6/9/2005	Lower Lake	157.8	nm		nm		84		nm		nm		nm		nm		6		nm		nm		12		20	U	5	U	20		nm		nm		nm		nm		nm		nm		10	U
Lower Lake	11/21/2005	Lower Lake	147.8	nm		nm		157		nm		nm		nm		nm		1	U	nm		nm		9		40		5	U	90		nm		nm		nm		nm		nm		nm		20	U
Lower Lake	5/12/2006	Lower Lake	127.8	nm		nm		132		nm		nm		nm		nm		1	U	nm		nm		4		20	U	5	U	10		nm		nm		nm		nm		nm		nm		20	U
Lower Lake	6/6/2007	Lower Lake	113.7	100	U	183		79		nm		nm		100	U	1	U	1	U	1	U	10	U	8		40		5	U	10		6	U	10	U	nm		5	U	51		10	U	10	U
Lower Lake	10/31/2007	Lower Lake	132.8	nm		nm		134		nm		nm		nm		nm		1		nm		nm		7		40		5	U	130		nm		nm		42		nm		nm		nm		10	U
Lower Lake	4/30/2008	Lower Lake	154.4	100	U	245		41		nm		nm		100	U	1	U	2		1	U	10	U	11		40		5	U	130		6	U	10	U	34		5	U	73		10	U	20	
Lower Lake	10/24/2008	Lower Lake	125.3	nm		nm		217		nm		nm		nm		nm		1		nm		nm		10		50		7		130		nm		nm		39		nm		nm		nm		20	U
Lower Lake	5/1/2009	Lower Lake	139.4	50	UJ	140		51	J	nm		nm		100	U	1	U	2.6	UJ	1	U	3	UJ	10		70		2.1		70		0.01	U	10	U	30		0.5	J	34.6		10	U	10	U
Lower Lake	10/29/2009	Lower Lake	121.9	100	U	98		211		nm		nm		100	U	1	U	1	U	1	U	10	U	7		40		5	U	110		1	U	10	U	23		5	UJ	14		10	U	10	U
Lower Lake	7/8/2010	Lower Lake	103.7	50	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Lower Lake	8/3/2010	LL-21	105.3	50	U	48		167		nm		nm		100	U	1	U	0.4		1	U	0.5	U	6		20	U	1.4		260		0.04		10	U	12		0.5	U	6.8		100	U	10	U
Lower Lake	8/3/2010	LL-22	107.8	50	U	47		171		nm		nm		100	U	1	U	0.6		1	U	0.5	U	6		20	U	1.8		280		0.05		10	U	12		0.5	U	6.6		100	U	10	U
Lower Lake	8/3/2010	LL-23	102.8	50	U	46		161		nm		nm		100	U	1	U	0.4		1	U	0.5	U	5		20	U	1.3		270		0.05		10	U	11		0.5	U	6.2		100	U	10	U
Lower Lake	8/3/2010	LL-24	102.8	50	U	46		164		nm		nm		100	U	1	U	0.4		1	U	0.5	U	5		20	U	1.3		260		0.03		10	U	11		0.5	U	6.4		100	U	10	U
Lower Lake	8/3/2010	LL-25	105.3	50	U	47		167		nm		nm		100	U	1	U	0.4		1	U	0.5	U	5		20	U	1.7		280		0.04		10	U	12		0.5	U	6.5		100	U	10	U
Prickly Pear Creek	10/1/2003	PPC_2	114	200	U	60	U	15	U	nm		nm		27.1		5	U	0.1		10	U	50	U	25	U	81.2		10	U	34.8		nm		40	U	35	U	-	R	25	U	2.9		137	
Prickly Pear Creek	10/1/2003	PPC_3	118	200	U	60	U	11.4		nm		nm		28.9		5	U	0.23		0.85		50	U	3.4		177		10	U	73.4		nm		40	U	9.3		0.69		25	U	3.6		130	
Prickly Pear Creek	10/1/2003	PPC_4	118	200	U	60	U	12.4		nm		nm		26.9		5	U	0.17		10	U	50	U	25	U	123		10	U	37.6		nm		40	U	8.4		0.69		25	U	2.9		71.3	
Prickly Pear Creek	10/1/2003	PPC_5	141	200	U	60	U	15	U	nm		nm		49.6		5	U	1	U	10	U	50	U	25	U	58.8		10	U	13.3		nm		40	U	7.1		1.3		25	U	3.9		113	
Prickly Pear Creek	5/10/2000	PPC-101	86.3	nm		nm		5		9	U	10	U	nm		nm		1	U	nm		nm		4	U	100	J	5	U	70		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/10/2000	PPC-102	86.3	nm		nm		5	U	8	U	10	U	nm		nm		1	U	nm		nm		4	U	70	J	5	U	60		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/10/2000	PPC-103	86.7	nm		nm		5	U	8	U	10	U	nm		nm		1	U	nm		nm		4	U	50	J	5	U	50		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/10/2000	PPC-3A	86.3	nm		nm		5	U	8	U	10	U	nm		nm		1	U	nm		nm		4	U	50	UJ	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/10/2000	PPC-5	86.7	nm		nm		5	U	9	U	10	U	nm		nm		1	U	nm		nm		4	U	200	J	5	U	70		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/10/2000	PPC-7	86.3	nm		nm		5	U	8	U	10	U	nm		nm		1	U	nm		nm		4	U	50	UJ	5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/10/2000	PPC-8	88.8	nm		nm		5	U	8	U	10	U	nm		nm		1	U	nm		nm		4	U	70	J	5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	10/31/2000	PPC-101	100.0	nm		nm		10		20	U	20	U	nm		nm		1	U	nm		nm		4	U	100	UJ	5	U	90		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	10/31/2000	PPC-102	104.5	nm		nm		10		20	U	20	U	nm		nm		1	U	nm		nm		4	U	100	UJ	5	U	100		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	10/31/2000	PPC-103	100.4	nm		nm		8		20	U	20	U	nm		nm		1	U	nm		nm		4	U	90	UJ	5	U	80		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	10/31/2000	PPC-3A	97.1	nm		nm		5	U	20	U	20		nm		nm		1	U	nm		nm		4	U	200	UJ	5	U	20		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	10/31/2000	PPC-5	100.4	nm		nm		6		20	U	20	U	nm		nm		1	U	nm		nm		4	U	200	UJ	5	U	70		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	10/31/2000	PPC-7	100.0	nm		nm		8		20	U	20	U	nm		nm		1	U	nm		nm		4	U	200	UJ	5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	10/31/2000	PPC-8	103.3	nm		nm		8		20	U	20	U	nm		nm		1	U	nm		nm		4	U	80	UJ	5	U	50		nm		nm		nm		nm		nm		nm		40	

Table B-3. Surface Water Chemistry Data (Dissolved Metals)

			Dissolved Metals																																										
	Sample	Location	Hardness	Al		Sb		As		As ^{III}		As ^{V}		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Prickly Pear Creek	5/3/2001	PPC-101	55.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-102	50.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-103	55.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-3A	55.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	20		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-5	55.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-7	55.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-8	55.2	nm		nm		5	U	5	U	5	U	nm		nm		1	U	nm		nm		4	U	50	U	5	U	30		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	11/16/2001	PPC-101	105.0	50	U	nm		6		6		5		nm		nm		1	U	nm		nm		4	U	100		5	U	90		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	11/16/2001	PPC-102	107.0	50	U	nm		5		5	U	5		nm		nm		1	U	nm		nm		4	U	100		5	U	80		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	11/16/2001	PPC-103	107.9	50	U	nm		5		5	U	5		nm		nm		1	U	nm		nm		4	U	100		5	U	80		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	11/16/2001	PPC-3A	104.5	50	U	nm		5	U	5	U	5		nm		nm		1	U	nm		nm		4	U	50		5	U	20		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	11/16/2001	PPC-5	107.9	50	U	nm		6		5		6		nm		nm		1	U	nm		nm		4	U	100		5	U	90		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	11/16/2001	PPC-7	107.9	50	U	nm		7		6		6		nm		nm		1	U	nm		nm		4	U	90		5	U	80		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	11/16/2001	PPC-8	110.4	50	U	nm		6		5		6		nm		nm		1	U	nm		nm		4	U	80		5	U	70		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	5/15/2002	PPC-101	233.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-102	82.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-103	81.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-3A	81.3	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-5	78.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-6A	82.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-7	81.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-8	81.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-101	200.0	nm		nm		50		nm		nm		nm		nm		1	U	nm		nm		4	U	20	U	5	U	20		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	11/6/2002	PPC-102	106.2	nm		nm		5		nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	60		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	11/6/2002	PPC-103	103.7	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	50		5	U	60		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	11/6/2002	PPC-5	110.0	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	60		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	11/6/2002	PPC-6A	nr	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-7	110.0	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	30		5	U	60		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	11/6/2002	PPC-8	110.4	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	50		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	11/7/2002	PPC-3A	100.4	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	30		5	U	30		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	4/30/2003	PPC-103	62.7	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-3A	62.7	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	60		5	U	30		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-5	62.7	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	40		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-7	62.7	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	40		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-8	62.7	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	60		5	U	40		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	10/22/2003	PPC-103	120.3	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	65		5	U	110		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	10/22/2003	PPC-3A	117.8	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	20	U	5	U	28		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	10/22/2003	PPC-5	120.7	nm		nm		11		nm		nm		nm		nm		1	U	nm		nm		4	U	49		5	U	110		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	10/22/2003	PPC-7	117.8	nm		nm		11		nm		nm		nm		nm		1	U	nm		nm		4	U	24		5	U	62		nm		nm		nm		nm		nm		nm		44	
Prickly Pear Creek	10/22/2003	PPC-8	121.1	nm		nm		11		nm		nm		nm		nm		1	U	nm		nm		4	U	66		5	U	47		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	4/29/2004	PPC-103	89.6	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	110		5	U	70		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	4/29/2004	PPC-3A	87.1	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	90		5	U	30		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	4/29/2004	PPC-5	87.1	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	90		5	U	60		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	4/29/2004	PPC-7	87.1	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		5		100		5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/29/2004	PPC-8	87.1	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	80		5	U	50		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	11/4/2004	PPC-103	103.7	nm		nm		5	U	1	U	3.6		nm		nm		1	U	nm		nm		4	U	60		5	U	70		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	11/4/2004	PPC-3A	106.2	nm		nm		5	U	1	U	3.2		nm		nm		1	U	nm		nm		4	U	30		5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	11/4/2004	PPC-5	103.7	nm		nm		5		1	U	4		nm		nm		1	U	nm		nm		4	U	70		5	U	60		nm		nm		nm		nm		nm		nm		20	

Table B-3. Surface Water Chemistry Data (Dissolved Metals)

			Dissolved Metals																																										
	Sample	Location	Hardness	Al		Sb		As		As^{III}		As^{V}		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Prickly Pear Creek	11/4/2004	PPC-7	101.2	nm		nm		7		1	U	5.2		nm		nm		1	U	nm		nm		4	U	40		5	U	60		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	11/4/2004	PPC-8	101.2	nm		nm		7		1.2		5.3		nm		nm		1	U	nm		nm		4	U	40		5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	6/9/2005	PPC-103	49.8	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	20		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	6/9/2005	PPC-3A	52.3	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	20		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	6/9/2005	PPC-5	49.8	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	20		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	6/9/2005	PPC-7	52.3	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	30		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	6/9/2005	PPC-8	49.8	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	30		5	U	20		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	11/21/2005	PPC-103	120.3	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	110		5	U	90		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	11/21/2005	PPC-3A	120.3	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	50		5	U	40		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	11/21/2005	PPC-5	120.3	nm		nm		5		nm		nm		nm		nm		1	U	nm		nm		4	U	90		5	U	90		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	11/21/2005	PPC-7	120.3	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	90		5	U	80		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	11/21/2005	PPC-8	122.8	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	90		5	U	70		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	5/12/2006	PPC-103	80.5	nm		nm		3		nm		nm		nm		nm		1	U	nm		nm		4	U	60		5	U	50		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/12/2006	PPC-3A	78.0	nm		nm		2	U	nm		nm		nm		nm		1	U	nm		nm		4	U	40		5	U	30		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/12/2006	PPC-5	84.6	nm		nm		4		nm		nm		nm		nm		1	U	nm		nm		4	U	60		5	U	40		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/12/2006	PPC-7	80.5	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	40		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/12/2006	PPC-8	80.5	nm		nm		4		nm		nm		nm		nm		1	U	nm		nm		4	U	60		5	U	40		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	12/8/2006	PPC-103	121.2	nm		nm		3		nm		nm		nm		nm		1	U	nm		nm		4	U	80		5	U	80		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	12/8/2006	PPC-3A	118.7	nm		nm		3		nm		nm		nm		nm		1	U	nm		nm		4	U	50		5	U	40		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	12/8/2006	PPC-5	121.2	nm		nm		4		nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	90		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	12/8/2006	PPC-7	127.8	nm		nm		6		nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	90		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	12/8/2006	PPC-8	121.2	nm		nm		8		nm		nm		nm		nm		1	U	nm		nm		4	U	60		5	U	80		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	6/6/2007	PPC-103	52.3	100	U	5	U	5		nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	70		5	U	40		6	U	10	U	nm		5	U	2	U	10	U	40	
Prickly Pear Creek	6/6/2007	PPC-3A	49.8	100	U	5	U	5	U	nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	60		5	U	20		6	U	10	U	nm		5	U	2	U	10	U	40	
Prickly Pear Creek	6/6/2007	PPC-5	52.3	100	U	1	U	5.1		nm		nm		13		1	U	0.2		1	U	2	U	4	U	70		1.6		36		0.1	U	10		1	U	0.5	U	0.3	U	10	U	40	
Prickly Pear Creek	6/6/2007	PPC-7	52.3	100	U	5	U	5	U	nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	70		5	U	40		6	U	10	U	nm		5	U	2	U	10	U	50	
Prickly Pear Creek	6/6/2007	PPC-8	52.3	100	U	5	U	5	U	nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	60		5	U	40		6	U	10	U	nm		5	U	2	U	10	U	50	
Prickly Pear Creek	10/31/2007	PPC-103	120.3	nm		nm		8		nm		nm		nm		nm		1	U	nm		nm		4	U	150		5	U	90		nm		nm		5	U	nm		nm		nm		30	
Prickly Pear Creek	10/31/2007	PPC-3A	115.3	nm		nm		5	U	nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	20		nm		nm		5	U	nm		nm		nm		40	
Prickly Pear Creek	10/31/2007	PPC-5	120.3	nm		nm		9		nm		nm		nm		nm		1	U	nm		nm		4	U	140		5	U	90		nm		nm		5	U	nm		nm		nm		30	
Prickly Pear Creek	10/31/2007	PPC-7	120.3	nm		nm		11		nm		nm		nm		nm		1	U	nm		nm		4	U	130		5	U	80		nm		nm		5	U	nm		nm		nm		30	
Prickly Pear Creek	10/31/2007	PPC-8	120.3	nm		nm		11		nm		nm		nm		nm		1	U	nm		nm		4	U	120		5	U	70		nm		nm		5	U	nm		nm		nm		30	
Prickly Pear Creek	4/30/2008	PPC-103	108.7	100	U	5	U	4		nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	90		5	U	60		6	U	10	U	5	U	5	U	2	U	10	U	30	
Prickly Pear Creek	4/30/2008	PPC-3A	97.1	100	U	5	U	3		nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	90		5	U	30		6	U	10	U	5	U	5	U	2	U	10	U	30	
Prickly Pear Creek	4/30/2008	PPC-5	108.7	100	U	5	U	5		nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	80		5	U	60		6	U	10	U	5	U	5	U	2	U	10	U	30	
Prickly Pear Creek	4/30/2008	PPC-7	108.7	100	U	5	U	6		nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	90		5	U	50		6	U	10	U	5	U	5	U	2	U	10	U	30	
Prickly Pear Creek	4/30/2008	PPC-8	108.7	100	U	5	U	5		nm		nm		100	U	1	U	1	U	1	U	10	U	4	U	90		5	U	50		6	U	10	U	5	U	5	U	2	U	10	U	30	
Prickly Pear Creek	10/24/2008	PPC-103	94.6	nm		nm		5		nm		nm		nm		nm		1	U	nm		nm		4	U	190		5	U	70		nm		nm		5	U	nm		nm		nm		70	
Prickly Pear Creek	10/24/2008	PPC-3A	92.1	nm		nm		4		nm		nm		nm		nm		1	U	nm		nm		4	U	70		5	U	30		nm		nm		5	U	nm		nm		nm		50	
Prickly Pear Creek	10/24/2008	PPC-5	94.6	nm		nm		5		nm		nm		nm		nm		1	U	nm		nm		4	U	190		5	U	80		nm		nm		5	U	nm		nm		nm		60	
Prickly Pear Creek	10/24/2008	PPC-7	94.6	nm		nm		7		nm		nm		nm		nm		1	U	nm		nm		4	U	160		5	U	70		nm		nm		5	U	nm		nm		nm		60	
Prickly Pear Creek	10/24/2008	PPC-8	97.1	nm		nm		7		nm		nm		nm		nm		1	U	nm		nm		4	U	160		5	U	80		nm		nm		5	U	nm		nm		nm		60	
Prickly Pear Creek	5/1/2009	PPC-103	78.0	50	UJ	3	U	3.6	J	nm		nm		100	U	1	U	2	UJ	1	U	1.6	UJ	2		70		0.7		40		0.01	U	10	U	2		0.5	J	0.2	U	10	U	50	
Prickly Pear Creek	5/1/2009	PPC-103A	78.0	50	UJ	3	U	2.4	J	nm		nm		100	U	1	U	1.6	UJ	1	U	2.9	UJ	3		50		0.5	U	30		0.01	U	10	U	1		0.5	J	0.2	U	10	U	60	
Prickly Pear Creek	5/1/2009	PPC-5	78.0	50	UJ	3	U	3.6	J	nm		nm		100	U	1	U	1.8	UJ	1	U	1.9	UJ	2		80		0.5		40		0.01	U	10	U	2		0.5	J	0.2	U	10	U	50	
Prickly Pear Creek	5/1/2009	PPC-7	78.0	50	UJ	3	U	4	J	nm		nm		100	U	1	U	2.1	UJ	1	U	1.5	UJ	2		80		0.6		40		0.01	U	10	U	2		0.5	J	0.2	U	10	U	60	
Prickly Pear Creek	5/1/2009	PPC-8	73.0	50	UJ	3	U	4.2	J	nm		nm		100	U	1	U	2	UJ	1	U	0.9	UJ	3		60		0.6		40		0.01	U	10	U	1	U	0.5	J	0.2	U	10	U	50	
Prickly Pear Creek	5/15/2009	PPC-9A	nr	nm		nm		5	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		1		nm		nm		nm		nm	

Table B-3. Surface Water Chemistry Data (Dissolved Metals)

			Dissolved Metals																																										
	Sample	**Location**	**Hardness**	**Al**		**Sb**		**As**		**As ^{III}**		**As ^{V}**		**Ba**		**Be**		**Cd**		**Cr**		**Co**		**Cu**		**Fe**		**Pb**		**Mn**		**Hg**		**Ni**		**Se**		**Ag**		**Tl**		**V**		**Zn**	
CSM Unit	**Date**	**Sample ID**	**mg/L as $CaCO_3$**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Prickly Pear Creek	5/15/2009	PPC-9A	nr	nm		nm		5		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		4		nm		nm		nm		nm	
Prickly Pear Creek	10/29/2009	PPC-103	103.7	100	U	3	U	7		nm		nm		100	U	1	U	1	U	1	U	10	U	2		150		5	U	70		1	U	10	U	1	U	5	U	1	U	10	U	70	
Prickly Pear Creek	10/29/2009	PPC-3A	101.2	100	U	3	U	4		nm		nm		100	U	1	U	1	U	1	U	10	U	1		70		5	U	50		1	U	10	U	1	U	5	U	1	U	10	U	80	
Prickly Pear Creek	10/29/2009	PPC-5	101.2	100	U	nm		5		nm		nm		nm		1	U	1	U	1	U	10	U	2		130		5	U	70		1	U	10	U	1	U	5	U	1	U	10	U	70	
Prickly Pear Creek	10/29/2009	PPC-7	101.2	100	U	3	U	6		nm		nm		100	U	1	U	1	U	1	U	10	U	2		130		5	U	70		1	U	10	U	1	U	5	U	1	U	10	U	70	
Prickly Pear Creek	10/29/2009	PPC-8	101.2	100	U	3	U	6		nm		nm		100	U	1	U	1	U	1	U	10	U	2		120		5	U	60		1	U	10	U	1	U	5	U	1	U	10	U	70	
Prickly Pear Creek	7/8/2010	PPC-103	58.9	50	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	7/8/2010	PPC-3A	58.9	50	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	7/8/2010	PPC-5	58.9	50	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	7/8/2010	PPC-7	66.4	50	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	7/8/2010	PPC-8	58.9	50	U	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	8/4/2010	PPC-22 (SG-03A)	92.1	50	U	3	U	3.9		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		40		0.5		30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Prickly Pear Creek	8/4/2010	PPC-102 (SG-06)	89.6	50	U	3	U	4.4		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		80		1.1		60		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek	8/4/2010	PPC-5 (SG-07)	92.1	50	U	3	U	5.2		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		80		1.1		60		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek	8/4/2010	PPC-23 (SG-08)	87.1	50	U	3	U	6.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		80		1.2		60		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek	8/4/2010	PPC-7 (SG-09)	83.0	50	U	3	U	5.6		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		70		1.1		50		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek	8/4/2010	PPC-8 (SG-10)	80.5	50	U	3	U	5.8		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		60		1.1		50		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek	8/4/2010	SG-11	85.5	50	U	3	U	5.8		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		70		1.2		50		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek (Ref)	10/1/2003	PPC_1	57	200	U	60	U	15	U	nm		nm		200	U	5	U	1	U	10	U	50	U	25	U	70.7		10	U	14.6		nm		40	U	35	U	-	R	25	U	2		176	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-1	80.5	50	U	3	U	3.9		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.5	U	20		0.01		10	U	1	U	0.5	U	0.2	U	100	U	20	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-2	89.6	50	U	3	U	4.3		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.5	U	30		0.02		10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-3	89.6	50	U	3	U	4.2		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		40		0.5	U	30		0.01		10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-4	83.0	50	U	3	U	3.9		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		40		0.5		30		0.02		10	U	1	U	0.5	U	0.2	U	100	U	40	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-5	83.0	50	U	3	U	3.7		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		40		0.5	U	30		0.02		10	U	1	U	0.5	U	0.2	U	100	U	40	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-6	80.5	50	U	3	U	3.5		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.5	U	30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	30	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-7	83.0	50	U	3	U	3.5		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.5	U	30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	40	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-8	80.5	50	U	3	U	3.3		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.5	U	30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	40	
Upper Lake/Marsh	9/30/2003	ULM_1	139	200	U	60	U	7.5		nm		nm		13.2		5	U	1	U	0.77		50	U	3.2		103		10	U	25.1		nm		40	U	35	U	1.1		25	U	2.1		60	U
Upper Lake/Marsh	9/30/2003	ULM_10	121	200	U	60	U	15	U	nm		nm		35.8		5	U	0.25		10	U	50	U	4.1		75.2		6.1		71.1		nm		40	U	35	U	10	U	25	U	50	U	57.3	
Upper Lake/Marsh	9/30/2003	ULM_3	119	200	U	60	U	15	U	nm		nm		34.6		5	U	0.12		10	U	50	U	3.2		185		3.9		66.1		nm		40	U	35	U	0.77		25	U	50	U	30.8	
Upper Lake/Marsh	9/30/2003	ULM_4	116	200	U	60	U	15	U	nm		nm		32		5	U	1	U	10	U	50	U	3.4		119		3.6		83.2		nm		40	U	35	U	10	U	25	U	50	U	45.6	
Upper Lake/Marsh	9/30/2003	ULM_7	118	200	U	60	U	15	U	nm		nm		30		5	U	0.13		10	U	50	U	3.3		106		10	U	51.6		nm		40	U	35	U	10	U	25	U	50	U	37.6	
Upper Lake/Marsh	9/30/2003	ULM_11	117	200	U	60	U	15	U	nm		nm		33		5	U	1	U	10	U	50	U	3.1		164		10	U	39.3		nm		40	U	35	U	10	U	25	U	50	U	56.4	
Upper Lake/Marsh	9/30/2003	ULM_12	119	200	U	60	U	15	U	nm		nm		39.1		5	U	1	U	10	U	50	U	4.8		59.5		6.6		66.1		nm		40	U	35	U	10	U	25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_2	127	200	U	10.3		15	U	nm		nm		43.5		5	U	0.43		2.1		2		11.7		112		10	U	1940		nm		40	U	35	U	10	U	25	U	50	U	123	
Upper Lake/Marsh	9/30/2003	ULM_5	117	200	U	60	U	6.9		nm		nm		33		5	U	1	U	10	U	50	U	3.5		114		10	U	164		nm		40	U	35	U	10	U	25	U	50	U	139	
Upper Lake/Marsh	9/30/2003	ULM_6	117	200	U	60	U	8.2		nm		nm		25.1		5	U	1	U	10	U	50	U	3.7		89.7		10	U	15.3		nm		40	U	35	U	10	U	25	U	50	U	45.9	
Upper Lake/Marsh	9/30/2003	ULM_8	163	200	U	60	U	15	U	nm		nm		36.8		5	U	0.37		1		50	U	7.7		154		10	U	899		nm		40	U	35	U	10	U	25	U	50	U	119	
Upper Lake/Marsh	9/30/2003	ULM_9	116	200	U	60	U	15	U	nm		nm		28.8		5	U	0.29		10	U	50	U	5.1		106		10	U	35.1		nm		40	U	35	U	10	U	25	U	50	U	73.1	
Upper Lake/Marsh	11/7/2002	Upper Lake	127.0	nm		nm		5	U	nm		nm		nm		nm		4	U	nm		nm		4	U	20	U	7		100		nm		nm		nm		nm		nm		nm		40	
Upper Lake/Marsh	5/6/2009	Upper Lake	75.5	50	U	3	U	4		nm		nm		100	U	1	U	1.1		1	U	0.5	U	3		40		5.3		30		0.0137		10	U	1	U	0.5	U	0.2	U	10	U	40	J
Upper Lake/Marsh	10/29/2009	Upper Lake	103.7	100	U	3	U	5		nm		nm		100	U	1	U	1	U	1	U	10	U	2		90		8		40		1	U	10	U	1	U	5	UJ	1	U	10	U	50	
Upper Lake/Marsh	8/3/2010	UL-21	87.1	50	U	3	U	6.5		nm		nm		100	U	1	U	0.2		1	U	0.5	U	2		70		3.5		30		0.01		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Upper Lake/Marsh	8/5/2010	UL-22	92.1	50	U	3	U	4.9		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		120		1		80		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	UL-23	92.1	50	U	3	U	5.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		110		2.1		120		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	UL-24	92.1	50	U	3	U	6.7		nm		nm		100	U	1	U	0.2		1	U	0.5	U	2		60		3.3		10	U	0.01		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Upper Lake/Marsh	8/5/2010	UL-25	107.1	50	U	3	U	5.9		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		100		1.2		80		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	
Upper Lake/Marsh	8/5/2010	ULM-1	94.6	50	U	3	U	8.8		nm		nm		100	U	1	U	0.5		1	U	0.5	U	4		230		4.3		190		0.01		10	U	1	U	0.5	U	0.2	U	100	U	30	

Table B-3. Surface Water Chemistry Data (Dissolved Metals)

			Dissolved Metals																																										
	Sample	Location	Hardness	Al		Sb		As		As ^{III}		As ^{V}		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Upper Lake/Marsh	8/5/2010	ULM-2	85.5	50	U	3	U	3.8		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.6		30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	ULM-3	97.1	50	U	3	U	4.2		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		80		0.9		60		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	ULM-4	90.5	50	U	3	U	4.5		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		50		0.7		30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	50	U	3	U	4.6		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.9		20		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	50	U	3	U	4.5		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.9		20		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Upper Lake/Marsh	8/5/2010	ULM-6	83.0	50	U	3	U	4.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		130		1.4		150		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	ULM-7	83.0	50	U	3	U	5.8		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		50		0.8		60		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	ULM-8	89.6	50	U	3	U	4.6		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		60		0.8		60		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Upper Lake/Marsh	8/5/2010	ULM-9	89.6	50	U	3	U	4		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		40		0.6		30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Walker Creek (Marsh)	8/11/2010	WPM-1	48.0	60		3	U	1.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		200		0.5	U	10	U	0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Marsh)	8/12/2010	WPM-2	50.5	70		3	U	1.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		260		0.5	U	10		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Marsh)	8/12/2010	WPM-3	94.6	50	U	3	U	0.7		nm		nm		400		1	U	0.1	U	1	U	0.7		1	U	370		0.5	U	2860		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	40	
Walker Creek (Marsh)	8/12/2010	WPM-4	50.5	90		3	U	1.3		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		480		0.5	U	40		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Marsh)	8/12/2010	WPM-5	48.0	80		3	U	1.2		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		280		0.5	U	20		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-1	50.5	60		3	U	1.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		190		0.5	U	10	U	0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-2	48.0	60		3	U	1.2		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		190		0.5	U	10	U	0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-3	48.0	70		3	U	1.2		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		170		0.5	U	10	U	0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-4	48.0	60		3	U	1.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		170		0.5	U	10	U	0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-5	50.5	60		3	U	1.1		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		170		0.5	U	10	U	0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	10	U
Wilson Ditch	6/4/2001	WD-1	61.8	nm		nm		5		nm		nm		nm		nm		1	U	nm		nm		4	U	80		5	U	50		nm		nm		nm		nm		nm		nm		20	U
Wilson Ditch	6/4/2001	WD-2	61.4	nm		nm		5		nm		nm		nm		nm		1	U	nm		nm		4	U	80		5	U	50		nm		nm		nm		nm		nm		nm		20	U
Wilson Ditch	6/20/2002	WD-1	50.2	nm		nm		10		nm		nm		nm		nm		2		nm		nm		7		80		20		20		nm		nm		nm		nm		nm		nm		20	U
Wilson Ditch	6/20/2002	WD-2	50.2	nm		nm		7		nm		nm		nm		nm		1	U	nm		nm		5		90		10		40		nm		nm		nm		nm		nm		nm		20	U
Wilson Ditch	8/10/2010	WD-2	89.6	50	U	3	U	4.4		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	2		90		1.1		50		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Wilson Ditch	8/10/2010	WD-25	92.1	50	U	3	U	4.2		nm		nm		100	U	1	U	0.2		1	U	0.5	U	2		90		1.2		30		0.01	U	10	U	1	U	0.5	U	0.2	U	100	U	20	
Wilson Ditch	8/10/2010	WD-26	87.1	50	U	3	U	10.5		nm		nm		100	U	1	U	0.7		1	U	0.5	U	4		40		2		20		0.01	U	10	U	10	U	0.5	U	0.2	U	100	U	10	
Wilson Ditch	8/10/2010	WD-3	92.1	50	U	3	U	4.3		nm		nm		100	U	1	U	0.1		1	U	0.5	U	2		90		1.4		40		0.01	U	10	U	10	U	0.5	U	0.2	U	100	U	20	
Wilson Ditch	8/10/2010	WD-4	94.6	50	U	3	U	4.5		nm		nm		100	U	1	U	0.1	U	1	U	0.5	U	1		90		1.2		40		0.01	U	10	U	10	U	0.5	U	0.2	U	100	U	20	

Notes:

nr = not reported

nm = not measured

U = not detected

J = estimated value

R = rejected

Table B-4. Surface Water Chemistry Data (Total Metals)

	Sample	Location	Total Metals																																								
			Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Canyon Ferry (Ref)	10/1/2003	CFR_1	194.0	6880		6.9		14.8		125		0.52		0.17		6.5		2.2		7.5		5760		3.9		63.5		nm		4.9		9.6		-	R	25	U	15.5		103	
Canyon Ferry (Ref)	10/1/2003	CFR_2	193.0	5770		60	U	11.5		119		0.43		0.52		5.7		2.1		10.8		5370		14.9		61.1		nm		5.7		13.7		0.81		25	U	14.1		118	
Lower Lake	5/10/2000	Lower Lake	608.0	nm		nm		200		nm		nm		40		nm		nm		70		400	U	90		400		nm		nm		nm		nm		nm		nm		200	
Lower Lake	10/31/2000	Lower Lake	457.0	nm		nm		100		nm		nm		20		nm		nm		40		200	UJ	80		400		nm		nm		nm		nm		nm		nm		100	
Lower Lake	5/3/2001	Lower Lake	254.8	nm		nm		100		nm		nm		20		nm		nm		30		400		80		300		nm		nm		nm		nm		nm		nm		100	
Lower Lake	11/16/2001	Lower Lake	278.5	60		nm		90		nm		nm		10		nm		nm		20		200		30		300		nm		nm		nm		nm		nm		nm		60	
Lower Lake	5/15/2002	Lower Lake	280.9	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Lower Lake	11/7/2002	Lower Lake	229.4	nm		nm		200		nm		nm		8		nm		nm		50		400		100		400		nm		nm		nm		nm		nm		nm		30	
Lower Lake	4/30/2003	Lower Lake	203.6	nm		nm		200		nm		nm		7		nm		nm		30		500		50		500		nm		nm		nm		nm		nm		nm		60	
Lower Lake	10/22/2003	Lower Lake	211.0	nm		nm		210		nm		nm		10		nm		nm		31		480		98		250		nm		nm		nm		nm		nm		nm		94	
Lower Lake	4/27/2004	Lower Lake	192.7	nm		nm		86		nm		nm		10		nm		nm		52		560		108		280		nm		nm		nm		nm		nm		nm		80	
Lower Lake	11/4/2004	Lower Lake	161.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Lower Lake	6/9/2005	Lower Lake	157.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Lower Lake	11/21/2005	Lower Lake	147.8	nm		nm		175		nm		nm		4		nm		nm		20		330		38		130		nm		nm		nm		nm		nm		nm		20	
Lower Lake	5/12/2006	Lower Lake	127.8	nm		nm		203		nm		nm		7		nm		nm		36		710		178		250		nm		nm		nm		nm		nm		nm		120	
Lower Lake	6/6/2007	Lower Lake	113.7	100	U	186		99		100	U	1	U	4		1	U	10	U	17		380		70		60		6	U	10	U	nm		5	U	51		10	U	40	
Lower Lake	10/31/2007	Lower Lake	132.8	nm		nm		145		nm		nm		2		nm		nm		10		240		12		140		nm		nm		40		nm		nm		nm		10	
Lower Lake	4/30/2008	Lower Lake	154.4	100	U	260		67		100	U	1	U	4		1	U	10	U	19		450		55		140		6	U	10	U	34		5	U	77		10	U	40	
Lower Lake	10/24/2008	Lower Lake	125.3	nm		nm		243		nm		nm		3		nm		nm		12		370		41		140		nm		nm		37		nm		nm		nm		20	U
Lower Lake	5/1/2009	Lower Lake	139.4	50	U	144		62.5		100	U	1	U	3	UJ	5	UJ	0.5	U	15		300		9.2		70		0.015		10	U	26		0.5	U	32.5		10	U	10	
Lower Lake	10/29/2009	Lower Lake	121.9	100	U	99		228		100	U	1	U	3	J	1	U	10	U	15	J	280		48	J	130		1	U	10	U	21		5	U	14		10	U	20	
Lower Lake	7/8/2010	Lower Lake	103.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Lower Lake	9/30/2003	LL_1	180.0	200	U	375		221		38.3		5	U	8.2		1		50	U	26.8		356		65.9		204		nm		40	U	48.1		2.1		65.7		50	U	77.5	
Lower Lake	9/30/2003	LL_2	203.0	200	U	423		239		43.4		5	U	8.3		0.67		50	U	30.1		400		78.9		221		nm		3.9		50.4		1.2		66		50	U	125	
Lower Lake	9/30/2003	LL_3	207.0	200	U	437		242		43.9		5	U	8.9		0.9		50	U	31.8		442		87.1		224		nm		4.3		54.1		10	U	67.5		50	U	123	
Lower Lake	8/3/2010	LL-21	105.3	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.04	J	nm		nm		nm		nm		nm		nm	
Lower Lake	8/3/2010	LL-22	107.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.05	J	nm		nm		nm		nm		nm		nm	
Lower Lake	8/3/2010	LL-23	102.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.05	J	nm		nm		nm		nm		nm		nm	
Lower Lake	8/3/2010	LL-24	102.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.03	J	nm		nm		nm		nm		nm		nm	
Lower Lake	8/3/2010	LL-25	105.3	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.04		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/10/2000	PPC-101	86.3	nm		nm		6		nm		nm		1	U	nm		nm		5		500	U	8		90		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	10/31/2000	PPC-101	100.0	nm		nm		20		nm		nm		1	U	nm		nm		4	U	400	UJ	5	U	100		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-101	55.2	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	400		6		70	UJ	nm		nm		nm		nm		nm		nm		50	U
Prickly Pear Creek	11/16/2001	PPC-101	105.0	50	U	nm		5	U	nm		nm		1	U	nm		nm		4	U	400		5	U	100		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	5/15/2002	PPC-101	233.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-101	200.0	nm		nm		40		nm		nm		1	U	nm		nm		5		20	U	5	U	20		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	5/10/2000	PPC-102	86.3	nm		nm		5		nm		nm		1	U	nm		nm		4	U	400	U	5		80		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	10/31/2000	PPC-102	104.5	nm		nm		10		nm		nm		1	U	nm		nm		4	U	600		5		100		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-102	50.2	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	500		6		70	UJ	nm		nm		nm		nm		nm		nm		50	U
Prickly Pear Creek	11/16/2001	PPC-102	107.0	50	U	nm		5	U	nm		nm		1	U	nm		nm		4	U	400		5	U	90		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	5/15/2002	PPC-102	82.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-102	106.2	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		5	U	80		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/10/2000	PPC-103	86.7	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	500	U	5		80		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	10/31/2000	PPC-103	100.4	nm		nm		10		nm		nm		1	U	nm		nm		4	U	500	U	5		100		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-103	55.2	nm		nm		6		nm		nm		1	U	nm		nm		4		400		6		80	UJ	nm		nm		nm		nm		nm		nm		50	U
Prickly Pear Creek	11/16/2001	PPC-103	107.9	50	U	nm		5	U	nm		nm		1	U	nm		nm		4	U	700		5	U	90		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	5/15/2002	PPC-103	81.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-103	103.7	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		5	U	70		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	4/30/2003	PPC-103	62.7	nm		nm		5		nm		nm		1	U	nm		nm		4	U	300		5	U	60		nm		nm		nm		nm		nm		nm		50	

Table B-4. Surface Water Chemistry Data (Total Metals)

			Total Metals																																						
	Sample	Location	Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Prickly Pear Creek	10/22/2003	PPC-103	120.3	nm		nm		7		nm		nm		1	U	nm		nm		4	U	360		5	U	120		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	4/29/2004	PPC-103	89.6	nm		nm		5		nm		nm		1	U	nm		nm		4	U	360		5	U	70		nm		nm		nm		nm		nm		nm		20	UJ
Prickly Pear Creek	11/4/2004	PPC-103	103.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	6/9/2005	PPC-103	49.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/21/2005	PPC-103	120.3	nm		nm		7		nm		nm		1	U	nm		nm		4	U	260		5	U	110		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	5/12/2006	PPC-103	80.5	nm		nm		4		nm		nm		1	U	nm		nm		4	U	170		5	U	60		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	12/8/2006	PPC-103	121.2	nm		nm		5		nm		nm		1	U	nm		nm		4		280		5	U	90		nm		nm		nm		nm		nm		nm		80	
Prickly Pear Creek	6/6/2007	PPC-103	52.3	200		5	U	8		100	U	1	U	1	U	1	U	10	U	4		380		6		70		6	U	10	U	nm		5	U	2	U	10	U	60	
Prickly Pear Creek	10/31/2007	PPC-103	120.3	nm		nm		9		nm		nm		1	U	nm		nm		4	U	330		5	U	100		nm		nm		5	U	nm		nm		nm		40	
Prickly Pear Creek	4/30/2008	PPC-103	108.7	100	U	5	U	6		100	U	1	U	1	U	1	U	10	U	4	U	300		5	U	70		6	U	10	U	5	U	5	U	2	U	10	U	40	
Prickly Pear Creek	10/24/2008	PPC-103	94.6	nm		nm		6		nm		nm		1	U	nm		nm		4	U	330		5	U	80		nm		nm		5	U	nm		nm		nm		70	
Prickly Pear Creek	5/1/2009	PPC-103	78.0	140		3	U	3.9		100	U	1	U	1.1	UJ	5	UJ	0.5	U	3		300		3.5		50		0.01	U	10	U	1		0.5	U	0.2	U	10	U	50	
Prickly Pear Creek	10/29/2009	PPC-103	103.7	100	U	3	U	8		100	U	1	U	1	UJ	1	U	10	U	2	J	240		5	U	80		1	U	10	U	1	U	5	UJ	1	U	10	U	80	
Prickly Pear Creek	7/8/2010	PPC-103	58.9	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/1/2009	PPC-103A	78.0	210		3	U	3.3		100	U	1	U	1.4	UJ	5	UJ	0.5	U	3		370		3.1		50		0.01	U	10	U	1		0.5	U	0.2	U	10	U	60	
Prickly Pear Creek	5/10/2000	PPC-3A	86.3	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	700	U	5	U	60		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	10/31/2000	PPC-3A	97.1	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300	UJ	5	U	30		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-3A	55.2	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	400		5		60	UJ	nm		nm		nm		nm		nm		nm		50	U
Prickly Pear Creek	11/16/2001	PPC-3A	104.5	50	U	nm		5	U	nm		nm		1	U	nm		nm		4	U	200		5	U	30		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	5/15/2002	PPC-3A	81.3	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/7/2002	PPC-3A	100.4	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	200		5	U	50		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	4/30/2003	PPC-3A	62.7	nm		nm		5	U	nm		nm		1	U	nm		nm		4		400		5	U	50		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	10/22/2003	PPC-3A	117.8	nm		nm		6		nm		nm		1	U	nm		nm		4	U	170		5	U	41		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	4/29/2004	PPC-3A	87.1	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	330		5	U	60		nm		nm		nm		nm		nm		nm		30	UJ
Prickly Pear Creek	11/4/2004	PPC-3A	106.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	6/9/2005	PPC-3A	52.3	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/21/2005	PPC-3A	120.3	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	240		5	U	60		nm		nm		nm		nm		nm		nm		80	
Prickly Pear Creek	5/12/2006	PPC-3A	78.0	nm		nm		4		nm		nm		1	U	nm		nm		4	U	170		5	U	40		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	12/8/2006	PPC-3A	118.7	nm		nm		4		nm		nm		1	U	nm		nm		4	U	190		5	U	50		nm		nm		nm		nm		nm		nm		80	
Prickly Pear Creek	6/6/2007	PPC-3A	49.8	300		5	U	5	U	100	U	1	U	1	U	1	U	10	U	4		530		7		60		6	U	10	U	nm		5	U	2	U	10	U	70	
Prickly Pear Creek	10/31/2007	PPC-3A	115.3	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	130		5	U	20		nm		nm		5	U	nm		nm		nm		40	
Prickly Pear Creek	4/30/2008	PPC-3A	97.1	100		5	U	4		100	U	1	U	1	U	1	U	10	U	4	U	380		5	U	60		6	U	10	U	5	U	5	U	2	U	10	U	50	
Prickly Pear Creek	10/24/2008	PPC-3A	92.1	nm		nm		4		nm		nm		1	U	nm		nm		4	U	150		5	U	40		nm		nm		5	U	nm		nm		nm		60	
Prickly Pear Creek	10/29/2009	PPC-3A	101.2	100	U	3	U	4		100	U	1	U	1	UJ	1	U	10	U	2	J	140		5	J	50		1	U	10	U	1	U	5	UJ	1	U	10	U	90	
Prickly Pear Creek	7/8/2010	PPC-3A	58.9	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/10/2000	PPC-5	86.7	nm		nm		6		nm		nm		1	U	nm		nm		4	U	600	U	8		90		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	10/31/2000	PPC-5	100.4	nm		nm		8		nm		nm		1	U	nm		nm		4		400	UJ	10		80		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/3/2001	PPC-5	55.2	nm		nm		5		nm		nm		1	U	nm		nm		4	U	500		7		70	UJ	nm		nm		nm		nm		nm		nm		50	U
Prickly Pear Creek	11/16/2001	PPC-5	107.9	50	U	nm		5	U	nm		nm		1	U	nm		nm		4	U	500		5	U	100		nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	5/15/2002	PPC-5	78.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-5	110.0	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	400		5	U	80		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-5	62.7	nm		nm		5	U	nm		nm		1	U	nm		nm		4		400		5	U	60		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	10/22/2003	PPC-5	120.7	nm		nm		14		nm		nm		1	U	nm		nm		5		380		5		130		nm		nm		nm		nm		nm		nm		20	U
Prickly Pear Creek	4/29/2004	PPC-5	87.1	nm		nm		7		nm		nm		1	U	nm		nm		4	U	380		6		90		nm		nm		nm		nm		nm		nm		30	UJ
Prickly Pear Creek	11/4/2004	PPC-5	103.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	6/9/2005	PPC-5	49.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/21/2005	PPC-5	120.3	nm		nm		6		nm		nm		1	U	nm		nm		4	U	270		5	U	110		nm		nm		nm		nm		nm		nm		80	
Prickly Pear Creek	5/12/2006	PPC-5	84.6	nm		nm		4		nm		nm		1	U	nm		nm		4	U	180		5	U	60		nm		nm		nm		nm		nm		nm		50	

Table B-4. Surface Water Chemistry Data (Total Metals)

			Total Metals																																						
	Sample	Location	Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Prickly Pear Creek	12/8/2006	PPC-5	121.2	nm		nm		5		nm		nm		1	U	nm		nm		4	U	260		5	U	100		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	6/6/2007	PPC-5	52.3	298		1	U	4	U	16		1	U	0.3		2	U	2	U	10	U	492		8.1		67		0.1	U	1		1	U	0.5	U	0.3	U	10	U	57	
Prickly Pear Creek	10/31/2007	PPC-5	120.3	nm		nm		10		nm		nm		1	U	nm		nm		4	U	290		5	U	90		nm		nm		5	U	nm		nm		nm		30	
Prickly Pear Creek	4/30/2008	PPC-5	108.7	100	U	5	U	6		100	U	1	U	1	U	1	U	10	U	5		320		5		70		6	U	10	U	5	U	5	U	2	U	10	U	40	
Prickly Pear Creek	10/24/2008	PPC-5	94.6	nm		nm		6		nm		nm		1	U	nm		nm		4	U	350		5	U	90		nm		nm		5	U	nm		nm		nm		70	
Prickly Pear Creek	5/1/2009	PPC-5	78.0	120		3	U	3.9		100	U	1	U	0.2	UJ	5	UJ	0.5	U	3		290		2.8		50		0.01	U	10	U	1	U	0.5	U	0.2	U	10	U	50	
Prickly Pear Creek	10/29/2009	PPC-5	101.2	100	U	3	U	6		100	U	1	U	1	UJ	1	U	10	U	2	J	230		5	J	80		1	U	10	U	1	U	5	UJ	1	U	10	U	80	
Prickly Pear Creek	7/8/2010	PPC-5	58.9	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2002	PPC-6A	82.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-6A	nr	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/10/2000	PPC-7	86.3	nm		nm		6		nm		nm		1	U	nm		nm		4		600	U	9		90		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	10/31/2000	PPC-7	100.0	nm		nm		10		nm		nm		1	U	nm		nm		4	U	500	UJ	20		70		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	5/3/2001	PPC-7	55.2	nm		nm		5		nm		nm		1	U	nm		nm		4	U	500		8		70	UJ	nm		nm		nm		nm		nm		nm		60	U
Prickly Pear Creek	11/16/2001	PPC-7	107.9	50	U	nm		8		nm		nm		1	U	nm		nm		4	U	400		5	U	90		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	5/15/2002	PPC-7	81.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-7	110.0	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-7	62.7	nm		nm		5		nm		nm		1	U	nm		nm		4		400		5	U	60		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	10/22/2003	PPC-7	117.8	nm		nm		13		nm		nm		1	U	nm		nm		7		330		7		87		nm		nm		nm		nm		nm		nm		54	
Prickly Pear Creek	4/29/2004	PPC-7	87.1	nm		nm		7		nm		nm		1	U	nm		nm		4	U	390		6		80		nm		nm		nm		nm		nm		nm		30	UJ
Prickly Pear Creek	11/4/2004	PPC-7	101.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	6/9/2005	PPC-7	52.3	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/21/2005	PPC-7	120.3	nm		nm		6		nm		nm		1	U	nm		nm		4	U	250		5	U	80		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	5/12/2006	PPC-7	80.5	nm		nm		7		nm		nm		1	U	nm		nm		4	U	190		5	U	60		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	12/8/2006	PPC-7	127.8	nm		nm		7		nm		nm		1	U	nm		nm		4	U	340		6		100		nm		nm		nm		nm		nm		nm		90	
Prickly Pear Creek	6/6/2007	PPC-7	52.3	300		5	U	6		100	U	1	U	1	U	1	U	10	U	4		450		8		70		6	U	10	U	nm		5	U	2	U	10	U	60	
Prickly Pear Creek	10/31/2007	PPC-7	120.3	nm		nm		7		100	U	1	U	1	U	1	U	10	U	4	U	330		6		70		6	U	10	U	5	U	5	U	2	U	10	U	40	
Prickly Pear Creek	4/30/2008	PPC-7	108.7	100	U	5	U	8		nm		nm		1	U	nm		nm		4	U	310		5	U	80		nm		nm		5	U	nm		nm		nm		70	
Prickly Pear Creek	10/24/2008	PPC-7	94.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/1/2009	PPC-7	78.0	140		3	U	5.2		100	U	1	U	0.3	UJ	5	UJ	0.5	U	3		290		3.1		50		0.01	U	10	U	1	U	0.5	U	0.2	U	10	U	50	
Prickly Pear Creek	10/29/2009	PPC-7	101.2	100	U	3	U	nm		100	U	1	U	1	UJ	1	U	10	U	2	J	230		5	UJ	80		1	U	10	U	1	U	5	UJ	1	U	10	U	90	
Prickly Pear Creek	7/8/2010	PPC-7	66.4	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/10/2000	PPC-8	88.8	nm		nm		6		nm		nm		1	U	nm		nm		4		600	U	8		90		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	10/31/2000	PPC-8	103.3	nm		nm		10		nm		nm		1	U	nm				4	U	400	UJ	7		60		nm		nm				nm						50	
Prickly Pear Creek	5/3/2001	PPC-8	55.2	nm		nm		6		nm		nm		1	U	nm		nm		4		500		8		80	UJ	nm		nm		nm		nm		nm		nm		60	U
Prickly Pear Creek	11/16/2001	PPC-8	110.4	50	U	nm		7		nm		nm		1	U	nm		nm		4	U	400		5	U	80		nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	5/15/2002	PPC-8	81.7	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/6/2002	PPC-8	110.4	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		5	U	60		nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	4/30/2003	PPC-8	62.7	nm		nm		5		nm		nm		1	U	nm		nm		5		400		5	U	60		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	10/22/2003	PPC-8	121.1	nm		nm		12		nm		nm		1	U	nm		nm		5		290		5	U	52		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	4/29/2004	PPC-8	87.1	nm		nm		7		nm		nm		1	U	nm		nm		4	U	420		7		90		nm		nm		nm		nm		nm		nm		30	UJ
Prickly Pear Creek	11/4/2004	PPC-8	101.2	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	6/9/2005	PPC-8	49.8	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	11/21/2005	PPC-8	122.8	nm		nm		6		nm		nm		1	U	nm		nm		4	U	230		5	U	70		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	5/12/2006	PPC-8	80.5	nm		nm		9		nm		nm		1	U	nm		nm		4	U	190		5	U	60		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	12/8/2006	PPC-8	121.2	nm		nm		9		nm		nm		1	U	nm		nm		4	U	290		6		110		nm		nm		nm		nm		nm		nm		90	
Prickly Pear Creek	6/6/2007	PPC-8	52.3	300		5	U	6		100	U	1	U	1	U	1	U	10	U	4		450		7		70		6	U	10	U	nm		5	U	2	U	10	U	70	
Prickly Pear Creek	10/31/2007	PPC-8	120.3	nm		nm		12		nm		nm		1	U	nm		nm		4	U	270		5	U	80		nm		nm		5	U	nm		nm		nm		30	
Prickly Pear Creek	4/30/2008	PPC-8	108.7	100	U	5	U	7		100	U	1	U	1	U	1	U	10	U	6		380		9		90		6	U	10	U	5	U	5	U	2	U	10	U	50	

Table B-4. Surface Water Chemistry Data (Total Metals)

			Total Metals																																						
	Sample	Location	Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Prickly Pear Creek	10/24/2008	PPC-8	97.1	nm		nm		8		nm		nm		1	U	nm		nm		4	U	300		5	U	80		nm		nm		5	U	nm		nm		nm		70	
Prickly Pear Creek	5/1/2009	PPC-8	73.0	160		3	U	4.8		100	U	1	U	1.1	UJ	5	U	0.5	U	3		330		3.8		50		0.01	U	10	U	1		0.5	U	0.4	J	10	U	60	
Prickly Pear Creek	10/29/2009	PPC-8	101.2	100	U	3	U	7		100	U	1	U	1	UJ	1	U	10	U	4	J	250		5	J	80		1	U	10	U	1	U	5	U	1	U	10	U	90	
Prickly Pear Creek	7/8/2010	PPC-8	58.9	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2009	PPC-9A	nr	nm		nm		7		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		3		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2009	PPC-9A	nr	nm		nm		7		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		4		nm		nm		nm		nm	
Prickly Pear Creek	10/1/2003	PPC_2	119.0	200	U	60	U	15	U	29.3		5	U	0.21		10	U	50	U	5		269		4.1		56.2		nm		40	U	35	U	10	U	25	U	50	U	65.3	
Prickly Pear Creek	10/1/2003	PPC_3	108.0	200	U	60	U	11.5		27.6		5	U	0.36		10	U	50	U	4.7		368		4.7		89		nm		40	U	35	U	10	U	25	U	50	U	86.9	
Prickly Pear Creek	10/1/2003	PPC_4	115.0	200	U	60	U	10.1		27.9		5	U	0.29		10	U	50	U	4.4		327		4.9		67.5		nm		40	U	35	U	10	U	25	U	50	U	68.2	
Prickly Pear Creek	10/1/2003	PPC_5	139.0	200	U	60	U	15	U	49.5		5	U	0.11		10	U	50	U	4.3		90		10	U	15.9		nm		40	U	35	U	10	U	25	U	50	U	94.7	
Prickly Pear Creek (Ref)	10/1/2003	PPC_1	58.1	200	U	10.9		15	U	200	U	5	U	1	U	10	U	50	U	4.5		191		10	U	20.3		nm		40	U	35	U	10	U	25	U	50	U	80.9	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-1	80.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-2	89.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.02		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-3	89.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-4	83.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.02		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-5	83.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.02		nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-6	80.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-7	83.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-8	80.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	11/7/2002	Upper Lake	127.0	nm		nm		30		nm		nm		30		nm		nm		90	U	1700		800		200		nm		nm		nm		nm		nm		nm		300	
Upper Lake/Marsh	5/6/2009	Upper Lake	75.5	230		3	U	6.8		100	U	1	U	3		6		0.5	U	11		330		44.4		40		nm		10	U	1	U	0.5	U	0.2	U	10	U	60	
Upper Lake/Marsh	10/29/2009	Upper Lake	103.7	100	U	3	U	6		100	U	1	U	2	J	1	U	10	U	6	J	210		27	J	40		1	U	10	U	1	U	5	U	1	U	10	U	60	
Upper Lake/Marsh	8/3/2010	UL-21	87.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	J	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	UL-22	92.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	UL-23	92.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	UL-24	92.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01		nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	UL-25	107.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-1	94.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01		nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-2	85.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-3	97.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-4	90.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-6	83.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-7	83.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-8	89.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	8/5/2010	ULM-9	89.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	9/30/2003	ULM_1	133.0	132		60	U	15	U	14.6		5	U	0.21		10	U	50	U	4		120		6.9		47.6		nm		40	U	35	U	10	U	25	U	2.7		27.4	
Upper Lake/Marsh	9/30/2003	ULM_10	111.0	200	U	60	U	7.7		34.2		5	U	0.85		10	U	50	U	5.4		283		31.6		90.1		nm		40	U	35	U	10	U	25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_3	107.0	200	U	60	U	15	U	32.2		5	U	0.44		0.67		50	U	4.1		265		16.5		70.8		nm		40	U	35	U	0.86		25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_4	114.0	200	U	60	U	9.1		32		5	U	0.11		10	U	50	U	4		293		10	U	85.2		nm		40	U	35	U	10	U	25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_7	107.0	200	U	60	U	15	U	26.8		5	U	0.18		0.96		50	U	3.8		230		10	U	49.5		nm		40	U	35	U	10	U	25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_11	112.0	200	U	60	U	15	U	35		5	U	1.1		0.69		50	U	8.3		201		28.2		79.2		nm		40	U	35	U	-	R	25	U	50	U	31.9	
Upper Lake/Marsh	9/30/2003	ULM_12	110.0	294		60	U	8.4		45.5		5	U	5.6		0.89		50	U	22.1		603		156		97.9		nm		40	U	35	U	0.94		25	U	50	U	97.9	
Upper Lake/Marsh	9/30/2003	ULM_2	127.0	828		60	U	21.4		63.5		5	U	2.1		2.9		2.7		23.4		4560		57.6		2180		nm		40	U	35	U	10	U	25	U	5.6		253	
Upper Lake/Marsh	9/30/2003	ULM_5	122.0	1620		60	U	14.4		45.9		5	U	2.9		1.9		1.1		27.7		2040		115		241		nm		40	U	35	U	-	R	25	U	3.9		140	
Upper Lake/Marsh	9/30/2003	ULM_6	115.0	168		60	U	10.3		27.2		5	U	0.25		4.1		50	U	7.9		215		19.9		40.7		nm		40	U	35	U	0.81		25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_8	157.0	200	U	60	U	31.5		58.9		5	U	3.1		2.4		50	U	21.5		8370		68.4		1740		nm		40	U	35	U	0.8		25	U	3.2		127	
Upper Lake/Marsh	9/30/2003	ULM_9	111.0	200	U	60	U	15	U	35.4		5	U	1.4		1.1		50	U	13.4		1000		20.6		382		nm		40	U	35	U	10	U	25	U	50	U	59.3	

Table B-4. Surface Water Chemistry Data (Total Metals)

			Total Metals																																						
	Sample	Location	Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Walker Creek (Marsh)	8/11/2010	WPM-1	48.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Marsh)	8/12/2010	WPM-2	50.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Marsh)	8/12/2010	WPM-3	94.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Marsh)	8/12/2010	WPM-4	50.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Marsh)	8/12/2010	WPM-5	48.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Pond)	8/11/2010	WP-1	50.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Pond)	8/11/2010	WP-2	48.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Pond)	8/11/2010	WP-3	48.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Pond)	8/11/2010	WP-4	48.0	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (Pond)	8/11/2010	WP-5	50.5	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Walker Creek (WC-1)	8/12/2010	WC-1	nm	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm	
Wilson Ditch	6/4/2001	WD-1	61.8	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		10		60		nm		nm		nm		nm		nm		nm		30	
Wilson Ditch	6/20/2002	WD-1	50.2	nm		nm		10		nm		nm		3		nm		nm		10		200		60		40		nm		nm		nm		nm		nm		nm		40	
Wilson Ditch	6/4/2001	WD-2	61.4	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		7		60		nm		nm		nm		nm		nm		nm		30	
Wilson Ditch	6/20/2002	WD-2	50.2	nm		nm		7		nm		nm		2		nm		nm		7		300		30		60		nm		nm		nm		nm		nm		nm		100	
Wilson Ditch	8/10/2010	WD-2	61.4	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Wilson Ditch	8/10/2010	WD-25	92.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Wilson Ditch	8/10/2010	WD-26	87.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Wilson Ditch	8/10/2010	WD-3	92.1	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	
Wilson Ditch	8/10/2010	WD-4	94.6	nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		0.01	U	nm		nm		nm		nm		nm		nm	

Notes:
nr = not reported
nm = not measured
U = not detected
J = estimated value
R = rejected

Table B-5. Surface Water Chemistry Data (Total Recoverable Metals)

			Total Recoverable Metals																																								
	Sample	Location	Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as CaCO$_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Lower Lake	5/15/2002	Lower Lake	280.9	nm		nm		100		nm		nm		8		nm		nm		30		200		40		400		nm		nm		nm		nm		nm		nm		50	
Lower Lake	11/4/2004	Lower Lake	161.2	nm		nm		132		nm		nm		3	UJ	nm		nm		14		160	J	22		270		nm		nm		nm		nm		nm		nm		20	
Lower Lake	6/9/2005	Lower Lake	157.8	nm		nm		102		nm		nm		9		nm		nm		23		320		63		160		nm		nm		nm		nm		nm		nm		50	
Lower Lake	5/1/2009	Lower Lake	139.4	50.0	U	146		65		100	U	1	U	2.9	J	2		0.5	U	14		300		9.1		80		nm		10	U	28		0.5	U	35.4		10	U	20	
Lower Lake	7/8/2010	Lower Lake	103.7	nm		58		129		100	U	1	U	2		1	U	0.5	U	9		20	UJ	4.9		150		1E-04	U	10	U	16		0.5	U	11.9		10	U	10	U
Lower Lake	8/3/2010	LL-21	105.3	50	U	51		184		nm		1	U	1.4		1	U	0.5	U	10		120		13.5		350		nm		10	U	12		0.5	U	7.5		100	U	10	U
Lower Lake	8/3/2010	LL-22	107.8	50	U	49		183		nm		1	U	1.5		1	U	0.5	U	10		110		11.8		340		nm		10	U	12		0.5	U	7.6		100	U	10	U
Lower Lake	8/3/2010	LL-23	102.8	50		67		200		nm		1	U	6.3		1	U	0.5	U	60		430		55.8		710		nm		10	U	12		0.5	U	15.1		100	U	30	
Lower Lake	8/3/2010	LL-24	102.8	50	U	50		178		nm		1	U	1.1		1	U	0.5	U	8		90		7.6		330		nm		10	U	12		0.5	U	7.4		100	U	10	U
Lower Lake	8/3/2010	LL-25	105.3	50	U	49		184		nm		1	U	1.2		1	U	0.5	U	8		90		8		350		nm		10	U	12		0.5	U	7.4		100	U	10	U
Prickly Pear Creek	5/15/2002	PPC-101	233.2	nm		nm		30		nm		nm		1	U	nm		nm		10		20	UJ	5	U	50		nm		nm		nm		nm		nm		nm		100	
Prickly Pear Creek	5/15/2002	PPC-102	82.2	nm		nm		5	U	nm		nm		1	U	nm		nm		4		400		5		90		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	5/15/2002	PPC-103	81.7	nm		nm		5	U	nm		nm		1	U	nm		nm		4		400		6		80		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	11/4/2004	PPC-103	103.7	nm		nm		6		nm		nm		1	U	nm		nm		4	U	270	J	5	U	80	J	nm		nm		nm		nm		nm		nm		30	
Prickly Pear Creek	6/9/2005	PPC-103	49.8	nm		nm		5	U	nm		nm		1	U	nm		nm		5		670		9		60		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	5/1/2009	PPC-103	78.0	130.0		3	U	4		100	U	1	U	1.2	J	3		0.5	U	4		270		2.6		50		nm		10	U	1	U	0.5	U	0.2	U	10	U	70	
Prickly Pear Creek	7/8/2010	PPC-103	58.9	nm		3	U	9.3		100	U	1	U	0.6		1	U	0.5	U	8		860	J	22.6		110		1E-04	U	10	U	1	U	0.5	U	0.2	U	10	U	80	
Prickly Pear Creek	5/1/2009	PPC-103A	78.0	210.0		3	U	3.4		100	U	1	U	1.4	J	2		0.5	U	3		320		3.1		50		nm		10	U	1	U	0.5	U	0.2	U	10	U	80	
Prickly Pear Creek	5/15/2002	PPC-3A	81.3	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	400		5	U	60		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	11/4/2004	PPC-3A	106.2	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	240	J	5	U	50	J	nm		nm		nm		nm		nm		nm		40	
Prickly Pear Creek	6/9/2005	PPC-3A	52.3	nm		nm		5	U	nm		nm		1	U	nm		nm		5		650		9		60		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	7/8/2010	PPC-3A	58.9	nm		3	U	5.1		100	U	1	U	0.3		1	U	0.5	U	5		660	J	8.9		80		1E-04	U	10	U	1	U	0.5	U	0.2	U	10	U	60	
Prickly Pear Creek	5/15/2002	PPC-5	78.8	nm		nm		5	U	nm		nm		1	U	nm		nm		4		400		6		80		nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	11/4/2004	PPC-5	103.7	nm		nm		5		nm		nm		1	U	nm		nm		4	U	200	J	5	U	60	J	nm		nm		nm		nm		nm		nm		20	
Prickly Pear Creek	6/9/2005	PPC-5	49.8	nm		nm		5		nm		nm		1	U	nm		nm		5		550		8		50		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	5/1/2009	PPC-5	78.0	120.0		3	U	4.6		100	U	1	U	0.1	UJ	2		0.5	U	4		270		2.6		50		nm		10	U	1	U	0.5	U	0.2	U	10	U	60	
Prickly Pear Creek	7/8/2010	PPC-5	58.9	nm		3	U	5.7		100	U	1	U	0.3		1	U	0.5	U	5		420	J	9.1		70		1E-04	U	10	U	1	U	0.5	U	0.2	U	10	U	50	
Prickly Pear Creek	5/15/2002	PPC-6A	82.2	nm		nm		5	U	nm		nm		1	U	nm		nm		5		500		7		90		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	5/15/2002	PPC-7	81.7	nm		nm		5		nm		nm		1	U	nm		nm		5		500		7		90		nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	11/4/2004	PPC-7	101.2	nm		nm		9		nm		nm		1	U	nm		nm		4	U	250	J	5	U	70	J	nm		nm		nm		nm		nm		nm		50	
Prickly Pear Creek	6/9/2005	PPC-7	52.3	nm		nm		6		nm		nm		1	U	nm		nm		6		580		9		50		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	5/1/2009	PPC-7	78.0	130.0		3	U	5.2		100	U	1	U	0.2	J	2		0.5	U	4		260		2.9		50		nm		10	U	1	U	0.5	U	0.2	U	10	U	60	
Prickly Pear Creek	7/8/2010	PPC-7	66.4	nm		3	U	6.1		100	U	1	U	0.3		1	U	0.5	U	5		450	J	9.6		80		1E-04	U	10	U	1	U	0.5	U	0.2	U	10	U	60	
Prickly Pear Creek	5/15/2002	PPC-8	81.7	nm		nm		5		nm		nm		1	U	nm		nm		7		500		8		100		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	11/4/2004	PPC-8	101.2	nm		nm		9		nm		nm		1	U	nm		nm		4	U	270	J	5	U	70	J	nm		nm		nm		nm		nm		nm		60	
Prickly Pear Creek	6/9/2005	PPC-8	49.8	nm		nm		6		nm		nm		1	U	nm		nm		5		560		9		60		nm		nm		nm		nm		nm		nm		70	
Prickly Pear Creek	5/1/2009	PPC-8	73.0	170.0		3	U	4.3		100	U	1	U	1.2	J	2		0.5	U	4		280		3.5		50		nm		10	U	1	U	0.5	U	0.2	U	10	U	70	
Prickly Pear Creek	7/8/2010	PPC-8	58.9	nm		3	U	6.3		100	U	1	U	0.3		1	U	0.5	U	5		450	J	9.8		70		1E-04	U	10	U	1	U	0.5	U	0.2	U	10	U	60	
Prickly Pear Creek	5/15/2009	PPC-9A	nr	nm		nm		7		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		2		nm		nm		nm		nm	
Prickly Pear Creek	5/15/2009	PPC-9A	nr	nm		nm		6		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		nm		4		nm		nm		nm		nm	
Prickly Pear Creek	8/4/2010	PPC-22 (SG-03A)	92.1	70		3	U	4.7		100	U	1	U	0.2		1	U	0.5	U	3		230		3		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Prickly Pear Creek	8/4/2010	PPC-102 (SG-06)	89.6	50	U	3	U	5.5		100	U	1	U	0.2		1	U	0.5	U	3		260		4.9		90		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Prickly Pear Creek	8/4/2010	PPC-5 (SG-07)	92.1	50	U	3	U	6.6		100	U	1	U	0.2		1	U	0.5	U	3		260		5.3		90		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Prickly Pear Creek	8/4/2010	PPC-23 (SG-08)	87.1	50	U	3	U	6.9		100	U	1	U	0.3		1	U	0.5	U	3		270		6		90		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Prickly Pear Creek	8/4/2010	PPC-7 (SG-09)	83.0	50		3	U	7		100	U	1	U	0.3		1	U	0.5	U	3		290		6.2		90		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Prickly Pear Creek	8/4/2010	PPC-8 (SG-10)	80.5	50		3	U	7.1		100	U	1	U	0.3		1	U	0.5	U	3		280		6.3		90		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Prickly Pear Creek	8/4/2010	SG-11	85.5	60		3	U	6.9		100	U	1	U	0.3		1	U	0.5	U	3		290		6.5		80		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	

Table B-5. Surface Water Chemistry Data (Total Recoverable Metals)

			Total Recoverable Metals																																						
	Sample	Location	Hardness	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Prickly Pear Creek (Piezometer)	8/5/2010	PPC-102 (piezometer)	86.3	50	U	3	U	304		100		1	U	0.1	U	1	U	0.5	U	1		6320		6.1		1370		nm		10	U	1	U	0.5	U	0.2	U	100	U	1820	
Prickly Pear Creek (Piezometer)	8/5/2010	PPC-103 (piezometer)	86.7	50	U	26		2900		100	U	1	U	0.7		1	U	0.5		2		1740		5.7		710		nm		10	U	1		0.5	U	3.9		100	U	1880	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-1	80.5	60		3	U	5.1		100	U	1	U	0.2		1	U	0.5	U	3		230		2.6		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-2	89.6	60		3	U	5.4		100	U	1	U	0.2		1	U	0.5	U	3		260		2.9		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	60	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-3	89.6	60		3	U	5.2		100	U	1	U	0.2		1	U	0.5	U	3		220		2.6		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-4	83.0	60		3	U	5.1		100	U	1	U	0.2		1	U	0.5	U	3		230		2.9		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	60	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-5	83.0	80		3	U	5		100	U	1	U	0.2		1	U	0.5	U	3		250		3.7		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	70	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-6	80.5	80		3	U	4.3		100	U	1	U	0.2		1	U	0.5	U	3		270		2.9		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	60	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-7	83.0	80		3	U	4.4		100	U	1	U	0.2		1	U	0.5	U	3		270		3.6		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	60	
Prickly Pear Creek (Ref)	8/3/2010	REF-PPC-8	80.5	70		3	U	4.4		100	U	1	U	0.2		1	U	0.5	U	3		250		3.2		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	60	
Upper Lake/Marsh	5/6/2009	Upper Lake	75.5	220.0		3	U	7.2		100	U	1	U	3.1		1	U	0.5	U	10		330		44.5		50		nm		10	U	1		0.5	U	0.2	U	10	U	60	
Upper Lake/Marsh	8/3/2010	UL-21	87.1	350		3	U	10.4		100	U	1	U	1.6		1	U	0.5	U	11		490		44.5		80		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Upper Lake/Marsh	8/5/2010	UL-22	92.1	50	U	3	U	6		100	U	1	U	0.1		1	U	0.5	U	3		320		3.5		110		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	UL-23	92.1	50	U	3	U	6.4		100	U	1	U	0.2		1	U	0.5	U	3		330		7.3		150		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	UL-24	92.1	50	U	3	U	9.3		100	U	1	U	1.3		1	U	0.5	U	6		280		35.3		70		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	UL-25	107.1	50		3	U	7.5		100	U	1	U	0.2		1	U	0.5	U	3		380		5.4		140		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	ULM-1	94.6	1960		3		29.3		100	U	1	U	3.2		2		2.4		54		4180		286		1030		nm		10	U	1	U	1.5		0.2	U	100	U	290	
Upper Lake/Marsh	8/5/2010	ULM-2	85.5	60		3	U	4.7		100	U	1	U	0.1		1	U	0.5	U	3		220		3.2		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Upper Lake/Marsh	8/5/2010	ULM-3	97.1	50	U	3	U	5		100	U	1	U	0.1		1	U	0.5	U	3		270		3.5		80		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Upper Lake/Marsh	8/5/2010	ULM-4	90.5	50	U	3	U	5.1		100	U	1	U	0.1		1	U	0.5	U	3		190		2.9		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	50	U	3	U	5.5		100	U	1	U	0.2		1	U	0.5	U	4		210		5.8		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	ULM-6	83.0	50	U	3	U	5.8		100	U	1	U	0.3		1	U	0.5	U	3		420		5.3		200		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Upper Lake/Marsh	8/5/2010	ULM-7	83.0	130		3	U	10.4		100	U	1	U	0.3		1	U	0.5	U	5		410		7.1		210		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Upper Lake/Marsh	8/5/2010	ULM-8	89.6	160		3	U	6.3		100	U	1	U	0.2		1	U	0.5	U	4		450		7.2		90		nm		10	U	1	U	0.5	U	0.2	U	100	U	50	
Upper Lake/Marsh	8/5/2010	ULM-9	89.6	50	U	3	U	4.7		100	U	1	U	0.1		1	U	0.5	U	3		170		2.3		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	40	
Walker Creek (Marsh)	8/11/2010	WPM-1	48.0	390		3	U	1.6		100	U	1	U	0.1	U	1	U	0.5	U	4		1050		0.9		60		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Marsh)	8/12/2010	WPM-2	50.5	220		3	U	1.5		100	U	1	U	0.1	U	1	U	0.5	U	3		720		0.5	U	40		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Marsh)	8/12/2010	WPM-3	94.6	55700		4		106		7100		2	U	2		50		86		298		345000		74		68200		nm		70		7.8		10	U	1	U	300		430	
Walker Creek (Marsh)	8/12/2010	WPM-4	50.5	380		3	U	1.6		100	U	1	U	0.1	U	1	U	0.5	U	3		880		0.5	U	90		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Marsh)	8/12/2010	WPM-5	48.0	330		3	U	1.4		100	U	1	U	0.1	U	1	U	0.5	U	3		650		0.5	U	30		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-1	50.5	230		3	U	1.4		100	U	1	U	0.1	U	1	U	0.5	U	3		580		0.5	U	20		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-2	48.0	490		3	U	1.7		100	U	1	U	0.1	U	1	U	0.5	U	4		1120		0.6		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-3	48.0	280		3	U	1.4		100	U	1	U	0.1	U	1	U	0.5	U	3		640		0.5	U	30		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-4	48.0	510		3	U	1.6		100	U	1	U	0.1	U	1	U	0.5	U	4		970		0.7		40		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (Pond)	8/11/2010	WP-5	50.5	230		3	U	1.5		100	U	1	U	0.1	U	1	U	0.5	U	3		560		0.5	U	20		nm		10	U	1	U	0.5	U	0.2	U	100	U	10	U
Walker Creek (WC-1)	8/12/2010	WC-1	nm	nm		nm		1.2		nm		nm		0.1	U	nm		nm		2		300		0.5	U	nm		nm		nm		1	U	nm		nm		nm		10	U
Wilson Ditch	6/4/2001	WD-1	61.8	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		10		60		nm		nm		nm		nm		nm		nm		20	
Wilson Ditch	6/4/2001	WD-2	61.4	nm		nm		5	U	nm		nm		1	U	nm		nm		4	U	300		7		60		nm		nm		nm		nm		nm		nm		20	
Wilson Ditch	8/10/2010	WD-2	61.4	50	U	3	U	5.3		100	U	1	U	0.2		1	U	0.5	U	3		240		6		60		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Wilson Ditch	8/10/2010	WD-25	92.1	70		3	U	5		100	U	1	U	0.4		1	U	0.5	U	3		270		6.7		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Wilson Ditch	8/10/2010	WD-26	87.1	50		3	U	12		100	U	1	U	1.3		1	U	0.5	U	7		170		8.1		60		nm		10	U	1	U	0.5	U	0.2	U	100	U	20	
Wilson Ditch	8/10/2010	WD-3	92.1	50	U	3	U	5.2		100	U	1	U	0.2		1	U	0.5	U	2		220		4		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	
Wilson Ditch	8/10/2010	WD-4	94.6	50	U	3	U	5.3		100	U	1	U	0.2		1	U	0.5	U	9		220		4.5		50		nm		10	U	1	U	0.5	U	0.2	U	100	U	30	

Notes:
nr = not reported
nm = not measured
U = not detected
J = estimated value
R = rejected

Table B-6. Sediment Porewater Chemistry Data (Conventional Parameters and Dissolved Metals)

			Conventionals					Dissolved Metals																																					
	Sample	Location	Hardness	Ca	K	Mg	Na	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	ug/L	ug/L	ug/L	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q	ug/L	Q
Canyon Ferry (ref)	10/1/03	CFR_1	227	54,600	4,590	22,000	31,900	200	U	60	U	31.5		107		5	U	5	U	0.99		50	U	3.2		83.8		10	U	237		-		40	U	35	U	0.85		25	U	50	U	60	U
Canyon Ferry (ref)	10/1/03	CFR_2	232	55,700	4,920	22,500	30,200	200	U	60	U	13.6		110		5	U	5	U	1.5		50	U	4		100	U	10	U	358		-		40	U	6.9		0.95		25	U	50	U	60	U
Lower Lake	9/30/03	LL_1	193	66,300	22,800	6,660	399,000	145		483		2530		42.9		5	U	3.2		4.6		50	U	7.6		323		17.7		773		-		6.1		7.2		1.5		25	U	4.6		40.9	
Prickly Pear Creek	10/1/2003	PPC_2	118	34,900	2,740	7,480	16,200	200	U	60	U	15	U	200	U	5	U	1		0.75		50	U	4.3		89.4		10	U	547		0.2	U	40	U	35	U	1.2		25	U	2.9		194	
Prickly Pear Creek	10/1/2003	PPC_3	116	33,300	3,320	8,020	18,800	200	U	60	U	8		27.2		5	U	0.27		10	U	50	U	6.4		82.6		10	U	15	U	0.2	U	40	U	8.1		0.7		25	U	2.9		187	
Prickly Pear Creek	10/1/2003	PPC_4	118	34,100	3,260	8,050	18,700	200	U	12.1		10.3		30.3		5	U	0.31		10	U	50	U	6		82.2		10	U	15	U	0.2	U	40	U	10.5		0.99		25	U	3.8		140	
Prickly Pear Creek	10/1/2003	PPC_5	212	61,300	3,000	14,200	16,000	200	U	60	U	15	U	108		5	U	2.2		1.2		3.8		3.9		55.2		10	U	1260		0.2	U	40	U	14.1		1		25	U	5.4		170	
Prickly Pear Creek (piezometer)	8/5/2010	PPC-102	107	33,000	3,000	6,000	33,000	50	U	3	U	144		100	U	1	U	0.1	U	1	U	0.5	U	1	U	430		0.5	U	1210		0.005	U	10	U	1	U	0.5	U	0.2	U	100	U	1360	
Prickly Pear Creek (piezometer)	8/5/2010	PPC-103	115	36,000	6,000	6,000	60,000	50	U	24		2430		100	U	1	U	0.1	U	1	U	0.5	U	1	U	20	U	0.5	U	640		0.0101		10	U	1	U	0.5	U	3.4		100	U	970	
Prickly Pear Creek (Reference)	10/1/2003	PPC_1	51.4	16,000	1,460	2,770	3,950	200	U	60	U	15	U	200	U	5	U	0.38		1		50	U	3.2		47.6		10	U	939		0.2	U	40	U	35	U	-	R	25	U	2.6		95.7	
Upper Lake/Marsh	9/30/2003	ULM_3	182	52,800	3,580	12,200	19,900	200	U	60	U	15	U	142		5	U	5	U	1.6		50	U	3.5		825		10	U	916		0.2	U	3.1		35	U	0.94		25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_4	154	45,600	3,860	9,760	18,900	200	U	60	U	15	U	113		5	U	5	U	2		50	U	25	U	2200		10	U	1990		0.2	U	40	U	35	U	10	U	25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_7	290	85,300	4,580	18,600	20,400	200	U	60	U	15	U	112		5	U	0.35		2.7		1.2		25	U	19900		10	U	2700		0.2	U	40	U	35	U	1.2		25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_10	196	58,100	4,520	12,400	19,400	200	U	60	U	15	U	126		5	U	5	U	3.1		50	U	3.3		2390		7.5		3010		0.2	U	40	U	35	U	1.4		25	U	50	U	30	
Upper Lake/Marsh	9/30/2003	ULM_6	229	68,300	5,780	14,200	20,700	200	U	60	U	15	U	180		5	U	5	U	2.3		50	U	3.8		260		4.7		1840		0.2	U	40	U	35	U	1.1		25	U	50	U	60	U
Upper Lake/Marsh	9/30/2003	ULM_12	222	65,900	5,070	13,900	19,200	200	U	60	U	15	U	183		5	U	5	U	2.7		50	U	3.1		5080		10.5		2460		0.2	U	40	U	35	U	0.78		25	U	50	U	60	U

Notes:

nr = not reported

nm = not measured

U = not detected

J = estimated value

R = rejected

Table B-7. Sediment Chemistry Data (Conventional Parameters and Total Metals)

			Conventionals							Total Metals (mg/kg dry-weight)																			
	Sample	Location	Field pH	TOC	Moisture	Grain Size Fraction (%)				Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe	
CSM Unit	Date	Sample ID	s.u.	%	%	Sand	Silt	Clay	Fine Sand	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Canyon Ferry (Ref)	10/1/2003	CFR_1	nm	nm	nm	nm	nm	nm	nm	13200		23.2	U	12.4		166		1.5		0.97		21.2		8.4		28.1		16100	
Canyon Ferry (Ref)	10/1/2003	CFR_2	nm	nm	nm	nm	nm	nm	nm	17600		24.2	U	15.6		175		1.8		1.2		23.6		9.3		33.6		19500	
Lower Lake	9/30/2003	LL_1	nm	nm	nm	nm	nm	nm	nm	4440		990		1660		173		0.56		1230		10.4		25.6		1920		17500	
Lower Lake	9/30/2003	LL_2	nm	nm	nm	nm	nm	nm	nm	13000		353		2730		245		1.8		1150		22.1		35.1		1900		35200	
Lower Lake	9/30/2003	LL_3	nm	nm	nm	nm	nm	nm	nm	11500		530		3030		205		1.3		2680		21.9		34.6		2600		30300	
Lower Lake	8/3/2010	LL-21	8.81	1.12	31.3	57	14	26	3	5010		111		901	J	229		10	U	228		9		15		932	J	22800	
Lower Lake	8/3/2010	LL-22	8.1	2.67	27.5	73	14	10	3	4620		121		223	J	100	U	10	U	92		6		6		220	J	9000	
Lower Lake	8/3/2010	LL-23	8.0 (lab)	1.96	32.8	59	20	10	11	6180		11		133	J	100	U	10	U	30		8		5		239	J	12100	
Lower Lake	8/3/2010	LL-24	9.49	1.56	17.2	78	8	14	0 U	4480		55		94	J	130		10	U	19		17		8		168	J	17300	
Lower Lake	8/3/2010	LL-25	7.7	2.71	29.2	76	12	12	0 U	4410		14		138	J	100	U	10	U	40		6		4		223	J	11100	
Prickly Pear Creek	10/1/2003	PPC_2	nm	nm	nm	nm	nm	nm	nm	7750		15.5	U	52.1		135		1.1		6		10.3		12.3		93.9		18600	
Prickly Pear Creek	10/1/2003	PPC_3	nm	nm	nm	nm	nm	nm	nm	9500		4.1		122		250		1.3		22.8		15.9		15.5		221		24800	
Prickly Pear Creek	10/1/2003	PPC_4	nm	nm	nm	nm	nm	nm	nm	10100		4.5		250		352		1.4		36.8		21.2		21.2		480		38100	
Prickly Pear Creek	10/1/2003	PPC_5	nm	nm	nm	nm	nm	nm	nm	4880		1.9		32.1		85.3		0.63		4.1		8.2		7		44.1		11800	
Prickly Pear Creek	7/28/2010	PPC-102	7.43	1.56	34.7	65	4	18	13	3630		1.1		44		100	U	10	U	4.7		6		4		41		9390	
Prickly Pear Creek	7/28/2010	PPC-103	7.48	0.31	22.3	92	6	2	0 U	1640		0.5		36		100	U	10	U	0.7		5	U	2		11		4990	
Prickly Pear Creek	7/30/2010	PPC-22	7.06	0.51	nm	80	8	4	8	2690		0.5		12		100	U	10	U	1.1		7		3		20		9090	
Prickly Pear Creek	7/28/2010	PPC-23	7.63	0.59	22	77	12	6	5	4500		1.5	J	24		100	U	10	U	2.1		10		5		42		13900	
Prickly Pear Creek	7/28/2010	PPC-24	7.43	0.42	28.3	84	6	4	6	2890		0.8	J	19		100	U	10	U	1.2		8		4		25		10100	
Prickly Pear Creek	7/28/2010	PPC-5	7.33	0.27	21.5	92	6	2	0 U	1770		0.5	U	23		100	U	10	U	0.7		7		3		13		8740	
Prickly Pear Creek	7/28/2010	PPC-7	7.46	0.73	32.4	82	10	4	4	3810		1	J	26		100	U	10	U	1.8		9		5		40		13400	
Prickly Pear Creek	7/28/2010	PPC-8	7.4	0.28	24.4	92	6	2	0 U	2090		0.5	U	16		100	U	10	U	0.8		5	U	3		17		7210	
Prickly Pear Creek (Ref)	10/1/2003	PPC_1	nm	nm	nm	nm	nm	nm	nm	8590		-	R	11.5		106		0.91		3.5		18		9.9		59.7		20700	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-1	7.1	0.31	23.1	83	10	4	3	3270		0.6	J	20		100	U	10	U	1.1		5	U	4		24		10500	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-2	7.69	0.22	21	90	8	2	0 U	2110		0.5	U	12		100	U	10	U	0.7		5	U	3		14		7320	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-3	7.7	0.55	21.2	84	8	4	4	3890		0.8	J	19		100	U	10	U	1.1		11		4		27		14100	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-4	7.4 (lab)	0.78	28.4	79	14	4	3	3900		0.6	J	20		100	U	10	U	1.3		7		5		29		12100	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-5	7.56	0.42	27.1	85	6	4	5	3700		0.6	J	18		100	U	10	U	0.9		5	U	4		23		10300	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-6	7.21	0.6	27.3	82	10	4	4	3780		0.8	J	18		100	U	10	U	1.2		10		5		22		13100	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-7	7.53	1.29	30.1	73	14	6	7	4030		1	J	21		100	U	10	U	2.4		6		4		38		10200	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-8	7.5	0.63	26.1	85	10	4	1	4250		0.6	J	20		100	U	10	U	1.2		9		5		25		12100	
Upper Lake/Marsh	8/3/2010	UL-21	7.63	3.2	37.5	58	22	18	2	9340		14		251	J	218		10	U	56		9		5		308	J	13300	
Upper Lake/Marsh	8/5/2010	UL-22	7.08	3.31	51	35	34	22	9	5830		17.8		115		100	U	10	U	31.3		10		6		316		10700	
Upper Lake/Marsh	8/5/2010	UL-23	6.96	3.02	42.1	28	40	26	6	6380		40.7		531		103		10	U	105		10		8		720		13900	
Upper Lake/Marsh	8/5/2010	UL-24	7.08	2.34	31.4	71	14	14	1	4560		57.2		353		184		10	U	74.7		8		7		511		12900	
Upper Lake/Marsh	8/5/2010	UL-25	7.28	2.52	44.1	52	24	20	4	5240		4.1	J	57		100	U	10	U	25.5		10		4		105		10300	
Upper Lake/Marsh	8/5/2010	ULM-1	7.69	2.58	25.6	78	12	10	0 U	4430		7.8		75		100	U	10	U	9.6		7		4		189		12200	
Upper Lake/Marsh	8/5/2010	ULM-2	6.97	3.11	45.2	45	30	14	11	6330		1.1	J	37		100	U	10	U	4.4		10		6		74		11100	
Upper Lake/Marsh	8/5/2010	ULM-3	6.96	4.04	53.7	6	60	22	12	8730		4.3	J	98		114		10	U	14.1		12		8		155		15800	
Upper Lake/Marsh	8/5/2010	ULM-4	6.86	3.39	51.9	1 U	66	30	4	9950		2.5	J	108		120		10	U	11.4		14		9		125		19600	
Upper Lake/Marsh	8/5/2010	ULM-5	6.9	5.02	58.5	1	60	30	9	8830		5.4	J	119		101		10	U	26		13		7		217		12900	
Upper Lake/Marsh	8/5/2010	ULM-6	6.78	3.93	54	13	48	24	15	8680		8.5	J	78		105		10	U	39.8		13		8		280		11900	
Upper Lake/Marsh	8/5/2010	ULM-7	7.55	2.09	47	38	36	12	14	6010		1.5	J	38		104		10	U	2.9		8		5		71		11800	
Upper Lake/Marsh	8/5/2010	ULM-8	6.93	4.44	66.2	4	68	18	10	6140		1.9	J	51		100	U	10	U	4.2		8		4		91		11000	
Upper Lake/Marsh	8/5/2010	ULM-9	7.67	1.01	35	73	14	8	5	5560		0.9	J	21		100	U	10	U	1.6		10		5		41		12400	
Upper Lake/Marsh	9/30/2003	ULM_1	nm	nm	nm	nm	nm	nm	nm	15700		19.5		229		150		1.5		112		19.5		12.2		686		23500	
Upper Lake/Marsh	9/30/2003	ULM_10	nm	nm	nm	nm	nm	nm	nm	14200		60		337		179		1.6		238		20.1		18		1310		25600	
Upper Lake/Marsh	9/30/2003	ULM_3	nm	nm	nm	nm	nm	nm	nm	15700		5.6		162		282		2.1		66.9		22.3		19.2		430		29200	
Upper Lake/Marsh	9/30/2003	ULM_4	nm	nm	nm	nm	nm	nm	nm	11900		16.8		116		143		1.2		42.5		15.6		11.5		404		18400	
Upper Lake/Marsh	9/30/2003	ULM_7	nm	nm	nm	nm	nm	nm	nm	9650		1.2		54.6		120		1		15		12.4		8.6		158		16300	
Upper Lake/Marsh	9/30/2003	ULM_11	nm	nm	nm	nm	nm	nm	nm	17500		112		581		201		2		338		27.3		24.1		2290		30200	
Upper Lake/Marsh	9/30/2003	ULM_12	nm	nm	nm	nm	nm	nm	nm	15900		64.9		452		228		2		316		24.7		21.5		1970		29300	
Upper Lake/Marsh	9/30/2003	ULM_2	nm	nm	nm	nm	nm	nm	nm	14500		1.7		121		213		1.9		12.2		20.5		17.5		191		32600	
Upper Lake/Marsh	9/30/2003	ULM_5	nm	nm	nm	nm	nm	nm	nm	9490		10.9		124		111		1		46.6		13.1		9.1		332		16000	
Upper Lake/Marsh	9/30/2003	ULM_6	nm	nm	nm	nm	nm	nm	nm	20000		68.6		326		228		1.9		199		26.7		18.8		1270		34400	
Upper Lake/Marsh	9/30/2003	ULM_8	nm	nm	nm	nm	nm	nm	nm	12200		6.5		297		149		1.3		38.3		15.8		13.6		391		19300	
Upper Lake/Marsh	9/30/2003	ULM_9	nm	nm	nm	nm	nm	nm	nm	15600		0.43		146		214		1.7		17.7		20.9		17.4		180		26200	
Walker Creek (Marsh)	8/11/2010	WPM-1	6.48	0.59	21.9	76	13	9	2	7120		0.5	U	2		100	U	10	U	0.5	U	7		5		40		16700	

Table B-7. Sediment Chemistry Data (Conventional Parameters and Total Metals)

			Conventionals								Total Metals (mg/kg dry-weight)																	
	Sample	Location	Field pH	TOC	Moisture	Grain Size Fraction (%)				Al	Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	s.u.	%	%	Sand	Silt	Clay	Fine Sand	mg/kg	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Canyon Ferry (Ref)	10/1/2003	CFR_1	nm	nm	nm	nm	nm	nm	nm	13200	17.2		198		0.22	U	16.8		13.5	U	3.9	U	9.7	U	24.1		81.4	
Canyon Ferry (Ref)	10/1/2003	CFR_2	nm	nm	nm	nm	nm	nm	nm	17600	23.5		258		0.29	U	18.8		14.1	U	4	U	10.1	U	27.8		102	
Lower Lake	9/30/2003	LL_1	nm	nm	nm	nm	nm	nm	nm	4440	9470		851		53.3		24.7		432		101		1980		20.4		4490	
Lower Lake	9/30/2003	LL_2	nm	nm	nm	nm	nm	nm	nm	13000	9420		1230		38		36.4		221		93.7		700		57.7		6080	
Lower Lake	9/30/2003	LL_3	nm	nm	nm	nm	nm	nm	nm	11500	14400		1370		48.4		34		316		141		884		44.4		6930	
Lower Lake	8/3/2010	LL-21	8.81	1.12	31.3	57	14	26	3	5010	3900	J	726	J	28		13		13.9		38.6		57		22		2280	
Lower Lake	8/3/2010	LL-22	8.1	2.67	27.5	73	14	10	3	4620	846	J	192	J	14		7		24.9		10		87		19		1220	
Lower Lake	8/3/2010	LL-23	8.0 (lab)	1.96	32.8	59	20	10	11	6180	506	J	562	J	3.5		6		2.5		3.7		7		25		1070	
Lower Lake	8/3/2010	LL-24	9.49	1.56	17.2	78	8	14	0 U	4480	600	J	465	J	4.1		8		11.9		5.1		23		56		1620	
Lower Lake	8/3/2010	LL-25	7.7	2.71	29.2	76	12	12	0 U	4410	1070	J	471	J	8		5	U	3.3		4.9		6		19		864	
Prickly Pear Creek	10/1/2003	PPC_2	nm	nm	nm	nm	nm	nm	nm	7750	370		672		0.43		9.9		1.3		2.6	U	6.5	U	34		925	
Prickly Pear Creek	10/1/2003	PPC_3	nm	nm	nm	nm	nm	nm	nm	9500	878		3920		2.5		12.7		2.8		0.85		-	R	44.1		1860	
Prickly Pear Creek	10/1/2003	PPC_4	nm	nm	nm	nm	nm	nm	nm	10100	1090		9030		3.1		16.1		5.3		2.5		-	R	55.2		3930	
Prickly Pear Creek	10/1/2003	PPC_5	nm	nm	nm	nm	nm	nm	nm	4880	203		558		0.27		6.2		1.1		2.4	U	6	U	24.8		444	
Prickly Pear Creek	7/28/2010	PPC-102	7.43	1.56	34.7	65	4	18	13	3630	118		322		0.19		5	U	0.5	U	1.1		1	U	20		420	
Prickly Pear Creek	7/28/2010	PPC-103	7.48	0.31	22.3	92	6	2	0 U	1640	43		168		0.05	U	5	U	0.5	U	0.3		1	U	10	U	125	
Prickly Pear Creek	7/30/2010	PPC-22	7.06	0.51	nm	80	8	4	8	2690	61		329		0.5	U	5	U	0.5	U	0.3		1	U	21		259	
Prickly Pear Creek	7/28/2010	PPC-23	7.63	0.59	22	77	12	6	5	4500	165		389	J	0.33		5		0.5	U	1.1		1	U	32		386	
Prickly Pear Creek	7/28/2010	PPC-24	7.43	0.42	28.3	84	6	4	6	2890	116		419	J	0.28		5	U	0.5	U	0.7		1	U	25		328	
Prickly Pear Creek	7/28/2010	PPC-5	7.33	0.27	21.5	92	6	2	0 U	1770	57		253	J	0.058		5	U	0.5	U	0.5		1	U	24		172	
Prickly Pear Creek	7/28/2010	PPC-7	7.46	0.73	32.4	82	10	4	4	3810	173		452	J	0.28		6		0.5	U	1.1		1	U	30		448	
Prickly Pear Creek	7/28/2010	PPC-8	7.4	0.28	24.4	92	6	2	0 U	2090	92		369	J	0.05	U	5	U	0.5	U	0.4		1	U	17		241	
Prickly Pear Creek (Ref)	10/1/2003	PPC_1	nm	nm	nm	nm	nm	nm	nm	8590	104		720		-	R	10.4		-	R	-	R	-	R	39.7		454	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-1	7.1	0.31	23.1	83	10	4	3	3270	95		522	J	0.051		5	U	0.5	U	0.7		1	U	24		308	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-2	7.69	0.22	21	90	8	2	0 U	2110	45		459	J	0.05	U	5	U	0.5	U	0.3		1	U	16		197	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-3	7.7	0.55	21.2	84	8	4	4	3890	96		611	J	0.05	U	5	U	0.5	U	0.8		1	U	41		276	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-4	7.4 (lab)	0.78	28.4	79	14	4	3	3900	111		490	J	0.055		6		0.5	U	0.9		1	U	30		395	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-5	7.56	0.42	27.1	85	6	4	5	3700	110		524	J	0.05	U	5	U	0.5	U	0.7		1	U	24		308	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-6	7.21	0.6	27.3	82	10	4	4	3780	106		506	J	0.05	U	5		0.5	U	0.7		1	U	32		310	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-7	7.53	1.29	30.1	73	14	6	7	4030	174		414	J	0.12		5	U	0.5	U	1.3		1	U	23		366	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-8	7.5	0.63	26.1	85	10	4	1	4250	113		513	J	0.053		6		0.5	U	0.8		1	U	30		363	
Upper Lake/Marsh	8/3/2010	UL-21	7.63	3.2	37.5	58	22	18	2	9340	2550	J	310	J	230		9		1.3		6.7		5	U	31		817	
Upper Lake/Marsh	8/5/2010	UL-22	7.08	3.31	51	35	34	22	9	5830	1270		299		22	J	9		2.9		13.7		1	U	26		1220	
Upper Lake/Marsh	8/5/2010	UL-23	6.96	3.02	42.1	28	40	26	6	6380	10800		409		79	J	11		21.8		61.4		5		24		3190	
Upper Lake/Marsh	8/5/2010	UL-24	7.08	2.34	31.4	71	14	14	1	4560	3890		295		15	J	9		2.5		30.7		2		22		1410	
Upper Lake/Marsh	8/5/2010	UL-25	7.28	2.52	44.1	52	24	20	4	5240	557		221		130	J	6		0.9		3.6		1	U	27		1010	
Upper Lake/Marsh	8/5/2010	ULM-1	7.69	2.58	25.6	78	12	10	0 U	4430	863		510		28	J	5	U	1.6		12.7		1	U	21		601	
Upper Lake/Marsh	8/5/2010	ULM-2	6.97	3.11	45.2	45	30	14	11	6330	188		420		14	J	7		0.5	U	1.9		1	U	29		670	
Upper Lake/Marsh	8/5/2010	ULM-3	6.96	4.04	53.7	6	60	22	12	8730	573		680		150	J	10		1		5.6		1	U	34		909	
Upper Lake/Marsh	8/5/2010	ULM-4	6.86	3.39	51.9	1 U	66	30	4	9950	492		660		160	J	10		0.8		3.5		1	U	42		656	
Upper Lake/Marsh	8/5/2010	ULM-5	6.9	5.02	58.5	1	60	30	9	8830	991		532		27	J	10		1.5		6.9		1	U	35		1230	
Upper Lake/Marsh	8/5/2010	ULM-6	6.78	3.93	54	13	48	24	15	8680	1420		381		11	J	11		2.5		10.6		1		37		1140	
Upper Lake/Marsh	8/5/2010	ULM-7	7.55	2.09	47	38	36	12	14	6010	253		619		0.74	J	6		0.5	U	1.5		1	U	25		682	
Upper Lake/Marsh	8/5/2010	ULM-8	6.93	4.44	66.2	4	68	18	10	6140	267		519		0.5	U	6		0.5	U	1.9		1	U	23		754	
Upper Lake/Marsh	8/5/2010	ULM-9	7.67	1.01	35	73	14	8	5	5560	151		519		0.5	U	6		0.5	U	0.8		1	U	30		470	
Upper Lake/Marsh	9/30/2003	ULM_1	nm	nm	nm	nm	nm	nm	nm	15700	4270		720		14.2		17.9		14		29.1		1.9		41.9		1810	
Upper Lake/Marsh	9/30/2003	ULM_10	nm	nm	nm	nm	nm	nm	nm	14200	5140		911		28.3		19.6		11.5		64.1		-	R	43.6		4260	
Upper Lake/Marsh	9/30/2003	ULM_3	nm	nm	nm	nm	nm	nm	nm	15700	1470		955		4.7		20.1		4.3		10.2		-	R	50.4		3540	
Upper Lake/Marsh	9/30/2003	ULM_4	nm	nm	nm	nm	nm	nm	nm	11900	1170		576		5.9		12.1		4.5		14		10.5	U	34		2100	
Upper Lake/Marsh	9/30/2003	ULM_7	nm	nm	nm	nm	nm	nm	nm	9650	486		472		1.2		9.3		3.2		2.7		8.5	U	27.1		1360	
Upper Lake/Marsh	9/30/2003	ULM_11	nm	nm	nm	nm	nm	nm	nm	17500	10400		1300		50.6		24.8		19.9		127		-	R	59.4		6550	
Upper Lake/Marsh	9/30/2003	ULM_12	nm	nm	nm	nm	nm	nm	nm	15900	8990		1190		59.1		23		20.4		107		-	R	52.4		6420	
Upper Lake/Marsh	9/30/2003	ULM_2	nm	nm	nm	nm	nm	nm	nm	14500	594		2520		0.59		16.2		2.8		0.65		-	R	56.2		1680	
Upper Lake/Marsh	9/30/2003	ULM_5	nm	nm	nm	nm	nm	nm	nm	9490	1610		484		14.5		10.1		3.8		11.9		8.3	U	34.3		1680	
Upper Lake/Marsh	9/30/2003	ULM_6	nm	nm	nm	nm	nm	nm	nm	20000	5360		747		27.3		22.5		14		59.3		4.8		58.9		4200	
Upper Lake/Marsh	9/30/2003	ULM_8	nm	nm	nm	nm	nm	nm	nm	12200	1850		890		10.1		13.4		5.2		14.2		6.6	U	46.2		2120	
Upper Lake/Marsh	9/30/2003	ULM_9	nm	nm	nm	nm	nm	nm	nm	15600	529		755		2.1		17.9		2.9		2.6	U	6.4	U	57.5		1670	
Walker Creek (Marsh)	8/11/2010	WPM-1	6.48	0.59	21.9	76	13	9	2	7120	3		230	J	0.05	U	5	U	0.5	U	0.1	U	1	U	32		21	

Table B-7. Sediment Chemistry Data (Conventional Parameters and Total Metals)

			Conventionals							Total Metals (mg/kg dry-weight)																			
	Sample	Location	Field pH	TOC	Moisture	Grain Size Fraction (%)				Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe	
CSM Unit	Date	Sample ID	s.u.	%	%	Sand	Silt	Clay	Fine Sand	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Walker Creek (Marsh)	8/12/2010	WPM-2	6.76	1	22.7	71	15	7	7	7840		0.5	U	3		100	U	10	U	0.5	U	9		11		36		15000	
Walker Creek (Marsh)	8/12/2010	WPM-3	7.13	2.26	36.7	47	33	17	3	10800		0.5	U	4		124		10	U	0.5	U	8		7		42		14600	
Walker Creek (Marsh)	8/12/2010	WPM-4	6.47	0.9	26.2	62	23	11	4	6410		0.5	U	2		100	U	10	U	0.5	U	10		5		32		16300	
Walker Creek (Marsh)	8/12/2010	WPM-5	6.56	0.73	22.8	63	21	11	5	8400		0.5	U	2		100	U	10	U	0.5	U	12		6		36		20100	
Walker Creek (Pond)	8/11/2010	WP-1	6.7	1.08	22.2	79	13	7	1	6740		0.5	U	2		102		10	U	0.5	U	7		4		32		11800	
Walker Creek (Pond)	8/11/2010	WP-2	7.01	0.86	19.6	72	15	9	4	8360		0.5	U	3		118		10	U	0.5	U	7		7		43		15800	
Walker Creek (Pond)	8/11/2010	WP-3	6.9	1.24	28.1	64	21	11	4	6800		0.6		3		100	U	10	U	0.5	U	6		5		25		10600	
Walker Creek (Pond)	8/11/2010	WP-4	6.8	0.61	18.3	68	20	10	2	8420		0.5	U	3		105		10	U	0.5	U	9		7		33		19800	
Walker Creek (Pond)	8/11/2010	WP-5	6.89	0.44	18.1	71	15	9	5	8270		0.5	U	2		122		10	U	0.5	U	9		7		35		17000	
Wilson Ditch	8/10/2010	WD-2	7.75	3.03	52	55	22	16	7	4430		5.9	J	79		100	U	10	U	20.8		5	U	5		154		8950	
Wilson Ditch	8/10/2010	WD-25	7.49	3.73	48.7	45	24	24	7	5980		1.2	J	23		100	U	10	U	10.1		5	U	4		41		9270	
Wilson Ditch	8/10/2010	WD-26	7.57	3.25	39.1	41	24	24	11	7070		2.4	J	44		100	U	10	U	27.7		7		6		68		11700	
Wilson Ditch	8/10/2010	WD-3	7.51	3.55	49	37	36	22	5	6650		1.9	J	34		100	U	10	U	19.6		8		5		78		12200	
Wilson Ditch	8/10/2010	WD-4	7.59	5.12	64.1	24	42	24	10	5820		2.9	J	28		100	U	10	U	17.1		6		5		93		10300	

Notes:

nr = not reported

nm = not measured

U = not detected

J = estimated value

R = rejected

Table B-7. Sediment Chemistry Data (Conventional Parameters and Total Metals)

			Conventionals								Total Metals (mg/kg dry-weight)																	
	Sample	Location	Field pH	TOC	Moisture	Grain Size Fraction (%)				Al	Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Date	Sample ID	s.u.	%	%	Sand	Silt	Clay	Fine Sand	mg/kg	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Walker Creek (Marsh)	8/12/2010	WPM-2	6.76	1	22.7	71	15	7	7	7840	4		203		0.05	U	5	U	0.5	U	0.1	U	1	U	35		28	
Walker Creek (Marsh)	8/12/2010	WPM-3	7.13	2.26	36.7	47	33	17	3	10800	5		238		0.05	U	5	U	0.5	U	0.1	U	1	U	36		28	
Walker Creek (Marsh)	8/12/2010	WPM-4	6.47	0.9	26.2	62	23	11	4	6410	5		154		0.05	U	5	U	0.5	U	0.1	U	1	U	45		24	
Walker Creek (Marsh)	8/12/2010	WPM-5	6.56	0.73	22.8	63	21	11	5	8400	5		180		0.05	U	5	U	0.5	U	0.1	U	1	U	54		29	
Walker Creek (Pond)	8/11/2010	WP-1	6.7	1.08	22.2	79	13	7	1	6740	6		183	J	0.05	U	5	U	0.5	U	0.1	U	1	U	32		28	
Walker Creek (Pond)	8/11/2010	WP-2	7.01	0.86	19.6	72	15	9	4	8360	5		343	J	0.05	U	5	U	0.5	U	0.1	U	1	U	36		29	
Walker Creek (Pond)	8/11/2010	WP-3	6.9	1.24	28.1	64	21	11	4	6800	6		129	J	0.05	U	5	U	0.5	U	0.1	U	1	U	27		31	
Walker Creek (Pond)	8/11/2010	WP-4	6.8	0.61	18.3	68	20	10	2	8420	6		301	J	0.05	U	5	U	0.5	U	0.1	U	1	U	45		33	
Walker Creek (Pond)	8/11/2010	WP-5	6.89	0.44	18.1	71	15	9	5	8270	5		303	J	0.05	U	5	U	0.5	U	0.1	U	1	U	43		29	
Wilson Ditch	8/10/2010	WD-2	7.75	3.03	52	55	22	16	7	4430	1610		1010		20		5	U	1.6		11.1		2		18		678	
Wilson Ditch	8/10/2010	WD-25	7.49	3.73	48.7	45	24	24	7	5980	320		790		1.4		5	U	0.5	U	2.2		1	U	17		421	
Wilson Ditch	8/10/2010	WD-26	7.57	3.25	39.1	41	24	24	11	7070	536		839		120		5		0.7		3.6		1		25		583	
Wilson Ditch	8/10/2010	WD-3	7.51	3.55	49	37	36	22	5	6650	625		919		4.7		6		0.6		4.7		1	U	27		586	
Wilson Ditch	8/10/2010	WD-4	7.59	5.12	64.1	24	42	24	10	5820	680		1120		5		5	U	1		6.8		1	U	17		720	

Notes:

nr = not reported

nm = not measured

U = not detected

J = estimated value

R = rejected

Table B-8. Acid-Volatile Sulfide (AVS) and Simultaneously-Extracted Metal (SEM) Concentrations in Sediments

			Conventionals			SEM Metals (umol/g dry-weight)									
	Sample	Location	TOC	Acid Volatile Sulfide		Cd		Cu		Pb		Ni		Zn	
CSM Unit	**Date**	**Sample ID**	**%**	**umol/g dry-weight**	**Q ^{b}**	**umol/g**	**Q**	**umol/g**	**Q**	**umol/g**	**Q**	**umol/g**	**Q**	**umol/g**	**Q**
Lower Lake	8/3/2010	LL-25	2.71	25.8		0.525		0.08	U	7.44		0.09	U	16.1	
Lower Lake	8/3/2010	LL-22	2.67	19.3		0.874		0.08	U	3.06		0.09	U	11.8	
Lower Lake	8/3/2010	LL-21	1.12	14.2		0.576		0.08	U	5.79		0.12		12.5	
Lower Lake	8/3/2010	LL-24	1.56	17.5		0.081		0.08	U	1.08		0.09	U	5.09	
Lower Lake	8/3/2010	LL-23	1.96	29.6		0.486		0.08	U	1.2		0.09	U	12.3	
Prickly Pear Creek	7/28/2010	PPC-24	0.42	0.4	U	0.009		0.33		0.64		0.09	U	9.45	J
Prickly Pear Creek	7/28/2010	PPC-7	0.73	0.4	U	0.025		0.38		0.76		0.09	U	5.65	J
Prickly Pear Creek	7/28/2010	PPC-5	0.27	0.4	U	0.013		0.24		0.41		0.09	U	3.09	J
Prickly Pear Creek	7/28/2010	PPC-103	0.31	1.8	J	0.013		0.16		0.29		0.09	U	2.98	J
Prickly Pear Creek	7/28/2010	PPC-102	1.56	9.57	J	0.021		0.15		0.48		0.09	U	4.36	J
Prickly Pear Creek	7/29/2010	PPC-22	0.51	3.98	J	0.017		0.31		0.73		0.09	U	6.07	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-4	0.78	0.4	U	0.009		0.2		0.44		0.09	U	4.2	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-6	0.6	0.4	U	0.009		0.2		0.4		0.09	U	3.68	
Prickly Pear Creek (Ref)	7/27/2010	Ref-PPC-8	0.63	0.921	J	0.017		0.37		0.79		0.09	U	6.85	
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-2	0.22	0.4	U	0.009	U	0.1		0.23		0.09	U	2.48	J
Prickly Pear Creek (Ref)	7/28/2010	Ref-PPC-1	0.31	0.4	U	0.016		0.39		0.64		0.09	U	5.48	J
Upper Lake/Marsh	8/3/2010	UL-21	3.2	5.3		0.316		1.02		11		0.09		16.9	
Upper Lake/Marsh	8/5/2010	UL-24	2.34	2.42	J	1.42		4.98	J	31.4		0.13		36.9	
Upper Lake/Marsh	8/5/2010	UL-23	3.02	1.13	J	1.92		7.15	J	121		0.13		59.8	
Upper Lake/Marsh	8/5/2010	UL-22	3.31	92.4		0.645		0.08	U	4.51		0.15		35.7	
Upper Lake/Marsh	8/5/2010	UL-25	2.52	116		0.294		0.08	U	3.47		0.12		33	
Upper Lake/Marsh	8/5/2010	ULM-2	3.11	6.9		0.046		0.5		1.08		0.09	U	13.7	
Upper Lake/Marsh	8/5/2010	ULM-3	4.04	56.5		0.249		0.08	U	2.61		0.1		31.5	
Upper Lake/Marsh	8/5/2010	ULM-4	3.39	83.5		0.564		0.08	U	5.03		0.14		33.9	
Upper Lake/Marsh	8/5/2010	ULM-5	5.02	94.4		0.668		0.08	U	7.56		0.2		61.9	
Upper Lake/Marsh	8/5/2010	ULM-1	2.58	0.667	J	0.134		2.61		5.49		0.09	U	11.6	
Walker Creek (Marsh)	8/11/2010	WPM-1	0.59	2.48		0.009	U	0.25		0.02	U	0.09	U	0.11	
Walker Creek (Marsh)	8/12/2010	WPM-2	1.0	0.507		0.009	U	0.22		0.02	U	0.09	U	0.08	
Walker Creek (Marsh)	8/12/2010	WPM-3	2.26	0.812		0.009	U	0.41		0.03		0.09	U	0.18	
Walker Creek (Marsh)	8/12/2010	WPM-4	0.9	0.4	U	0.009	U	0.19		0.02	U	0.09	U	0.13	
Walker Creek (Marsh)	8/12/2010	WPM-5	0.73	0.4	U	0.009	U	0.29		0.02	U	0.09	U	0.09	
Walker Creek (Pond)	8/11/2010	WP-3	1.24	0.598		0.009	U	0.1		0.02	U	0.09	U	0.13	
Walker Creek (Pond)	8/11/2010	WP-4	0.61	1.44		0.009	U	0.08	U	0.02	U	0.09	U	0.12	
Walker Creek (Pond)	8/11/2010	WP-5	0.44	0.856		0.009	U	0.13		0.02	U	0.09	U	0.11	
Walker Creek (Pond)	8/11/2010	WP-1	1.08	1.95		0.009	U	0.14		0.03		0.09	U	0.16	
Walker Creek (Pond)	8/11/2010	WP-2	0.86	2.65		0.009	U	0.27		0.02	U	0.09	U	0.08	
Wilson Ditch	8/10/2010	WD-2	3.03	0.4	U	0.408		4.72		23.6		0.1		19.2	

Notes:

J - estimated

U - not detected

Table B-9. Soil Chemistry Data (Conventional Parameters and Total Metals)

				Conventionals							Total Metals (mg/kg dry-weight)																																						
				Field pH	TOC	Moisture	Grain Size Fraction (%)				Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Station ID	Sample Depth (in)	Sample Date	s.u.	%	%	Sand	Silt	Clay	F. Sand	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Lower Lake	LL-BK-1	0-6	8/6/2010	8.3	2.75	21.4	36	24	36	4	9580		5		45		118		10	U	31.5		12		5		193		14100		497		331		2		11		2.9		11		1.2		38		287	
Lower Lake	LL-BK-2	0-6	8/6/2010	7.77	3.71	5	64	20	16	U	7450		115		1190		351		10	U	350		13		21		2410		27500		8130		1040		28		36		23		90		29		27		5270	
Lower Lake	LL-BK-3	0-6	8/6/2010	8.09	0.54	6.1	72	2	12	14	6490		7.9		45		100	U	10	U	29.7		14		5		184		17000		448		278		1.7		8		3.2		6		1.8		47		311	
Lower Lake	LL-BK-4	0-6	8/6/2010	8.14	0.21	6.6	36	32	24	8	12400		0.8		16		156		10	U	2.9		17		5		35		17000		57		304		0.29	J	11		0.5	U	2	U	0.5		48		71	
Tito Park	UOS-SS01	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		6075		nm		nm		6000		nm		nm		14575		nm		19350		nm		nm		nm		nm		nm		nm		nm		23625	
Tito Park	UOS-SS01	0-4	4/17/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		8091		nm		nm		1607		nm		nm		23599		nm		5186		nm		nm		nm		nm		nm		nm		nm		2768	
Tito Park	UOS-SS02	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3475		nm		nm		1813		nm		nm		3225		nm		24975		nm		nm		nm		nm		nm		nm		nm		10050	
Tito Park	UOS-SS02	0-4	4/17/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		39		nm		nm		10646		nm		nm		88		nm		28537		nm		nm		nm		nm		nm		nm		nm		19494	
Tito Park	UOS-SS03	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1078		nm		nm		413		nm		nm		1090		nm		10875		nm		nm		nm		nm		nm		nm		nm		3075	
Tito Park	UOS-SS03	0-4	4/27/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1636		nm		nm		9319		nm		nm		6354		nm		71196		nm		nm		nm		nm		nm		nm		nm		34579	
Tito Park	UOS-SS04	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		5650		nm		nm		14725		nm		nm		12175		nm		23625		nm		nm		nm		nm		nm		nm		nm		44050	
Tito Park	UOS-SS04	0-4	4/26/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		735		nm		nm		39		nm		nm		639		nm		443		nm		nm		nm		nm		nm		nm		nm		367	
Tito Park	UOS-SS05	0-4	4/17/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1868		nm		nm		40		nm		nm		3515		nm		376		nm		nm		nm		nm		nm		nm		nm		137	
Tito Park	UOS-SS06	0-4	4/26/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		437		nm		nm		412		nm		nm		690		nm		2628		nm		nm		nm		nm		nm		nm		nm		1264	
Tito Park	UOS-SS07	0-4	4/17/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3037		nm		nm		654		nm		nm		4089		nm		20323		nm		nm		nm		nm		nm		nm		nm		5105	
Tito Park	UOS-SS08	0-4	4/17/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3318		nm		nm		791		nm		nm		4818		nm		20210		nm		nm		nm		nm		nm		nm		nm		8599	
Tito Park	UOS-SS09	0-4	4/26/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		115		nm		nm		108		nm		nm		87		nm		596		nm		nm		nm		nm		nm		nm		nm		5066	
Tito Park	UOS-SS10	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2632		nm		nm		844		nm		nm		5111		nm		19221		nm		nm		nm		nm		nm		nm		nm		9197	
Tito Park	UOS-SS10	0-6	8/4/2010	8.43	0.46 J	10	39	32	20	9	10200		1.7		19		105		10	U	5.4	J	13		5		38	J	13900		104	J	200		0.4	J	8		1.4		2	U	0.8		42		68	J
Tito Park	UOS-SS11	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.006		nm		nm		555		nm		nm		0.041		nm		21913		nm		nm		nm		nm		nm		nm		nm		7648	
Tito Park	UOS-SS12	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3938		nm		nm		714		nm		nm		8067		nm		29987		nm		nm		nm		nm		nm		nm		nm		12553	
Tito Park	UOS-SS13	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1269		nm		nm		1046		nm		nm		3252		nm		21982		nm		nm		nm		nm		nm		nm		nm		7967	
Tito Park	UOS-SS14	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		533		nm		nm		675		nm		nm		866		nm		15954		nm		nm		nm		nm		nm		nm		nm		7973	
Tito Park	UOS-SS14	0-6	8/4/2010	8.26	0.52 J	10.8	25	40	28	7	13400		0.4		13		178		10	U	1.7	J	17		5		24	J	16400		38	J	240		0.15	J	12		0.5	U	2	U	0.1	U	45		51	J
Tito Park	UOS-SS15	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		961		nm		nm		354		nm		nm		1673		nm		10625		nm		nm		nm		nm		nm		nm		nm		7135	
Tito Park	UOS-SS16	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		972		nm		nm		204		nm		nm		1939		nm		4556		nm		nm		nm		nm		nm		nm		nm		3166	
Tito Park	UOS-SS17	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.058		nm		nm		276		nm		nm		0.007		nm		10990		nm		nm		nm		nm		nm		nm		nm		4852	
Tito Park	UOS-SS18	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		869		nm		nm		582		nm		nm		2235		nm		9676		nm		nm		nm		nm		nm		nm		nm		6578	
Tito Park	UOS-SS19	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		136		nm		nm		120		nm		nm		52		nm		16256		nm		nm		nm		nm		nm		nm		nm		6075	
Tito Park	UOS-SS20	0-4	10/3/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		391		nm		nm		72		nm		nm		641		nm		1202		nm		nm		nm		nm		nm		nm		nm		1240	
Tito Park	UOS-SS21	0-6	8/4/2010	8.42	0.4 J	12.6	27	36	28	9	11800		5.5		103		148		10	U	12	J	16		5		225	J	14200		329	J	338		1.2		11		1.4		4		0.9		41		144	J
Tito Park	UOS-SS22	0-6	8/4/2010	8	0.53 J	9.4	32	34	26	8	12100		44.6	J	214	J	146		10	U	110	J	18		9		616	J	18900		3610		493		10		19		9		39		50	U	39		1160	
Tito Park	UOS-SS22	0-6	8/11/2010	8.05	0.5	9.6	31	34	26	9	11800		67	J	307		163	J	10	U	124		18		9		790		20100		4320		436		8.7		24		13	J	42		8		41		1250	
Tito Park	UOS-SS24	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2115		nm		nm		613		nm		nm		4275		nm		16575		nm		nm		nm		nm		nm		nm		nm		7325	
Tito Park	UOS-SS8	0-6	8/4/2010	8.5	0.23 J	16.3	37	32	22	9	11500		0.9		10		117		10	U	5.9	J	13		5		19	J	14100		41	J	207		0.19	J	9		0.9		2	U	0.8		41		85	J
Upper Lake Marsh/PPC Diversion	ULM-7-SL	0-6	8/5/2010	7.4 (lab)	2.83	28.8	63	20	10	7	6290		3.5		53		100	U	10	U	7.9		12		5		101		15000		336		861		0.5	U	7		0.6		2		1	U	40		567	
Upper Lake/Marsh	UL-BK-1	0-6	8/6/2010	8.32	1.7	5.8	30	32	30	8	11800		5.6		80		143		10	U	37.6		17		6		70		17000		1020		292		8.6		10		1.6		3		1.8		48		266	
Upper Lake/Marsh	UL-BK-2	0-6	8/6/2010	7.74	0.91	5.4	34	26	34	6	11300		61		393		138		10	U	380		13		13		882		20300		8690		498		39		15		54		61		7		31		2620	
Upper Lake/Marsh	UL-BK-3	0-6	8/6/2010	8.26	3.75	2	66	20	8	6	1410		53		272		100	U	10	U	121		5	U	2		389		2750		2840		159		58		5	U	45		26		5		5		664	
Upper Lake/Marsh	UL-BK-4	0-6	8/6/2010	8.75	0.3	7.7	33	28	32	7	13100		1		17		129		10	U	3.3		15		5		42		16100		96		279		0.35		10		0.6		2	U	0.5		41		75	
Prickly Pear Creek	PPC-RZ-1	0-6	7/28/2010	7.52	1.96	24.6	61	28	10	1	6610		5.6		71.8		113		10	U	9.8		13		9		227		18700		665		1000		0.89		10		1.2		8		0.6		44		1100	
Prickly Pear Creek	PPC-RZ-2	0-6	7/28/2010	7.35	0.68	18	88	8	4	U	2800		13.2		69.5		100	U	10	U	17.7		16		4		244		17300		804		441	J	1.2		6		0.9		10		0.8		46		646	
Prickly Pear Creek	PPC-RZ-3	0-6	7/30/2010	6.87	3.04	32.4	48	28	10	14	7020		1.8		42		100	U	10	U	7.2		13		6		85		17700		298		570		1.4		7		0.6		2		0.5		41		705	
Prickly Pear Creek	PPC-RZ-4	0-6	7/30/2010	6.76	4.6	32.8	22	44	14	20	7890		8		78		126		10	U	13.9		11		9		356		20100		628		1010		0.85		8		1.2		8		0.7		36		1210	
Prickly Pear Creek	PPC-RZ-5	0-6	7/30/2010	6.79	1.37	3.3	67	20	8	5	7350		56	J	232		912		10	U	57.7		21		16		1030	J	43800		3590		1350		11		12		33		54		2.6		31		3010	
Railcar staging area	RCSA-01A	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1173		nm		nm		118		nm		nm		2757		nm		8064		nm		nm		nm		nm		nm		nm		nm		3404	
Railcar staging area	RCSA-01B	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1727		nm		nm		547		nm		nm		7162		nm		30611		nm		nm		nm		nm		nm		nm		nm		18686	
Railcar staging area	RCSA-01C	0-4	4/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1593		nm		nm		600		nm		nm		4384		nm		16890		nm		nm		nm		nm		nm		nm		nm		21098	
Railcar staging area	RCSA-01D	0-4	4/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		656		nm		nm		1065		nm		nm		2126		nm		30659		nm		nm		nm		nm		nm		nm		nm		11986	
Railcar staging area	RCSA-01E	0-4	4/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		926		nm		nm		354		nm		nm		2767		nm		30206		nm		nm		nm		nm		nm		nm		nm		15772	
Railcar staging area	RCSA-02A	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		902		nm		nm		528		nm		nm		1832		nm		14681		nm		nm		nm		nm		nm		nm		nm		8704	
Railcar staging area	RCSA-02B	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		604		nm		nm		700		nm		nm		4382		nm		19234		nm		nm		nm		nm		nm		nm		nm		13173	
Railcar staging area	RCSA-02C	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		533		nm		nm		381		nm		nm		2785		nm		15507		nm		nm		nm		nm		nm		nm		nm		13353	
Railcar staging area	RCSA-02D	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		191		nm		nm		173		nm		nm		35750		nm		8989		nm		nm		nm		nm		nm		nm		nm		7970	
Railcar staging area	RCSA-02E	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1634		nm		nm		151		nm		nm		4305		nm		8264		nm		nm		nm		nm		nm		nm		nm		11321	
Railcar staging area	RCSA-02F	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3255		nm		nm		40		nm		nm		10724		nm		1913		nm		nm		nm		nm		nm		nm		nm		3611	
Railcar staging area	RCSA-03	0-4	4/26/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		956		nm		nm		2875		nm		nm		4770		nm		60365		nm		nm		nm		nm		nm		nm		nm		39068	
Railcar staging area	RCSA-04	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2464		nm		nm		665		nm		nm		3196		nm		32348		nm		nm		nm		nm		nm		nm		nm		21874	
Railcar staging area	RCSA-05A	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3511		nm		nm		488		nm		nm		6447		nm		61147		nm		nm		nm		nm		nm		nm		nm		41638	
Railcar staging area	RCSA-05B	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3407		nm		nm		672		nm		nm		9688		nm		54667		nm		nm		nm		nm		nm		nm		nm		34496	
Railcar staging area	RCSA-05C	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2358		nm		nm		1185		nm		nm		6009		nm		62282		nm		nm		nm		nm		nm		nm		nm		52549	
Railcar staging area	RCSA-05D	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2067		nm		nm		1048		nm		nm		6317		nm		61424		nm		nm		nm		nm		nm		nm		nm		33013	

Table B-9. Soil Chemistry Data (Conventional Parameters and Total Metals)

				Conventionals							Total Metals (mg/kg dry-weight)																																							
		Sample	Sample	Field pH	TOC	Moisture	Grain Size Fraction (%)				Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Station ID	Depth (in)	Date	s.u.	%	%	Sand	Silt	Clay	F. Sand	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Railcar staging area	RCSA-05E	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2880		nm		nm		767		nm		nm		12208		nm		39682		nm		nm		nm		nm		nm		nm		nm		26441	
Railcar staging area	RCSA-05F	0-4	4/23/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2593		nm		nm		751		nm		nm		5903		nm		32478		nm		nm		nm		nm		nm		nm		nm		19404	
Railcar staging area	RCSA-06	0-4	4/24/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3889		nm		nm		527		nm		nm		7271		nm		46977		nm		nm		nm		nm		nm		nm		nm		71979	
Railcar staging area	RCSA-07	0-4	4/25/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3234		nm		nm		683		nm		nm		10354		nm		47871		nm		nm		nm		nm		nm		nm		nm		34445	
Railcar staging area	RCSA-08A	0-4	4/25/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1411		nm		nm		809		nm		nm		2755		nm		58640		nm		nm		nm		nm		nm		nm		nm		37734	
Railcar staging area	RCSA-08B	0-4	4/25/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1049		nm		nm		649		nm		nm		3158		nm		55755		nm		nm		nm		nm		nm		nm		nm		39989	
Railcar staging area	RCSA-08C	0-4	4/25/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		763		nm		nm		195		nm		nm		2114		nm		22576		nm		nm		nm		nm		nm		nm		nm		14419	
Railcar staging area	RCSA-08D	0-4	4/25/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		5516		nm		nm		264		nm		nm		7755		nm		18475		nm		nm		nm		nm		nm		nm		nm		11613	
Railcar staging area	RCSA-08E	0-4	4/25/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		6171		nm		nm		238		nm		nm		13210		nm		13901		nm		nm		nm		nm		nm		nm		nm		8891	
Lower Ore Storage Area	LOS-SS01	0-4	4/5/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		82		nm		nm		5	U	nm		nm		137		nm		396		nm		nm		nm		nm		nm		nm		nm		833	
Lower Ore Storage Area	LOS-SS02	0-4	4/5/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		151		nm		nm		19		nm		nm		795		nm		749		nm		nm		nm		nm		nm		nm		nm		266	
Lower Ore Storage Area	LOS-SS03	0-4	3/13/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		nm		nm		nm		30		nm		nm		146		nm		781		nm		nm		nm		nm		nm		nm		nm		463	
Lower Ore Storage Area	LOS-SS05	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1495		nm		nm		1093		nm		nm		8850		nm		21875		nm		nm		nm		nm		nm		nm		nm		46625	
Lower Ore Storage Area	LOS-SS05	0-4	4/5/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3192		nm		nm		329		nm		nm		2507		nm		2528		nm		nm		nm		nm		nm		nm		nm		846	
Lower Ore Storage Area	LOS-SS06	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3300		nm		nm		253		nm		nm		4200		nm		19400		nm		nm		nm		nm		nm		nm		nm		3975	
Lower Ore Storage Area	LOS-SS06	0-4	4/6/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.027		nm		nm		23		nm		nm		0.066		nm		573		nm		nm		nm		nm		nm		nm		nm		480	
Lower Ore Storage Area	LOS-SS07	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3400		nm		nm		373		nm		nm		8500		nm		22350		nm		nm		nm		nm		nm		nm		nm		43725	
Lower Ore Storage Area	LOS-SS07	0-4	4/5/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		89		nm		nm		410		nm		nm		78		nm		10472		nm		nm		nm		nm		nm		nm		nm		14347	
Lower Ore Storage Area	LOS-SS08	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3800		nm		nm		1013		nm		nm		18600		nm		21400		nm		nm		nm		nm		nm		nm		nm		14250	
Lower Ore Storage Area	LOS-SS08	0-4	3/13/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		396		nm		nm		5	U	nm		nm		1015		nm		249		nm		nm		nm		nm		nm		nm		nm		244	
Lower Ore Storage Area	LOS-SS09	0-4	3/15/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2310		nm		nm		170		nm		nm		3617		nm		3413		nm		nm		nm		nm		nm		nm		nm		3374	
Lower Ore Storage Area	LOS-SS10	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3900		nm		nm		1613		nm		nm		8350		nm		23900		nm		nm		nm		nm		nm		nm		nm		30425	
Lower Ore Storage Area	LOS-SS10	0-4	4/6/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1476		nm		nm		351		nm		nm		2081		nm		2129		nm		nm		nm		nm		nm		nm		nm		1735	
Lower Ore Storage Area	LOS-SS11	0-4	3/15/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		59		nm		nm		374		nm		nm		201		nm		28250		nm		nm		nm		nm		nm		nm		nm		11690	
Lower Ore Storage Area	LOS-SS12	0-4	4/6/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1007		nm		nm		628		nm		nm		1522		nm		13249		nm		nm		nm		nm		nm		nm		nm		17232	
Lower Ore Storage Area	LOS-SS13	0-4	3/13/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		367		nm		nm		24		nm		nm		532		nm		669		nm		nm		nm		nm		nm		nm		nm		457	
Lower Ore Storage Area	LOS-SS14	0-4	3/15/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		311		nm		nm		277		nm		nm		1247		nm		7975		nm		nm		nm		nm		nm		nm		nm		4387	
Lower Ore Storage Area	LOS-SS15	0-4	3/13/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		340		nm		nm		201		nm		nm		1134		nm		2475		nm		nm		nm		nm		nm		nm		nm		3536	
Lower Ore Storage Area	LOS-SS15	0-6	8/6/2010	7.89	1.14	4.3	65	16	14	5	7750		29.3		730		175		10	U	34.5	J	11		8		573	J	23800		2700		683		0.65		7		2.1		15	J	1.8		37		3270	
Lower Ore Storage Area	LOS-SS16	0-4	3/15/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1816		nm		nm		109		nm		nm		3299		nm		2675		nm		nm		nm		nm		nm		nm		nm		7529	
Lower Ore Storage Area	LOS-SS16A	0-2	5/14/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		276		nm		nm		208		nm		nm		797		nm		3331		nm		nm		nm		nm		nm		nm		nm		2668	
Lower Ore Storage Area	LOS-SS16A	2-4	5/14/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		77		nm		nm		5	U	nm		nm		268		nm		114		nm		nm		nm		nm		nm		nm		nm		96	
Lower Ore Storage Area	LOS-SS16B	0-2	7/19/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		261		nm		nm		216		nm		nm		812		nm		3361		nm		nm		nm		nm		nm		nm		nm		3002	
Lower Ore Storage Area	LOS-SS16B	2-4	7/19/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		79		nm		nm		5	U	nm		nm		136		nm		47		nm		nm		nm		nm		nm		nm		nm		88	
Lower Ore Storage Area	LOS-SS19	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		21625		nm		nm		2373		nm		nm		19850		nm		20250		nm		nm		nm		nm		nm		nm		nm		23300	
Lower Ore Storage Area	LOS-SS22	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3100		nm		nm		2213		nm		nm		11300		nm		21950		nm		nm		nm		nm		nm		nm		nm		23625	
Lower Ore Storage Area	LOS-SS3	0-6	8/4/2010	8.11	0.53 J	8.4	42	28	20	10	12400		17.4		261		161		10	U	114	J	16		7		270	J	18300		2780		498		17		10		9		12		5		54		731	
Lower Ore Storage Area	LOS-SS8	0-6	8/4/2010	8.32	0.46 J	5.1	37	34	22	7	12000		6.4		56		146		10	U	59.7	J	14		6		108	J	16800		825		467		0.62	J	11		1.2		4		1.6		45		613	
Lower Ore Storage Area	LOS-SS9	0-6	8/6/2010	8.18	5.04	4.5	43	30	18	9	10000		173		869		128		10	U	191	J	12		10		1220	J	15600		5240		476		11		84		12		133		5		34		1170	
Unpaved Facility Soils	UPS-SS01	0-4	3/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		33		nm		nm		3069		nm		nm		94		nm		8813		nm		nm		nm		nm		nm		nm		nm		4628	
Unpaved Facility Soils	UPS-SS02	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2297		nm		nm		433		nm		nm		6011		nm		573		nm		nm		nm		nm		nm		nm		nm		481	
Unpaved Facility Soils	UPS-SS03	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		518		nm		nm		64		nm		nm		1100		nm		578		nm		nm		nm		nm		nm		nm		nm		181	
Unpaved Facility Soils	UPS-SS04	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		986		nm		nm		603		nm		nm		3643		nm		39046		nm		nm		nm		nm		nm		nm		nm		11096	
Unpaved Facility Soils	UPS-SS05	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		203		nm		nm		320		nm		nm		787		nm		8187		nm		nm		nm		nm		nm		nm		nm		2637	
Unpaved Facility Soils	UPS-SS07	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.11		nm		nm		945		nm		nm		0.1	U	nm		10425		nm		nm		nm		nm		nm		nm		nm		6421	
Unpaved Facility Soils	UPS-SS08	0-4	3/15/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		483		nm		nm		80		nm		nm		1296		nm		2624		nm		nm		nm		nm		nm		nm		nm		1347	
Unpaved Facility Soils	UPS-SS09	0-4	3/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		334		nm		nm		31		nm		nm		1100		nm		917		nm		nm		nm		nm		nm		nm		nm		1611	
Unpaved Facility Soils	UPS-SS10	0-4	3/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1191		nm		nm		105		nm		nm		4101		nm		2439		nm		nm		nm		nm		nm		nm		nm		5345	
Unpaved Facility Soils	UPS-SS11	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1748		nm		nm		116		nm		nm		8221		nm		3255		nm		nm		nm		nm		nm		nm		nm		3560	
Unpaved Facility Soils	UPS-SS11	0-6	8/6/2010	7.8	4.5	5.2	62	20	12	6	11400		77.4		313		797		10	U	57.4	J	26		9		595	J	39900		4300		1710		5.2		15		4.9		22		1.6		45		17100	
Unpaved Facility Soils	UPS-SS12	0-4	3/16/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		5955		nm		nm		192		nm		nm		4039		nm		14172		nm		nm		nm		nm		nm		nm		nm		12858	
Unpaved Facility Soils	UPS-SS12	0-6	8/5/2010	7.79	4.07	4.6	65	20	10	5	7890		163		1020		608		10	U	204	J	22		43		3500	J	52900		14800		3910		14		39		20		133		6		29		27900	
Unpaved Facility Soils	UPS-SS13	0-4	3/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		21		nm		nm		843		nm		nm		40		nm		14989		nm		nm		nm		nm		nm		nm		nm		8045	
Unpaved Facility Soils	UPS-SS14	0-4	3/20/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		18		nm		nm		1160		nm		nm		23		nm		21303		nm		nm		nm		nm		nm		nm		nm		41988	
Unpaved Facility Soils	UPS-SS21	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		17075		nm		nm		1693		nm		nm		35350		nm		22575		nm		nm		nm		nm		nm		nm		nm		14875	
Unpaved Facility Soils	UPS-SS28	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		8625		nm		nm		2525		nm		nm		23600		nm		1535		nm		nm		nm		nm		nm		nm		nm		23925	
Unpaved Facility Soils	UPS-SS29	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		9525		nm		nm		2575		nm		nm		23700		nm		20300		nm		nm		nm		nm		nm		nm		nm		48550	
Unpaved Facility Soils	UPS-SS30	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		1633		nm		nm		373		nm		nm		5600		nm		12725		nm		nm		nm		nm		nm		nm		nm		7925	
Unpaved Facility Soils	UPS-SS31	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		2625		nm		nm		813		nm		nm		6900		nm		14600		nm		nm		nm		nm		nm		nm		nm		84650	
Unpaved Facility Soils	UPS-SS9	0-6	8/5/2010	7.91	4.94	9.3	63	22	12	3	7310		38.8		182		100	U	10	U	74.2	J	12		6		1140	J	15300		2290		443		1.5		8		6.4		18		2		50		7550	
Plant perimeter sample (east)	UOP-SS15	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		48		nm		nm		10		nm		nm		258		nm		472		nm		nm		nm		nm		nm		nm		nm		1594	
Plant perimeter sample (east)	UOP-SS16	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		121		nm		nm		92		nm		nm		16375		nm		1368		nm		nm		nm		nm		nm		nm		nm		1868	

Table B-9. Soil Chemistry Data (Conventional Parameters and Total Metals)

				Conventionals							Total Metals (mg/kg dry-weight)																																					
		Sample	Sample	Field pH	TOC	Moisture	Grain Size Fraction (%)				Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Station ID	Depth (in)	Date	s.u.	%	%	Sand	Silt	Clay	F. Sand	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Plant perimeter sample (east)	UOP-SS16	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		29		nm		nm		5	U	nm		nm		235		nm		216		nm		nm		nm		nm		nm		nm		nm		135	
Plant perimeter sample (east)	UOP-SS17	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		145		nm		nm		5	U	nm		nm		415		nm		552		nm		nm		nm		nm		nm		nm		nm		1377	
Plant perimeter sample (east)	UOP-SS17	0-6	8/9/2010	8.14	0.92	2.5	81	12	4	3	5830		5.5		55		107		10	U	11.7		15		8		403		22700		691		830		0.95		6		1.2		4		0.5		50		3560	
Plant perimeter sample (east)	UOP-SS18	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		101		nm		nm		5	U	nm		nm		200		nm		307		nm		nm		nm		nm		nm		nm		nm		189	
Plant perimeter sample (east)	UOP-SS19	0-4	3/21/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		387		nm		nm		80		nm		nm		500		nm		2706		nm		nm		nm		nm		nm		nm		nm		2585	
Plant perimeter sample (east)	UOP-SS20	0-4	3/21/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.1	U	nm		nm		28		nm		nm		0.1	U	nm		1094		nm		nm		nm		nm		nm		nm		nm		946	
Plant perimeter sample (east)	UOP-SS20	0-6	8/10/2010	7.94	1.25	4.9	57	24	14	5	6820		28		199		100	U	10	U	73.8		10		6		421		15100		2180		762		11		8		4.1		18		3.7		32		1250	
Plant perimeter sample (east)	UOP-SS21	0-4	3/21/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		3121		nm		nm		79		nm		nm		3346		nm		3811		nm		nm		nm		nm		nm		nm		nm		1816	
Plant perimeter sample (west)	UOP-SS01	0-4	3/29/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.1	U	nm		nm		137		nm		nm		0.1	U	nm		2991		nm		nm		nm		nm		nm		nm		nm		1734	
Plant perimeter sample (west)	UOP-SS02	0-4	3/29/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		324		nm		nm		227		nm		nm		342		nm		7958		nm		nm		nm		nm		nm		nm		nm		12492	
Plant perimeter sample (west)	UOP-SS03	0-4	3/29/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		91		nm		nm		39		nm		nm		268		nm		1534		nm		nm		nm		nm		nm		nm		nm		730	
Plant perimeter sample (west)	UOP-SS04	0-4	3/29/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		25		nm		nm		69		nm		nm		96		nm		2619		nm		nm		nm		nm		nm		nm		nm		1266	
Plant perimeter sample (west)	UOP-SS05	0-4	3/29/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		19		nm		nm		38		nm		nm		89		nm		1380		nm		nm		nm		nm		nm		nm		nm		657	
Plant perimeter sample (west)	UOP-SS06	0-4	3/8/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		60		nm		nm		5	U	nm		nm		150		nm		277		nm		nm		nm		nm		nm		nm		nm		155	
Plant perimeter sample (west)	UOP-SS07	0-4	3/8/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		238		nm		nm		5	U	nm		nm		501		nm		82		nm		nm		nm		nm		nm		nm		nm		85	
Plant perimeter sample (west)	UOP-SS08	0-4	3/8/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		540		nm		nm		32		nm		nm		1702		nm		632		nm		nm		nm		nm		nm		nm		nm		314	
Plant perimeter sample (west)	UOP-SS09	0-4	3/8/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		236		nm		nm		116		nm		nm		133		nm		2199		nm		nm		nm		nm		nm		nm		nm		1001	
Plant perimeter sample (west)	UOP-SS10	0-4	3/8/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		0.47		nm		nm		532		nm		nm		0.1	U	nm		7634		nm		nm		nm		nm		nm		nm		nm		5319	
Plant perimeter sample (west)	UOP-SS11	0-4	3/8/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		124		nm		nm		99		nm		nm		3903		nm		2071		nm		nm		nm		nm		nm		nm		nm		674	
Plant perimeter sample (west)	UOP-SS12	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		81		nm		nm		71		nm		nm		467		nm		2371		nm		nm		nm		nm		nm		nm		nm		2843	
Plant perimeter sample (west)	UOP-SS12	0-6	8/9/2010	8.26	4.28	4.7	55	24	16	5	9800		33		173		196		10	U	96.5		19		9		5830		21400		2970		427		3.3		15		5		30		4		53		2100	
Plant perimeter sample (west)	UOP-SS13	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		34		nm		nm		28		nm		nm		314		nm		884		nm		nm		nm		nm		nm		nm		nm		576	
Plant perimeter sample (west)	UOP-SS14	0-4	3/22/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		25		nm		nm		16		nm		nm		186		nm		757		nm		nm		nm		nm		nm		nm		nm		738	
Plant perimeter sample (west)	UOP-SS15	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		385		nm		nm		172		nm		nm		9750		nm		3250		nm		nm		nm		nm		nm		nm		nm		3975	
Plant perimeter sample (west)	UOP-SS2	0-6	8/9/2010	8.06	5.79	5.9	58	24	12	6	7660		92		829		838		10	U	363	J	26		46		3070	J	57500		10600		3290		8.2		82		27		233		6		41		14100	
Plant perimeter sample (west)	UOP-SS23	0-1	1/1/2001	nm	nm	nm	nm	nm	nm	nm	nm		nm		121		nm		nm		212		nm		nm		320		nm		11600		nm		nm		nm		nm		nm		nm		nm		1093	
Plant perimeter sample (west)	UOP-SS4	0-6	8/9/2010	8.16	0.84	6.7	32	18	22	28	12000		4.2		63.2		145		10	U	21.1	J	13		6		94	J	14500		531		406		1.2		10		0.9		3		1		36		265	
Plant perimeter sample (west)	UOP-SS9	0-6	8/9/2010	8.33	1.22	3	58	28	10	4	3250		12.4		78		100	U	10	U	32.7		5	U	2		243		4760		1580		272		2		5	U	1.6		15		1		11		345	
Walker Creek	WPS-1	0-6	8/11/2010	6.61	4.85	21	53	25	13	9	9140		0.1	U	7.3		175		10	U	0.5		16		7		41		16700		11		608		0.05	U	8		0.5	U	2	U	0.2		38		55	
Walker Creek	WPS-2	0-6	8/11/2010	6.04	2.62	35.3	67	16	10	7	6470		0.1	U	3.8		100	U	10	U	0.1	U	7		4		21		15300		10	U	174		0.05	U	5	U	0.5	U	2	U	0.1	U	36		22	
Walker Creek	WPS-3	0-6	8/11/2010	5.95	2.94	29.4	67	19	11	3	5560		0.1	U	2.9		100	U	10	U	0.2		6		3		18		10400		6		147		0.05	U	5	U	0.5	U	2	U	0.1	U	25		19	
Walker Creek	WPS-4	0-6	8/11/2010	4.98	1.34	12.5	69	16	10	5	7770		0.1	U	2.2		100	U	10	U	0.1	U	8		6		52		16500		4		291		0.05	U	5	U	0.5	U	2	U	0.3		37		27	
Walker Creek	WPS-5	0-6	8/11/2010	6.62	1.99	22	65	20	10	5	7950		0.1	U	2.8		102		10	U	0.1	U	8		5		26		13200		6		247		0.05	U	5	U	0.5	U	2	U	0.2		29		28	
Walker Creek	WPS-6	0-6	8/11/2010	6.19	0.85	12.4	71	15	9	5	8730		0.1	U	2.9		111		10	U	0.1	U	7		7		62		18300		4		485		0.05	U	5	U	0.5	U	2	U	0.3		39		27	

Notes:
nr = not reported
nm = not measured
U = not detected
J = estimated value
R = rejected

Table B-10. Aquatic Invertebrate Chemistry Data (Total Metals)

							Total Metals (mg/kg wet-weight)																					
					Sample	Solids	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb	
CSM Unit	Location ID	Sample ID	Sample Type	Comments	Date	%	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Canyon Ferry (Ref)	CFR_2	CFR_2	Benthic Inverts		10/1/2003	nr	nm		nm		2	U	nm		nm		0.2		nm		nm		10		nm		4.1	
Lower Lake	LL-22/21	BI-22	Benthic Inverts	Composite from 2 locations	7/31/2010	18.5	4.995		0.1388		0.5291		0.3349	J	0.0093	U	0.9879		0.0241	J	0.00999		1.5078		13.413		2.4975	
Lower Lake	LL-22	BI-23	Benthic Inverts		7/31/2010	24.1	56.635		0.723		2.4076		1.4002	J	0.0048	J	1.9786		0.0988		0.0682		5.784		106.04		16.051	
Lower Lake	LL-25	BI-24	Benthic Inverts		7/31/2010	19.4	32.786	J	0.9118	J	3.6472		1.0864	J	0.0039	J	1.8449		0.0698		0.0613		6.4602		68.288	J	15.501	J
Lower Lake	LL-24	BI-25	Benthic Inverts		7/31/2010	18.7	15.484	J	0.6919	J	0.7985		0.3385	J	0.0094	U	0.7499		0.058		0.02637		2.9172		25.432	J	5.3856	
Lower Lake	LL-21	BI-26	Benthic Inverts		7/31/2010	17.2	5.7964	J	0.2821	J	0.5607		0.3887	J	0.0017	J	0.903		0.0224	J	0.01359		2.0984		15.91	J	4.0592	
Lower Lake	LL-22	OA-08	Other Aquatic Inverts		7/31/2010	40.3	757.64	J	9.672	J	66.092	J	20.835	J	0.1169		19.546		1.5717		1.50319		96.317	J	1745	J	261.14	J
Lower Lake	LL-22/25	OA-09	Other Aquatic Inverts	Composite from 2 locations	7/31/2010	33.3	176.49	J	9.324	J	129.87	J	19.214	J	0.03	J	15.085		0.4329		0.79254		68.265	J	656.01	J	139.86	J
Lower Lake	LL-22/25	OA-10	Other Aquatic Inverts	Composite from 2 locations	7/31/2010	27.3	43.953	J	2.8665	J	8.2173		3.822	J	0.0082	J	3.9585		0.1693		0.15916		30.303	J	90.636	J	32.214	J
Prickly Pear Creek	PPC-22	BI-06	Benthic Inverts		7/28/2010	19.2	40.704		0.0269	J	0.384		0.8429		0.0019	J	0.119		0.073		0.06182		1.559		91.008	J	1.1136	J
Prickly Pear Creek	PPC-5	BI-07	Benthic Inverts		7/28/2010	16.1	30.59		0.0306	J	0.425		1.3814		0.0016	J	0.1111		0.0467		0.06215		1.3025		72.45	J	1.8354	
Prickly Pear Creek	PPC-102	BI-08	Benthic Inverts		7/28/2010	20.7	55.683		0.0497		1.6705		2.07		0.0021	J	0.2091		0.0952		0.07866		2.1528		119.65	J	2.3805	
Prickly Pear Creek	PPC-103	BI-09	Benthic Inverts		7/28/2010	16.5	33.825		0.0363		1.4735		2.64		0.002	J	0.1544		0.0578		0.06419		1.947		116.49	J	2.6895	
Prickly Pear Creek	PPC-7	BI-10	Benthic Inverts		7/28/2010	20.3	42.833		0.0548		0.9886		2.03	J	0.0041	J	0.2213		0.0731		0.09947		2.4157		130.73		2.9638	
Prickly Pear Creek	PPC-24	BI-11	Benthic Inverts		8/1/2010	20.4	34.272	J	0.0551	J	0.6242		0.9914	J	0.0041	J	0.1326		0.1285		0.08894		2.142		93.84	J	2.8968	
Prickly Pear Creek	PPC-22/5/102	OA-01	Other Aquatic Inverts	Composite from 3 locations	7/28/2010	20.4	28.56		0.0204	J	0.512		1.0078		0.0102	U	0.1163		0.0673		0.03611		5.916		57.936	J	1.0384	J
Prickly Pear Creek	PPC-103	OA-02	Other Aquatic Inverts		7/28/2010	18	55.62		0.0576		2.052		2.016	J	0.0036	J	0.2574		0.0666		0.09072		7.848		148.5		4.176	
Prickly Pear Creek	PPC-24	OA-12	Other Aquatic Inverts		8/1/2010	28.1	78.118	J	0.0843	J	1.686		2.9505	J	0.0112	J	0.6969		0.2529		0.20513		25.431		197.82	J	7.1936	
Prickly Pear Creek (Ref)	PPC-REF-8	BI-01	Benthic Inverts		7/27/2010	16.4	28.536		0.0197	J	0.3346		0.5379		0.0033	J	0.082		0.0525		0.05592		1.1956		55.924	J	0.861	J
Prickly Pear Creek (Ref)	PPC-REF-6	BI-02	Benthic Inverts		7/27/2010	20	44.6		0.028	J	0.476		1.286		0.002	J	0.148		0.096		0.0814		1.728		105.6	J	1.222	J
Prickly Pear Creek (Ref)	PPC-REF-4	BI-03	Benthic Inverts		7/27/2010	20.6	51.706		0.033	J	0.618		1.3575		0.0041	J	0.206		0.0762		0.11351		2.163		111.24	J	1.7016	J
Prickly Pear Creek (Ref)	PPC-REF-2	BI-04	Benthic Inverts		7/27/2010	21.7	52.297		0.0282	J	0.6141		1.3107		0.0043	J	0.1845		0.0868		0.10286		2.1917		120	J	1.5299	J
Prickly Pear Creek (Ref)	PPC-REF-1	BI-05	Benthic Inverts		7/27/2010	21	51.03		0.0315	J	0.5691		1.3923		0.0042	J	0.1218		0.0714		0.0798		1.7094		108.15	J	1.3377	J
Upper Lake/Marsh	ULM_1	ULM_1	Benthic Inverts		9/30/2003	nr	nm		nm		2	U	nm		nm		0.8		nm		nm		31.3		nm		11.9	
Upper Lake/Marsh	ULM_10	ULM_10	Benthic Inverts		9/30/2003	nr	nm		nm		2	U	nm		nm		9.6		nm		nm		79.5		nm		105.1	
Upper Lake/Marsh	UL-21A	BI-17	Benthic Inverts	East of UL-21	7/30/2010	13.9	8.1176		0.2641		0.7006		1.0564	J	0.007	U	0.2071		0.0195	J	0.01738		2.4464		15.429		15.012	
Upper Lake/Marsh	UL-21B	BI-18	Benthic Inverts	West of UL-21	7/30/2010	14.7	32.487		0.0853		0.4116		1.5141	J	0.0074	J	0.4204		0.0162	J	0.02205		2.0286		30.429		3.8514	
Upper Lake/Marsh	UL-24	BI-19	Benthic Inverts		7/30/2010	17.2	19.264		0.3337		0.7981		1.6168	J	0.0017	J	0.7413		0.0258	J	0.04076		3.44		34.744		17.544	
Upper Lake/Marsh	UL-23	BI-20	Benthic Inverts		7/30/2010	19.1	13.217		0.1184		0.4966		5.1379	J	0.0096	U	0.403		0.0344	J	0.02961		2.7886		28.841		8.7669	
Upper Lake/Marsh	UL-25	BI-21	Benthic Inverts		7/30/2010	17.9	18.079		0.0179	J	0.2417		3.759	J	0.009	U	0.102		0.0376		0.03222		1.4893		32.22		1.2441	
Upper Lake/Marsh	UL-21B/23	OA-05	Other Aquatic Inverts	Composite from 2 locations	7/30/2010	17.2	8.9612		0.0396		1.4758		0.4541	J	0.0086	U	0.1376		0.0155	J	0.05057		2.7004		37.152		4.4204	
Upper Lake/Marsh	UL-23/21A/21B/24	OA-06	Other Aquatic Inverts	Composite from 4 locations	7/30/2010	18.8	42.3		0.2294		1.1731		1.2596	J	0.0075	J	0.7558		0.0263	J	0.06279		4.888		51.512		15.66	
Upper Lake/Marsh	UL-23/25	OA-07	Other Aquatic Inverts	Composite from 2 locations	7/30/2010	18.9	12.512		0.1304		0.6955		0.8751	J	0.0095	U	0.2911		0.034	J	0.04328		3.1374		29.106		5.9913	
Upper Lake/Marsh	ULM-1	BI-12	Benthic Inverts		7/29/2010	16.1	8.9355		0.0193	J	0.1143		1.1479	J	0.0081	U	0.0789		0.0193	J	0.01433		1.2059		15.392		1.1576	
Upper Lake/Marsh	ULM-2	BI-13	Benthic Inverts		7/29/2010	16	18.08		0.0096	J	0.3504		3.76	J	0.008	U	0.0704		0.0352		0.03136		2.16		36.8		0.7552	
Upper Lake/Marsh	ULM-3	BI-14	Benthic Inverts		7/29/2010	19.8	26.136		0.0376	J	0.4891		4.9896	J	0.0099	U	0.1505		0.0416		0.0497		2.5344		69.894		1.1939	
Upper Lake/Marsh	ULM-4	BI-15	Benthic Inverts		7/29/2010	17	11.271		0.0136	J	0.2465		1.615	J	0.0085	U	0.1326		0.0255	J	0.02516		1.6218		29.41		0.7259	
Upper Lake/Marsh	ULM-5	BI-16	Benthic Inverts		7/29/2010	16.5	11.666		0.0132	J	0.1749		2.2935	J	0.0083	U	0.0479		0.0198	J	0.0264		1.0841		29.535		0.7029	
Upper Lake/Marsh	ULM-2/5	OA-03	Other Aquatic Inverts	Composite from 2 locations	7/29/2010	22.8	41.04		0.0798		2.508		1.5116	J	0.0046	J	0.2052		0.0684		0.08846		5.1756		105.79		2.9184	
Upper Lake/Marsh	ULM-3/4	OA-04	Other Aquatic Inverts	Composite from 2 locations	7/29/2010	10.2	3.1824		0.0051	J	0.2601		0.1214	J	0.0051	U	0.0184		0.0082	J	0.01326		0.4009		19.788		0.202	
Upper Lake/Marsh	ULM-4	OA-11	Other Aquatic Inverts		8/1/2010	21	15.75	J	0.168	J	0.924		0.735	J	0.021	U	0.3423		0.252		0.0924		9.912		37.59	J	9.261	
Walker Creek (Marsh)	WPM-1	BI-29	Benthic Inverts		8/3/2010	16.4	17.876		0.0328	U	0.0492		5.986	J	0.0082	U	0.0082		0.041		0.03772		0.597		50.84		0.0508	
Walker Creek (Marsh)	WPM-2	BI-31	Benthic Inverts		8/3/2010	13.6	21.76		0.0272	U	0.0802		6.7592	J	0.0068	U	0.0136		0.0245	J	0.07806		0.4678		99.96		0.0245	
Walker Creek (Marsh)	WPM-3	BI-32	Benthic Inverts		8/3/2010	15.1	21.442		0.0302	U	0.074		6.4779	J	0.0076	U	0.0106		0.0559		0.03549		0.8245		78.671		0.0211	
Walker Creek (Marsh)	WPM-5	BI-33	Benthic Inverts		8/3/2010	16	33.28		0.032	U	0.0704		9.312	J	0.008	U	0.0128		0.0832		0.05536		0.9792		66.24		0.0544	
Walker Creek (Marsh)	WPM-4	BI-37	Benthic Inverts		8/3/2010	17.1	40.185		0.0342	U	0.0941		5.7969	J	0.0034	J	0.0154		0.1129		0.04651		1.0841		138.34		0.0393	
Walker Creek (Pond)	WP-1	BI-28	Benthic Inverts		8/3/2010	12.9	11.971		0.0065	J	0.0387		3.3024	J	0.0065	U	0.0232		0.0155	J	0.0298		0.3831		27.606		0.1677	
Walker Creek (Pond)	WP-2	BI-30	Benthic Inverts		8/3/2010	14.2	12.524		0.0284	U	0.0454		4.0044	J	0.0071	U	0.0043	J	0.0199	J	0.0355		0.4217		64.61		0.0227	
Walker Creek (Pond)	WP-5	BI-34	Benthic Inverts		8/3/2010	13.9	36.835		0.0278	U	0.0751		5.699	J	0.007	U	0.0125		0.0514		0.04629		0.6672		64.774		0.0361	

Table B-10. Aquatic Invertebrate Chemistry Data (Total Metals)

					Total Metals (mg/kg wet-weight)																	
					Sample	Solids	Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Location ID	Sample ID	Sample Type	Comments	Date	%	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Canyon Ferry (Ref)	CFR_2	CFR_2	Benthic Inverts		10/1/2003	nr	nm		nm		nm		5	U	nm		nm		nm		17	
Lower Lake	LL-22/21	BI-22	Benthic Inverts	Composite from 2 locations	7/31/2010	18.5	11.026		0.016872		0.0167	J	0.4551		0.02424		0.0629		0.0204		11.692	
Lower Lake	LL-22	BI-23	Benthic Inverts		7/31/2010	24.1	29.884		0.047959		0.1012		1.00497		0.11809		0.26028		0.1904		22.823	
Lower Lake	LL-25	BI-24	Benthic Inverts		7/31/2010	19.4	27.354	J	0.146664	J	0.1145		1.19892		0.18527		0.27354		0.1377		18.682	
Lower Lake	LL-24	BI-25	Benthic Inverts		7/31/2010	18.7	5.8157	J	0.02618	J	0.0617		0.748		0.08901		0.29359		0.1047		9.2191	
Lower Lake	LL-21	BI-26	Benthic Inverts		7/31/2010	17.2	5.8652	J	0.01978	J	0.0344	J	0.30444		0.05194		0.07396		0.0327		10.079	
Lower Lake	LL-22	OA-08	Other Aquatic Inverts		7/31/2010	40.3	369.15	J	0.74152	J	1.6523		2.03112		2.52278		6.0853		4.9569		240.19	J
Lower Lake	LL-22/25	OA-09	Other Aquatic Inverts	Composite from 2 locations	7/31/2010	33.3	439.56	J	0.45954	J	0.7659		1.87812		1.40859		4.1958		1.5285		118.22	J
Lower Lake	LL-22/25	OA-10	Other Aquatic Inverts	Composite from 2 locations	7/31/2010	27.3	79.716	J	0.173082	J	0.2948		1.2012		0.48048		1.66803		0.3194		24.515	
Prickly Pear Creek	PPC-22	BI-06	Benthic Inverts		7/28/2010	19.2	17.568		0.0031488		0.0595		0.06336		0.01421		0.0096	U	0.2035		39.936	
Prickly Pear Creek	PPC-5	BI-07	Benthic Inverts		7/28/2010	16.1	33.971		0.0067298		0.0515		0.06118		0.01674		0.00805	U	0.1513		29.946	
Prickly Pear Creek	PPC-102	BI-08	Benthic Inverts		7/28/2010	20.7	39.33		0.0075969		0.0828		0.08694		0.02463		0.00414		0.3002		31.05	
Prickly Pear Creek	PPC-103	BI-09	Benthic Inverts		7/28/2010	16.5	40.59		0.011649		0.0479	J	0.05528		0.02129		0.00182		0.1683		18.645	
Prickly Pear Creek	PPC-7	BI-10	Benthic Inverts		7/28/2010	20.3	50.547		0.007308		0.1137		0.04872		0.02233		0.00609		0.2375		26.999	
Prickly Pear Creek	PPC-24	BI-11	Benthic Inverts		8/1/2010	20.4	26.724	J	0.0038556	J	0.1224		0.05916		0.02407		0.0102	U	0.3101		19.013	J
Prickly Pear Creek	PPC-22/5/102	OA-01	Other Aquatic Inverts	Composite from 3 locations	7/28/2010	20.4	18.727		0.002448		0.0469	J	0.02856		0.04427		0.0102	U	0.1142		6.2832	
Prickly Pear Creek	PPC-103	OA-02	Other Aquatic Inverts		7/28/2010	18	29.7		0.02646		0.0972		0.0432		0.0756		0.0054	J	0.2088		27	
Prickly Pear Creek	PPC-24	OA-12	Other Aquatic Inverts		8/1/2010	28.1	52.266	J	0.023323	J	0.2248	J	0.11521		0.14612		0.0281	U	0.7222		41.869	
Prickly Pear Creek (Ref)	PPC-REF-8	BI-01	Benthic Inverts		7/27/2010	16.4	11.906		0.0014268	J	0.0558		0.0328		0.01132		0.0082	U	0.1164		30.34	
Prickly Pear Creek (Ref)	PPC-REF-6	BI-02	Benthic Inverts		7/27/2010	20	25.8		0.001966	J	0.08		0.054		0.0144		0.01	U	0.076	J	23.8	
Prickly Pear Creek (Ref)	PPC-REF-4	BI-03	Benthic Inverts		7/27/2010	20.6	33.578		0.0013555	J	0.1195		0.06592		0.01772		0.0103	U	0.0783	J	28.016	
Prickly Pear Creek (Ref)	PPC-REF-2	BI-04	Benthic Inverts		7/27/2010	21.7	24.955		0.0014691		0.1042		0.06293		0.01823		0.01085	U	0.0977		29.078	
Prickly Pear Creek (Ref)	PPC-REF-1	BI-05	Benthic Inverts		7/27/2010	21	20.601		0.001869		0.0924		0.0504		0.02016		0.0105	U	0.2478		51.03	
Upper Lake/Marsh	ULM_1	ULM_1	Benthic Inverts		9/30/2003	nr	nm		nm		nm		5	U	nm		nm		nm		28	
Upper Lake/Marsh	ULM_10	ULM_10	Benthic Inverts		9/30/2003	nr	nm		nm		nm		5	U	nm		nm		nm		67	
Upper Lake/Marsh	UL-21A	BI-17	Benthic Inverts	East of UL-21	7/30/2010	13.9	4.9206		0.050318	J	0.0264	J	0.0556		0.12649		0.00417		0.0695		5.8797	
Upper Lake/Marsh	UL-21B	BI-18	Benthic Inverts	West of UL-21	7/30/2010	14.7	8.7024		0.019551		0.0235	J	0.04998		0.03455		0.01323		0.05		5.4096	
Upper Lake/Marsh	UL-24	BI-19	Benthic Inverts		7/30/2010	17.2	13.915		0.06278		0.0327	J	0.0946		0.13244		0.01548		0.086	J	10.406	
Upper Lake/Marsh	UL-23	BI-20	Benthic Inverts		7/30/2010	19.1	15.185		0.044503		0.0306	J	0.10123		0.06761		0.00764		0.0458		11.556	
Upper Lake/Marsh	UL-25	BI-21	Benthic Inverts		7/30/2010	17.9	11.975		0.0081445		0.0304	J	0.04296		0.01038		0.00179		0.0698		12.154	
Upper Lake/Marsh	UL-21B/23	OA-05	Other Aquatic Inverts	Composite from 2 locations	7/30/2010	17.2	10.251		0.072584		0.031	J	0.15652		0.0258		0.00688	J	0.0344	J	39.732	
Upper Lake/Marsh	UL-23/21A/21B/24	OA-06	Other Aquatic Inverts	Composite from 4 locations	7/30/2010	18.8	19.364		0.180856		0.062		0.11468		0.12784		0.01504		0.0733		15.717	
Upper Lake/Marsh	UL-23/25	OA-07	Other Aquatic Inverts	Composite from 2 locations	7/30/2010	18.9	13.948		0.154602		0.0435	J	0.12285		0.06426		0.00567	J	0.0435		20.034	
Upper Lake/Marsh	ULM-1	BI-12	Benthic Inverts		7/29/2010	16.1	8.0017		0.0081949		0.0145	J	0.05152		0.01159		0.00161		0.0403		6.4883	
Upper Lake/Marsh	ULM-2	BI-13	Benthic Inverts		7/29/2010	16	14.928		0.00272		0.0256	J	0.0336		0.0096		0.0016		0.0736		5.648	
Upper Lake/Marsh	ULM-3	BI-14	Benthic Inverts		7/29/2010	19.8	15.583		0.0075636		0.0455	J	0.06534		0.02		0.00198		0.101		16.137	
Upper Lake/Marsh	ULM-4	BI-15	Benthic Inverts		7/29/2010	17	9.231		0.004335		0.0255	J	0.0493		0.00969		0.0017		0.0561		8.16	
Upper Lake/Marsh	ULM-5	BI-16	Benthic Inverts		7/29/2010	16.5	13.58		0.0060555		0.0198	J	0.0396		0.00858		0.00825	U	0.0512		8.4315	
Upper Lake/Marsh	ULM-2/5	OA-03	Other Aquatic Inverts	Composite from 2 locations	7/29/2010	22.8	21.044		0.0024396		0.0821		0.14592		0.0456		0.0114		0.13		26.448	
Upper Lake/Marsh	ULM-3/4	OA-04	Other Aquatic Inverts	Composite from 2 locations	7/29/2010	10.2	1.4076		0.0079866		0.0071	J	0.03366		0.00418		0.0051	U	0.051	U	7.395	
Upper Lake/Marsh	ULM-4	OA-11	Other Aquatic Inverts		8/1/2010	21	11.655	J	0.015519	J	0.126	J	0.0567		0.1155		0.021	U	0.2772		17.682	
Walker Creek (Marsh)	WPM-1	BI-29	Benthic Inverts		8/3/2010	16.4	15.006		0.0024928		0.0295	J	0.02132		0.0018	J	0.0082	U	0.0787	J	3.0832	
Walker Creek (Marsh)	WPM-2	BI-31	Benthic Inverts		8/3/2010	13.6	26.384		0.0016864		0.0476		0.01224		0.00163	J	0.0068	U	0.0694	J	2.72	
Walker Creek (Marsh)	WPM-3	BI-32	Benthic Inverts		8/3/2010	15.1	17.063		0.0019781	J	0.0272	J	0.01963		0.00181	J	0.00755	U	0.0559	J	4.379	
Walker Creek (Marsh)	WPM-5	BI-33	Benthic Inverts		8/3/2010	16	20		0.001648		0.0496		0.0112		0.00192	J	0.008	U	0.128	J	4.048	
Walker Creek (Marsh)	WPM-4	BI-37	Benthic Inverts		8/3/2010	17.1	12.056		0.0015065	J	0.0359	J	0.02394		0.00274	J	0.00855	U	0.1573		3.249	
Walker Creek (Pond)	WP-1	BI-28	Benthic Inverts		8/3/2010	12.9	11.984		0.0020511		0.0194	J	0.00774		0.00323	J	0.00645	U	0.0516	J	2.2446	
Walker Creek (Pond)	WP-2	BI-30	Benthic Inverts		8/3/2010	14.2	10.281		0.0023856		0.0241	J	0.01988		0.00128	J	0.0071	U	0.071	J	2.2152	
Walker Creek (Pond)	WP-5	BI-34	Benthic Inverts		8/3/2010	13.9	10.8		0.0017375		0.0375	J	0.01251		0.00153	J	0.00695	U	0.1251		2.9329	

Table B-10. Aquatic Invertebrate Chemistry Data (Total Metals)

							Total Metals (mg/kg wet-weight)																					
					Sample	Solids	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb	
CSM Unit	**Location ID**	**Sample ID**	**Sample Type**	**Comments**	**Date**	**%**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Walker Creek (Pond)	WP-4	BI-35	Benthic Inverts		8/3/2010	15.8	26.228		0.0316	U	0.06		5.135	J	0.0079	U	0.0284		0.0284	J	0.05514		0.7363		39.026		0.0284	
Walker Creek (Pond)	WP-3	BI-36	Benthic Inverts		8/3/2010	15.3	27.387		0.0306	U	0.0398		2.8152	J	0.0015	J	0.0306		0.026	J	0.04238		0.638		46.359		0.023	
Wilson Ditch	WD-2	BI-27	Benthic Inverts		8/1/2010	17.2	23.736		0.0636	J	0.3457		4.1452		0.0086	U	0.3216		0.0722		0.02976		2.5628	J	38.528		4.5752	
Wilson Ditch	WD-2	OA-13	Other Aquatic Inverts		8/1/2010	15.2	13.285		0.1277	J	0.7615		0.5168		0.0106	U	0.1459		0.0456		0.04089		1.9	J	51.376		6.8552	

Notes:

nr = not reported

nm = not measured

U = not detected

J = estimated value

R = rejected

Table B-10. Aquatic Invertebrate Chemistry Data (Total Metals)

							Total Metals (mg/kg wet-weight)															
					Sample	Solids	Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	**Location ID**	**Sample ID**	**Sample Type**	**Comments**	**Date**	**%**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Walker Creek (Pond)	WP-4	BI-35	Benthic Inverts		8/3/2010	15.8	12.687		0.0025754		0.0253	J	0.0158		0.0019	J	0.0079	U	0.049	J	3.5392	
Walker Creek (Pond)	WP-3	BI-36	Benthic Inverts		8/3/2010	15.3	9.945		0.0020502		0.0199	J	0.01836		0.0026	J	0.00765	U	0.049	J	3.2589	
Wilson Ditch	WD-2	BI-27	Benthic Inverts		8/1/2010	17.2	27.004		0.021844		0.0447	J	0.04988		0.03302		0.0086	U	0.1015	J	9.1504	
Wilson Ditch	WD-2	OA-13	Other Aquatic Inverts		8/1/2010	15.2	14.79		0.021736		0.0426	J	0.05168		0.02432		0.005	J	0.0851	J	16.872	

Notes:
nr = not reported
nm = not measured
U = not detected
J = estimated value
R = rejected

Table B-11. Fish Tissue Chemistry Data (Total Metals)

								Total Metals (mg/kg wet weight)										
CSM Unit	Location ID	Sample ID	Species	Sample Type	Tissue Type	Sample Date	Comments	Solids	Al		Sb		As		Ba		Be	
								%	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Forage Fish Samples																		
Canyon Ferry (Ref)	CF	CF	nr	FF	WC	9/24/2003		nr	nm		nm		2.00	U	nm		nm	
Lower Lake	LL-24/25	FF-13	Fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	20.7	2.57	J	0.06		0.44		0.71		0.01	U
Lower Lake	LL-24/21	FF-14	Fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	19.5	2.75	J	0.04		0.37		0.43		0.01	U
Lower Lake	LL-22/25	FF-15	YOY/fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	18.5	72.71		0.87		3.42		1.35		0.04	U
Prickly Pear Creek	PPC-22	FF-01	Mottled sculpin	FF	WC	7/28/2010		19.8	4.30		0.04	U	0.16		0.36		0.01	U
Prickly Pear Creek	PPC-22	FF-02	Mottled sculpin	FF	WC	7/28/2010		21.9	3.92		0.01	J	0.15		0.28		0.01	U
Prickly Pear Creek	PPC-22	FF-03	Mottled sculpin	FF	WC	7/28/2010		20.9	3.43		0.01	J	0.12		0.31		0.01	U
Upper Lake/Marsh	UL-21B	FF-06	White sucker	FF	WC	7/30/2010	West of UL-21	21.6	6.87	J	0.02	J	0.11		0.31		0.01	U
Upper Lake/Marsh	UL-21B	FF-07	Fathead minnow	FF	WC	7/30/2010	West of UL-21	21.9	4.27	J	0.02	J	0.25		0.61		0.01	U
Upper Lake/Marsh	UL-21A	FF-08	White sucker	FF	WC	7/30/2010	East of UL-21	20.3	5.68	J	0.02	J	0.10		0.42		0.01	U
Upper Lake/Marsh	UL-21A	FF-09	Fathead minnow	FF	WC	7/30/2010	East of UL-21	21.3	8.73	J	0.03	J	0.34		1.21		0.02	U
Upper Lake/Marsh	UL-21A	FF-10	White sucker	FF	WC	7/30/2010	East of UL-21	19.9	3.70	J	0.01	J	0.08		0.35		0.01	U
Upper Lake/Marsh	ULM	ULM	Forage fish	FF	WC	9/23/2003		nr	nm		nm		2.00	U	nm		nm	
Upper Lake/Marsh	ULM-3	FF-04	YOY	FF	WC	7/29/2010		25.8	10.84	J	0.21	U	0.26		1.88		0.05	U
Upper Lake/Marsh	ULM-5	FF-05	YOY	FF	WC	7/29/2010		18.2	15.09		0.02	J	0.17		0.89		0.01	U
Upper Lake/Marsh	ULM-2	FF-11	Fathead minnow	FF	WC	7/30/2010		24.3	2.36	J	0.05	U	0.29		1.02		0.01	U
Upper Lake/Marsh	ULM-2	FF-12	Longnose dace	FF	WC	7/30/2010		25.1	1.81	J	0.05	U	0.05		0.63		0.01	U
Wilson Ditch	WD-2	FF-16	YOY	FF	WC	8/1/2010		14.8	10.54		0.03	J	0.14		0.48		0.01	U
Piscivorous Fish Samples																		
Prickly Pear Creek	PPC-22	PF-01	Brown trout	PF	WI	7/28/2010		23.9	1.58		0.05	U	0.06		0.12		0.01	U
Prickly Pear Creek	PPC-22	PF-02	Brown trout	PF	WI	7/28/2010		25.8	0.77	J	0.05	U	0.12		0.10		0.01	U
Prickly Pear Creek	PPC-22	PF-03	Brown trout	PF	WI	7/28/2010		24.5	3.11		0.05	U	0.14		0.20		0.01	U
Prickly Pear Creek	PPC-102/103	PF-04	Brown trout	PF	WI	7/28/2010	Collected between PPC102/103	21.8	0.52	J	0.04	U	0.09		0.09		0.01	U
Prickly Pear Creek	PPC-24	PF-10	Brown trout	PF	WI	8/1/2010		22.6	2.37	J	0.05	U	0.15		0.10		0.01	U
Upper Lake/Marsh	UL-21	PF-05	White sucker	PF	WC	7/31/2010	Near UL-21	24.3	7.29	J	0.01	J	0.09		0.29		0.01	U
Upper Lake/Marsh	UL-21	PF-06	White sucker	PF	WC	7/31/2010	Near UL-21	23.8	3.12	J	0.02	J	0.07		0.20		0.01	U
Upper Lake/Marsh	UL-21	PF-07	White sucker	PF	WC	7/31/2010	Near UL-21	23.1	5.75	J	0.02	J	0.11		0.38		0.01	U
Upper Lake/Marsh	UL-21	PF-08	White sucker	PF	WC	7/31/2010	Near UL-21	22.8	3.28	J	0.01	J	0.08		0.20		0.01	U
Upper Lake/Marsh	UL-21	PF-09	White sucker	PF	WC	7/31/2010	Near UL-21	22.5	9.74	J	0.02	J	0.12		0.42		0.01	U
Upper Lake/Marsh	UL-23	GF-09-Whole	Rainbow trout	PF	WI	7/30/2010	Whole body estimated [a]	32.8	0.57		0.07	U	0.04		0.33		0.02	U
Upper Lake/Marsh	UL-21	GF-10-Whole	Brown trout	PF	WI	7/30/2010	Whole body estimated [a]	26.7	1.55		0.05	U	0.06		0.45		0.01	U
Upper Lake/Marsh	UL-21	GF-11-Whole	Brown trout	PF	WI	7/31/2010	Whole body estimated [a]	26.1	1.45		0.03		0.06		0.53		0.01	U
Upper Lake/Marsh	UL-23	GF-13-Whole	Brown trout	PF	WI	7/31/2010	Whole body estimated [a]	23.3	0.69		0.05	U	0.04		0.55		0.01	U
Upper Lake/Marsh	UL-23	GF-14-Whole	Rainbow trout	PF	WI	7/31/2010	Whole body estimated [a]	27.6	0.55		0.06	U	0.04		0.25		0.01	U
Game Fish Samples																		
Prickly Pear Creek	PPC-102/103	GF-07	Brown trout	GFF	FI	7/28/2010	Collected between PPC102/103	22.2	0.75	J	0.04	U	0.11		0.18		0.01	U
Prickly Pear Creek	PPC-102/103	GF-08	Brown trout	GFF	FI	7/28/2010	Collected between PPC102/103	22.8	0.27	J	0.05	U	0.06		0.08		0.01	U
Prickly Pear Creek	PPC-24	GF-15	Brown trout	GFF	FI	8/1/2010		20.8	0.17	UJ	0.04	U	0.02	J	0.03	UJ	0.01	U
Prickly Pear Creek	PPC-24	GF-16	Brown trout	GFF	FI	8/1/2010		28	0.20	UJ	0.06	U	0.03	J	0.02	UJ	0.01	U
Prickly Pear Creek	PPC-24	GF-17	Brown trout	GFF	FI	8/1/2010		19.7	0.79	J	0.04	U	0.07		0.04	UJ	0.01	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-01	Brown trout	GFF	FI	7/27/2010		25.1	0.60	J	0.05	U	0.13		0.13		0.01	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-02	Brown trout	GFF	FI	7/27/2010		23.2	0.37	J	0.05	U	0.10		0.06	J	0.01	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-03	Brown trout	GFF	FI	7/27/2010		20.9	0.38	J	0.04	U	0.11		0.08		0.01	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-04	Brown trout	GFF	FI	7/27/2010		19.6	0.24	J	0.04	U	0.07		0.07		0.01	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-05	Brown trout	GFF	FI	7/27/2010		21.9	0.37	J	0.04	U	0.07		0.07		0.01	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-06	Brown trout	GFF	FI	7/27/2010		20.3	0.41	J	0.04	U	0.08		0.08		0.01	U
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		nr	nm		nm		2	U	nm		nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		nr	nm		nm		2	U	nm		nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		nr	nm		nm		-		nm		nm	
Upper Lake/Marsh	UL-23	GF-09-Fillet	Rainbow trout	GFF	FI	7/30/2010	Near UL-23	29.6	0.30	UJ	0.06	U	0.03	J	0.11	J	0.01	U
Upper Lake/Marsh	UL-21	GF-10-Fillet	Brown trout	GFF	FI	7/30/2010	Near UL-21	26.4	0.69	J	0.05	U	0.05		0.03	J	0.01	U
Upper Lake/Marsh	UL-21	GF-11-Fillet	Brown trout	GFF	FI	7/31/2010	Near UL-21	24.3	0.27	J	0.05	J	0.04		0.04	J	0.01	U

Table B-11. Fish Tissue Chemistry Data (Total Metals)

								Total Metals (mg/kg wet weight)													
				Sample Type	Tissue Type	Sample Date		Cd		Cr		Co		Cu		Fe		Pb		Mn	
CSM Unit	Location ID	Sample ID	Species				Comments	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Forage Fish Samples																					
Canyon Ferry (Ref)	CF	CF	nr	FF	WC	9/24/2003		0.20	U	nm		nm		2.10		nm		0.80	U	nm	
Lower Lake	LL-24/25	FF-13	Fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	0.11		0.03	J	0.01		0.76		7.74		0.54		4.45	
Lower Lake	LL-24/21	FF-14	Fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	0.11		0.04	J	0.01		0.82		7.64		0.47		4.29	
Lower Lake	LL-22/25	FF-15	YOY/fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	3.02		0.09	J	0.08		5.24		150.41		30.34		19.43	
Prickly Pear Creek	PPC-22	FF-01	Mottled sculpin	FF	WC	7/28/2010		0.02		0.02	J	0.01		0.18		10.36	J	0.19		2.40	
Prickly Pear Creek	PPC-22	FF-02	Mottled sculpin	FF	WC	7/28/2010		0.02		0.05		0.01		0.20		8.85	J	0.24		3.00	
Prickly Pear Creek	PPC-22	FF-03	Mottled sculpin	FF	WC	7/28/2010		0.02		0.03	J	0.01		0.19		8.53	J	0.27		3.47	
Upper Lake/Marsh	UL-21B	FF-06	White sucker	FF	WC	7/30/2010	West of UL-21	0.06		0.14		0.01		0.71		9.12		0.69		2.07	
Upper Lake/Marsh	UL-21B	FF-07	Fathead minnow	FF	WC	7/30/2010	West of UL-21	0.04		0.02	J	0.01		0.54		9.64		0.71		5.91	
Upper Lake/Marsh	UL-21A	FF-08	White sucker	FF	WC	7/30/2010	East of UL-21	0.04		0.02	J	0.01		0.40		9.99		0.86		2.58	
Upper Lake/Marsh	UL-21A	FF-09	Fathead minnow	FF	WC	7/30/2010	East of UL-21	0.05		0.04	J	0.02		0.81		17.34		1.09		7.86	
Upper Lake/Marsh	UL-21A	FF-10	White sucker	FF	WC	7/30/2010	East of UL-21	0.02		0.02	J	0.01		0.29		6.97		0.64		2.63	
Upper Lake/Marsh	ULM	ULM	Forage fish	FF	WC	9/23/2003		1.40		nm		nm		9.10		nm		25.00		nm	
Upper Lake/Marsh	ULM-3	FF-04	YOY	FF	WC	7/29/2010		0.03	J	0.08	J	0.01	J	0.70		28.90		0.35		5.29	
Upper Lake/Marsh	ULM-5	FF-05	YOY	FF	WC	7/29/2010		0.04		0.02	J	0.02		0.49		34.58		0.95		9.43	
Upper Lake/Marsh	ULM-2	FF-11	Fathead minnow	FF	WC	7/30/2010		0.02		0.03	J	0.01		0.57		7.78		0.29		1.65	
Upper Lake/Marsh	ULM-2	FF-12	Longnose dace	FF	WC	7/30/2010		0.04		0.04	J	0.01		0.34		7.58		0.19		1.73	
Wilson Ditch	WD-2	FF-16	YOY	FF	WC	8/1/2010		0.07		0.02	J	0.01		0.40		24.42		2.96		10.33	
Piscivorous Fish Samples																					
Prickly Pear Creek	PPC-22	PF-01	Brown trout	PF	WI	7/28/2010		0.03		0.02	J	0.02		0.45		5.33	J	0.11		2.44	
Prickly Pear Creek	PPC-22	PF-02	Brown trout	PF	WI	7/28/2010		0.09		0.05	U	0.01		0.57		6.58	J	0.11		1.34	
Prickly Pear Creek	PPC-22	PF-03	Brown trout	PF	WI	7/28/2010		0.05		0.01	J	0.02		0.81		10.36	J	0.14		2.01	
Prickly Pear Creek	PPC-102/103	PF-04	Brown trout	PF	WI	7/28/2010	Collected between PPC102/103	0.07		0.04	U	0.01		0.44		4.03	J	0.08		1.02	
Prickly Pear Creek	PPC-24	PF-10	Brown trout	PF	WI	8/1/2010		0.03		0.03	J	0.01		1.02		15.73		0.15		1.76	
Upper Lake/Marsh	UL-21	PF-05	White sucker	PF	WC	7/31/2010	Near UL-21	0.02		0.78		0.01		0.34		20.39		0.36		1.46	
Upper Lake/Marsh	UL-21	PF-06	White sucker	PF	WC	7/31/2010	Near UL-21	0.02		0.03	J	0.00	J	0.28		6.45		0.50		1.00	
Upper Lake/Marsh	UL-21	PF-07	White sucker	PF	WC	7/31/2010	Near UL-21	0.02		0.02	J	0.01		0.32		11.80		0.40		1.96	
Upper Lake/Marsh	UL-21	PF-08	White sucker	PF	WC	7/31/2010	Near UL-21	0.02		0.02	J	0.01	J	0.30		7.30		0.27		1.85	
Upper Lake/Marsh	UL-21	PF-09	White sucker	PF	WC	7/31/2010	Near UL-21	0.04		0.02	J	0.01		0.36		18.50		0.81		1.64	
Upper Lake/Marsh	UL-23	GF-09-Whole	Rainbow trout	PF	WI	7/30/2010	Whole body estimated [a]	0.02		0.07	U	0.01		0.50		3.44		0.05		0.91	
Upper Lake/Marsh	UL-21	GF-10-Whole	Brown trout	PF	WI	7/30/2010	Whole body estimated [a]	0.01		0.03		0.01		0.65		4.15		0.14		1.83	
Upper Lake/Marsh	UL-21	GF-11-Whole	Brown trout	PF	WI	7/31/2010	Whole body estimated [a]	0.01		0.02		0.01		0.52		3.82		0.21		1.05	
Upper Lake/Marsh	UL-23	GF-13-Whole	Brown trout	PF	WI	7/31/2010	Whole body estimated [a]	0.02		0.12		0.01		0.84		5.62		0.12		1.80	
Upper Lake/Marsh	UL-23	GF-14-Whole	Rainbow trout	PF	WI	7/31/2010	Whole body estimated [a]	0.01		0.06		0.01		0.49		2.83		0.33		1.51	
Game Fish Samples																					
Prickly Pear Creek	PPC-102/103	GF-07	Brown trout	GFF	FI	7/28/2010	Collected between PPC102/103	0.01	J	0.02	J	0.01		0.11		2.44		0.08		0.33	
Prickly Pear Creek	PPC-102/103	GF-08	Brown trout	GFF	FI	7/28/2010	Collected between PPC102/103	0.01	U	0.05	U	0.01		0.16		1.14		0.02		0.14	
Prickly Pear Creek	PPC-24	GF-15	Brown trout	GFF	FI	8/1/2010		0.01	J	0.02	J	0.01		0.12		1.56	J	0.02		0.08	J
Prickly Pear Creek	PPC-24	GF-16	Brown trout	GFF	FI	8/1/2010		0.01	J	0.07		0.01	J	0.20		1.48	J	0.02		0.20	
Prickly Pear Creek	PPC-24	GF-17	Brown trout	GFF	FI	8/1/2010		0.01	J	0.02	J	0.01		0.16		5.06	J	0.13		0.63	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-01	Brown trout	GFF	FI	7/27/2010		0.04		0.05	U	0.02		0.15		2.31		0.07		0.53	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-02	Brown trout	GFF	FI	7/27/2010		0.05		0.03	J	0.02		0.20		2.30		0.03		0.19	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-03	Brown trout	GFF	FI	7/27/2010		0.02		0.05		0.01		0.10		2.03		0.03		0.27	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-04	Brown trout	GFF	FI	7/27/2010		0.02		0.04	U	0.01		0.08		1.49		0.02		0.25	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-05	Brown trout	GFF	FI	7/27/2010		0.06		0.02	J	0.02		0.11		1.58		0.04		0.46	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-06	Brown trout	GFF	FI	7/27/2010		0.01	J	0.02	J	0.01		0.08		1.60		0.04		0.18	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		0.2	U	nm		nm		1.6		nm		0.8	U	nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		0.2	U	nm		nm		1.3		nm		0.8	U	nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		-		nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	UL-23	GF-09-Fillet	Rainbow trout	GFF	FI	7/30/2010	Near UL-23	0.01	U	0.06	U	0.00	J	0.10		1.39	J	0.02		0.15	
Upper Lake/Marsh	UL-21	GF-10-Fillet	Brown trout	GFF	FI	7/30/2010	Near UL-21	0.00		0.04	J	0.00		0.12		1.43	J	0.10		0.18	
Upper Lake/Marsh	UL-21	GF-11-Fillet	Brown trout	GFF	FI	7/31/2010	Near UL-21	0.00		0.01	J	0.00		0.10		1.00	J	0.03		0.17	

Table B-11. Fish Tissue Chemistry Data (Total Metals)

								Total Metals (mg/kg wet weight)													
				Sample	Tissue	Sample		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Location ID	Sample ID	Species	Type	Type	Date	Comments	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Forage Fish Samples																					
Canyon Ferry (Ref)	CF	CF	nr	FF	WC	9/24/2003		0.03		nm		5.00	U	nm		nm		nm		35.00	
Lower Lake	LL-24/25	FF-13	Fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	0.01		0.02	J	1.73		0.01		0.68		0.03	J	14.41	
Lower Lake	LL-24/21	FF-14	Fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	0.01		0.05	J	1.40		0.01		0.50		0.03	J	11.17	
Lower Lake	LL-22/25	FF-15	YOY/fathead minnow	FF	WC	7/31/2010	Composite from 2 locations	0.08		0.11	J	0.67		0.16		0.52		0.22		22.94	J
Prickly Pear Creek	PPC-22	FF-01	Mottled sculpin	FF	WC	7/28/2010		0.00		0.06	U	0.11		0.00	J	0.01	U	0.07		8.00	
Prickly Pear Creek	PPC-22	FF-02	Mottled sculpin	FF	WC	7/28/2010		0.01		0.07	U	0.10		0.00	J	0.01	U	0.08		6.75	
Prickly Pear Creek	PPC-22	FF-03	Mottled sculpin	FF	WC	7/28/2010		0.01		0.06	U	0.09		0.00	J	0.01	U	0.08		6.33	
Upper Lake/Marsh	UL-21B	FF-06	White sucker	FF	WC	7/30/2010	West of UL-21	0.02		0.02	J	0.10	J	0.01		0.01	U	0.03	J	6.67	
Upper Lake/Marsh	UL-21B	FF-07	Fathead minnow	FF	WC	7/30/2010	West of UL-21	0.02		0.02	J	0.08	J	0.01		0.01	U	0.04	J	9.02	
Upper Lake/Marsh	UL-21A	FF-08	White sucker	FF	WC	7/30/2010	East of UL-21	0.02		0.02	J	0.08	J	0.03		0.01	U	0.04	J	6.07	
Upper Lake/Marsh	UL-21A	FF-09	Fathead minnow	FF	WC	7/30/2010	East of UL-21	0.01		0.04	J	0.09	J	0.01		0.02	U	0.07	J	10.14	
Upper Lake/Marsh	UL-21A	FF-10	White sucker	FF	WC	7/30/2010	East of UL-21	0.02		0.01	J	0.07	J	0.01		0.01	U	0.03	J	5.43	
Upper Lake/Marsh	ULM	ULM	Forage fish	FF	WC	9/23/2003		0.07		nm		5.00	U	nm		nm		nm		66.00	
Upper Lake/Marsh	ULM-3	FF-04	YOY	FF	WC	7/29/2010		0.01		0.26	U	0.14		0.01	J	0.05	U	0.09	J	16.80	
Upper Lake/Marsh	ULM-5	FF-05	YOY	FF	WC	7/29/2010		0.01		0.02	J	0.07		0.01		0.01	U	0.07	J	12.78	
Upper Lake/Marsh	ULM-2	FF-11	Fathead minnow	FF	WC	7/30/2010		0.02		0.07	U	0.12	J	0.01		0.01	U	0.05	J	10.86	
Upper Lake/Marsh	ULM-2	FF-12	Longnose dace	FF	WC	7/30/2010		0.03		0.08	U	0.16	J	0.00	J	0.01	U	0.03	J	11.85	
Wilson Ditch	WD-2	FF-16	YOY	FF	WC	8/1/2010		0.01	J	0.01	J	0.04	J	0.01		0.003	J	0.06	J	8.87	
Piscivorous Fish Samples																					
Prickly Pear Creek	PPC-22	PF-01	Brown trout	PF	WI	7/28/2010		0.01		0.07	U	0.11		0.00	J	0.01	U	0.03		9.27	
Prickly Pear Creek	PPC-22	PF-02	Brown trout	PF	WI	7/28/2010		0.01		0.08	U	0.21		0.00	J	0.01	U	0.03		20.61	
Prickly Pear Creek	PPC-22	PF-03	Brown trout	PF	WI	7/28/2010		0.08		0.07	U	0.14		0.01		0.002	J	0.03		8.94	
Prickly Pear Creek	PPC-102/103	PF-04	Brown trout	PF	WI	7/28/2010	Collected between PPC102/103	0.01		0.07	U	0.17		0.00	J	0.01	U	0.02		19.82	
Prickly Pear Creek	PPC-24	PF-10	Brown trout	PF	WI	8/1/2010		0.01	J	0.07	U	0.10	J	0.00	J	0.01	U	0.06	J	6.69	
Upper Lake/Marsh	UL-21	PF-05	White sucker	PF	WC	7/31/2010	Near UL-21	0.03	J	0.04	J	0.07	J	0.00	J	0.01	U	0.05	J	4.47	J
Upper Lake/Marsh	UL-21	PF-06	White sucker	PF	WC	7/31/2010	Near UL-21	0.02	J	0.07	U	0.06	J	0.01	J	0.01	U	0.04	J	3.52	J
Upper Lake/Marsh	UL-21	PF-07	White sucker	PF	WC	7/31/2010	Near UL-21	0.01	J	0.07	U	0.07	J	0.01	J	0.01	U	0.04	J	4.34	J
Upper Lake/Marsh	UL-21	PF-08	White sucker	PF	WC	7/31/2010	Near UL-21	0.03	J	0.07	U	0.06	J	0.00	J	0.01	U	0.04	J	3.56	J
Upper Lake/Marsh	UL-21	PF-09	White sucker	PF	WC	7/31/2010	Near UL-21	0.02	J	0.07	U	0.06	J	0.01		0.01	U	0.05	J	4.01	J
Upper Lake/Marsh	UL-23	GF-09-Whole	Rainbow trout	PF	WI	7/30/2010	Whole body estimated [a]	0.05		0.10	U	0.12		0.01		0.01		0.02		4.59	
Upper Lake/Marsh	UL-21	GF-10-Whole	Brown trout	PF	WI	7/30/2010	Whole body estimated [a]	0.05		0.08	U	0.11		0.01		0.01	U	0.02		8.46	
Upper Lake/Marsh	UL-21	GF-11-Whole	Brown trout	PF	WI	7/31/2010	Whole body estimated [a]	0.03		0.08	U	0.10		0.01		0.01	U	0.02		12.09	
Upper Lake/Marsh	UL-23	GF-13-Whole	Brown trout	PF	WI	7/31/2010	Whole body estimated [a]	0.06		0.07	U	0.12		0.01		0.01	U	0.02		6.36	
Upper Lake/Marsh	UL-23	GF-14-Whole	Rainbow trout	PF	WI	7/31/2010	Whole body estimated [a]	0.03		0.08	U	0.12		0.00		0.01		0.02		9.11	
Game Fish Samples																					
Prickly Pear Creek	PPC-102/103	GF-07	Brown trout	GFF	FI	7/28/2010	Collected between PPC102/103	0.04		0.07	U	0.12		0.00	U	0.01	J	0.02	J	2.00	
Prickly Pear Creek	PPC-102/103	GF-08	Brown trout	GFF	FI	7/28/2010	Collected between PPC102/103	0.03		0.07	U	0.14	J	0.00	U	0.01	U	0.02	J	1.80	
Prickly Pear Creek	PPC-24	GF-15	Brown trout	GFF	FI	8/1/2010		0.03	J	0.06	U	0.08		0.01	U	0.01	U	0.01	J	3.35	
Prickly Pear Creek	PPC-24	GF-16	Brown trout	GFF	FI	8/1/2010		0.02	J	0.04	J	0.11		0.01	U	0.01	U	0.02	J	3.08	
Prickly Pear Creek	PPC-24	GF-17	Brown trout	GFF	FI	8/1/2010		0.01	J	0.06	U	0.08		0.01	U	0.01	U	0.02		3.23	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-01	Brown trout	GFF	FI	7/27/2010		0.01		0.02	J	0.07		0.01	U	0.01	U	0.02	J	4.02	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-02	Brown trout	GFF	FI	7/27/2010		0.02		0.07	U	0.10		0.00	J	0.00	J	0.02	J	2.85	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-03	Brown trout	GFF	FI	7/27/2010		0.01		0.06	U	0.08		0.00	U	0.01	U	0.02	J	2.40	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-04	Brown trout	GFF	FI	7/27/2010		0.01		0.06	U	0.07		0.00	U	0.01	U	0.02	J	2.16	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-05	Brown trout	GFF	FI	7/27/2010		0.01		0.07	U	0.08		0.00	U	0.01	U	0.02	J	3.15	
Prickly Pear Creek (Ref)	PPC-REF-4	GF-06	Brown trout	GFF	FI	7/27/2010		0.00		0.06	U	0.07		0.00	U	0.01	U	0.02	J	2.29	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		nm		nm		5	U	nm		nm		nm		13	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		nm		nm		5	U	nm		nm		nm		5	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	GFF	FI	9/23/2003		0.217		nm		nm		nm		nm		nm		nm	
Upper Lake/Marsh	UL-23	GF-09-Fillet	Rainbow trout	GFF	FI	7/30/2010	Near UL-23	0.05	J	0.09	U	0.08		0.01	U	0.01	U	0.01	J	1.72	
Upper Lake/Marsh	UL-21	GF-10-Fillet	Brown trout	GFF	FI	7/30/2010	Near UL-21	0.05	J	0.08	U	0.09		0.01	J	0.01	U	0.02	J	2.72	
Upper Lake/Marsh	UL-21	GF-11-Fillet	Brown trout	GFF	FI	7/31/2010	Near UL-21	0.03	J	0.07	U	0.08		0.01	J	0.01	U	0.01	J	3.45	

Table B-11. Fish Tissue Chemistry Data (Total Metals)

CSM Unit	Location ID	Sample ID	Species	Sample Type	Tissue Type	Sample Date	Comments	Total Metals (mg/kg wet weight)										
								Solids	Al		Sb		As		Ba		Be	
								%	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Upper Lake/Marsh	UL-23	GF-13-Fillet	Brown trout	GFF	FI	7/31/2010	Near UL-23	22.5	0.27	J	0.05	U	0.03		0.08	J	0.01	U
Upper Lake/Marsh	UL-23	GF-14-Fillet	Rainbow trout	GFF	FI	7/31/2010	Near UL-23	27.6	0.25	J	0.06	U	0.04	J	0.03	J	0.01	U
Walker Pond (Ref)	WP	GF-18	Rainbow trout	GFF	FI	8/3/2010		17.1	0.26	J	0.02	J	0.04		0.01	J	0.01	U
Walker Pond (Ref)	WP	GF-19	Rainbow trout	GFF	FI	8/3/2010		17.7	0.27	J	0.02	J	0.04		0.02	J	0.01	U
Walker Pond (Ref)	WP	GF-20	Rainbow trout	GFF	FI	8/3/2010		17.2	0.24	J	0.02	J	0.07		0.02	J	0.01	U
Walker Pond (Ref)	WP	GF-21	Rainbow trout	GFF	FI	8/3/2010		16.3	0.21	J	0.02	J	0.10		0.02	J	0.01	U
Walker Pond (Ref)	WP	GF-22	Rainbow trout	GFF	FI	8/3/2010		17.2	0.24	J	0.02	J	0.03	J	0.02	J	0.01	U
Miscellaneous Fish Samples																		
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Kidney	IND	9/30/2003		nm	nm		nm		2	U	nm		nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Liver	IND	9/30/2003		nm	nm		nm		2	U	nm		nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Whole Fish	WI	9/30/2003		nm	nm		nm		-		nm		nm	
Upper Lake/Marsh	ULM_11	ULM_11	Rainbow trout	Stomach contents	IND	9/30/2003		nm	nm		nm		2	U	nm		nm	
Upper Lake/Marsh	ULM_3	ULM_3	Rainbow trout	Stomach contents	IND	9/30/2003		nm	nm		nm		2	U	nm		nm	
Upper Lake/Marsh	UL	UL	Rainbow trout	Stomach contents	IND	9/30/2003		nm	nm		nm		3		nm		nm	
Upper Lake/Marsh	UL-23	GF-09-Carcass	Rainbow trout	GFC	IND	7/30/2010	Near UL-23	38.1	1.10	J	0.08	J	0.08	0	0.76		0.02	U
Upper Lake/Marsh	UL-21	GF-10-Carcass	Brown trout	GFC	IND	7/30/2010	Near UL-21	27.3	2.29	J	0.05	U	0.08	0	0.80	J	0.01	U
Upper Lake/Marsh	UL-21	GF-11-Carcass	Brown trout	GFC	IND	7/31/2010	Near UL-21	31.2	2.46	J	0.02	U	0.09	0	0.94		0.02	U
Upper Lake/Marsh	UL-23	GF-13-Carcass	Brown trout	GFC	IND	7/31/2010	Near UL-23	25.3	1.06	J	0.05	U	0.06	0	0.95		0.01	U
Upper Lake/Marsh	UL-23	GF-14-Carcass	Rainbow trout	GFC	IND	7/31/2010	Near UL-23	27.6	0.99	J	0.06	U	0.06	0	0.56	UJ	0.01	U

Notes:

nr = not reported
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R = rejected

FF = forage fish
PF = piscivorous fish
GFF = game fish fillet
GFC = game fish carcass
FI = Individual fish fillet

IND = individual fish sample
WC = whole body composite
WI = whole body individual
YOY = young of the year

(a) Whole body concentration estimated using the following equation:

$$C_{whole} = ((C_f \times W_f) + (C_c \times W_c)) / (W_f + W_c)$$

Where:

C_{whole} *= concentration in whole body*
C_f *= concentration in fillet*
C_c *= concentration in carcass*
W_f *= weight of fillet*
W_c *= weight of carcass*

Table B-11. Fish Tissue Chemistry Data (Total Metals)

								Total Metals (mg/kg wet weight)													
				Sample	Tissue	Sample		Cd		Cr		Co		Cu		Fe		Pb		Mn	
CSM Unit	Location ID	Sample ID	Species	Type	Type	Date	Comments	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Upper Lake/Marsh	UL-23	GF-13-Fillet	Brown trout	GFF	FI	7/31/2010	Near UL-23	0.00		0.19		0.00		0.17		3.40	J	0.04		0.16	
Upper Lake/Marsh	UL-23	GF-14-Fillet	Rainbow trout	GFF	FI	7/31/2010	Near UL-23	0.01		0.02		0.00		0.16		1.32	J	0.07		0.22	
Walker Pond (Ref)	WP	GF-18	Rainbow trout	GFF	FI	8/3/2010		0.01	U	0.03	U	0.00	J	0.06		1.30		0.02		0.03	J
Walker Pond (Ref)	WP	GF-19	Rainbow trout	GFF	FI	8/3/2010		0.01	U	0.04	U	0.00	J	0.08		1.27		0.04		0.19	
Walker Pond (Ref)	WP	GF-20	Rainbow trout	GFF	FI	8/3/2010		0.01	U	0.03	U	0.00	J	0.11		1.72		0.01		0.43	
Walker Pond (Ref)	WP	GF-21	Rainbow trout	GFF	FI	8/3/2010		0.01	U	0.01	J	0.00	J	0.15		1.42		0.01		0.05	J
Walker Pond (Ref)	WP	GF-22	Rainbow trout	GFF	FI	8/3/2010		0.01	U	0.03	U	0.00	J	0.07		1.14		0.01		0.12	
Miscellaneous Fish Samples																					
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Kidney	IND	9/30/2003		0.2	U	nm		nm		2.1		nm		0.8	U	nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Liver	IND	9/30/2003		0.9		nm		nm		140.1		nm		1.3		nm	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Whole Fish	WI	9/30/2003		-		nm		nm		-		nm		-		nm	
Upper Lake/Marsh	ULM_11	ULM_11	Rainbow trout	Stomach contents	IND	9/30/2003		0.4		nm		nm		9.2		nm		3.1		nm	
Upper Lake/Marsh	ULM_3	ULM_3	Rainbow trout	Stomach contents	IND	9/30/2003		0.4		nm		nm		7.2		nm		3.4		nm	
Upper Lake/Marsh	UL	UL	Rainbow trout	Stomach contents	IND	9/30/2003		9.6		nm		nm		18.5		nm		159.8		nm	
Upper Lake/Marsh	UL-23	GF-09-Carcass	Rainbow trout	GFC	IND	7/30/2010	Near UL-23	0.03		0.08	J	0.01		1.29		7.51		0.12		2.44	
Upper Lake/Marsh	UL-21	GF-10-Carcass	Brown trout	GFC	IND	7/30/2010	Near UL-21	0.02		0.02	J	0.01		1.11		6.47		0.19		3.22	
Upper Lake/Marsh	UL-21	GF-11-Carcass	Brown trout	GFC	IND	7/31/2010	Near UL-21	0.02		0.02	J	0.01		0.89		6.30		0.36		1.81	
Upper Lake/Marsh	UL-23	GF-13-Carcass	Brown trout	GFC	IND	7/31/2010	Near UL-23	0.04	U	0.07	U	0.01		1.41		7.69		0.19		3.19	
Upper Lake/Marsh	UL-23	GF-14-Carcass	Rainbow trout	GFC	IND	7/31/2010	Near UL-23	0.03	J	0.12	J	0.01		0.96		5.00	J	0.69		3.37	

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FI = Individual fish fillet

IND = individual fish sample
WC = whole body composite
WI = whole body individual
YOY = young of the year

(a) Whole body concentration estimated using the following equation:

$$C_{whole} = ((C_f \times W_f) + (C_c \times W_c)) / (W_f + W_c)$$

Where:

C_{whole} = *concentration in whole body*
C_f = *concentration in fillet*
C_c = *concentration in carcass*
W_f = *weight of fillet*
W_c = *weight of carcass*

Table B-11. Fish Tissue Chemistry Data (Total Metals)

								Total Metals (mg/kg wet weight)													
								Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	Location ID	Sample ID	Species	Sample Type	Tissue Type	Sample Date	Comments	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Upper Lake/Marsh	UL-23	GF-13-Fillet	Brown trout	GFF	FI	7/31/2010	Near UL-23	0.06	J	0.07	U	0.08		0.01	J	0.01	U	0.01	J	2.72	
Upper Lake/Marsh	UL-23	GF-14-Fillet	Rainbow trout	GFF	FI	7/31/2010	Near UL-23	0.03	J	0.08	U	0.11		0.00	J	0.01	J	0.01		3.48	
Walker Pond (Ref)	WP	GF-18	Rainbow trout	GFF	FI	8/3/2010		0.02		0.05	U	0.02		0.01	U	0.01	U	0.02	U	0.89	J
Walker Pond (Ref)	WP	GF-19	Rainbow trout	GFF	FI	8/3/2010		0.01		0.05	U	0.02		0.01	U	0.01	U	0.01	J	1.49	J
Walker Pond (Ref)	WP	GF-20	Rainbow trout	GFF	FI	8/3/2010		0.01		0.05	U	0.03		0.01	U	0.01	U	0.01	J	1.70	J
Walker Pond (Ref)	WP	GF-21	Rainbow trout	GFF	FI	8/3/2010		0.01		0.03	J	0.02		0.00	U	0.01	U	0.01	J	1.89	J
Walker Pond (Ref)	WP	GF-22	Rainbow trout	GFF	FI	8/3/2010		0.01		0.05	U	0.03		0.01	U	0.01	U	0.01	J	1.41	J
Miscellaneous Fish Samples																					
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Kidney	IND	9/30/2003		-		nm		5	U	nm		nm		nm		35	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Liver	IND	9/30/2003		-		nm		12		nm		nm		nm		51	
Upper Lake/Marsh	ULM	ULM	Rainbow trout	Whole Fish	WI	9/30/2003		0.106		nm		-		nm		nm		nm		-	
Upper Lake/Marsh	ULM_11	ULM_11	Rainbow trout	Stomach contents	IND	9/30/2003				nm		5	U	nm		nm		nm		64	
Upper Lake/Marsh	ULM_3	ULM_3	Rainbow trout	Stomach contents	IND	9/30/2003				nm		5	U	nm		nm		nm		51	
Upper Lake/Marsh	UL	UL	Rainbow trout	Stomach contents	IND	9/30/2003				nm		5	U	nm		nm		nm		188	
Upper Lake/Marsh	UL-23	GF-09-Carcass	Rainbow trout	GFC	IND	7/30/2010	Near UL-23	0.06	J	0.11	U	0.20	J	0.00	0	0.00	U	0.02	J	10.33	J
Upper Lake/Marsh	UL-21	GF-10-Carcass	Brown trout	GFC	IND	7/30/2010	Near UL-21	0.04		0.08	U	0.13		0.01	J	0.01	J	0.02	J	13.35	
Upper Lake/Marsh	UL-21	GF-11-Carcass	Brown trout	GFC	IND	7/31/2010	Near UL-21	0.04		0.09	U	0.14		0.01	U	0.02	U	0.02	J	19.75	
Upper Lake/Marsh	UL-23	GF-13-Carcass	Brown trout	GFC	IND	7/31/2010	Near UL-23	0.05		0.08	U	0.15	J	0.01	U	0.01	U	0.02	J	9.56	
Upper Lake/Marsh	UL-23	GF-14-Carcass	Rainbow trout	GFC	IND	7/31/2010	Near UL-23	0.03	J	0.08	U	0.15		0.00	U	0.00	U	0.03		17.19	

Notes:

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GFF = game fish fillet
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WC = whole body composite
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YOY = young of the year

(a) Whole body concentration estimated using the following equation:

$$C_{whole} = ((C_f \times W_f) + (C_c \times W_c)) / (W_f + W_c)$$

Where:

C_{whole} = *concentration in whole body*
C_f = *concentration in fillet*
C_c = *concentration in carcass*
W_f = *weight of fillet*
W_c = *weight of carcass*

Table B-12. Fish Tissue Arsenic Speciation Data

				Sample		Solids	Total As		Total Inorganic As		Arsenic ^{III}		Arsenic ^{V}	
CSM Unit	**Location ID**	**Sample ID**	**Sample Type**	**Date**	**Comments**	**%**	**mg/kg-dw**	**Q**	**mg/kg-dw**	**Q**	**mg/kg-dw**	**Q**	**mg/kg-dw**	**Q**
Prickly Pear Creek (Ref)	PPC-REF-4	GF-01	Brown trout-Fillet	7/27/2010		25.1	0.51		0.018		0.021		0.003	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-02	Brown trout-Fillet	7/27/2010		23.2	0.44		0.004	J	0.004	J	0.003	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-03	Brown trout-Fillet	7/27/2010		20.9	0.54		0.003	U	0.003	U	0.003	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-04	Brown trout-Fillet	7/27/2010		19.6	0.37		0.01	J	0.01		0.003	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-05	Brown trout-Fillet	7/27/2010		21.9	0.32		0.008	J	0.008	J	0.003	U
Prickly Pear Creek (Ref)	PPC-REF-4	GF-06	Brown trout-Fillet	7/27/2010		20.3	0.41		0.01		0.014		0.003	U
Prickly Pear Creek	PPC-102/103	GF-07	Brown trout-Fillet	7/28/2010	Collected between PPC102/103	22.2	0.51		0.006	J	0.005	J	0.003	U
Prickly Pear Creek	PPC-102/103	GF-08	Brown trout-Fillet	7/28/2010	Collected between PPC102/103	22.8	0.26		0.003	U	0.003	U	0.003	U
Prickly Pear Creek	PPC-24	GF-15	Brown trout-Fillet	8/1/2010		20.8	0.12	J	0.005	J	0.004	J	0.003	U
Prickly Pear Creek	PPC-24	GF-16	Brown trout-Fillet	8/1/2010		28	0.11	J	0.014		0.016		0.003	U
Prickly Pear Creek	PPC-24	GF-17	Brown trout-Fillet	8/1/2010		19.7	0.38		0.088		0.104		0.003	U
Upper Lake/Marsh	UL-23	GF-09-Fillet	Rainbow trout-Fillet	7/30/2010	Near UL-23	29.6	0.09	J	0.003	U	0.003	U	0.003	U
Upper Lake/Marsh	UL-21	GF-10-Fillet	Brown trout-Fillet	7/30/2010	Near UL-21	26.4	0.18	J	0.01	J	0.011		0.003	U
Upper Lake/Marsh	UL-21	GF-11-Fillet	Brown trout-Fillet	7/31/2010	Near UL-21	24.3	0.15	J	0.015		0.013		0.003	U
Upper Lake/Marsh	UL-23	GF-13-Fillet	Brown trout-Fillet	7/31/2010	Near UL-23	22.5	0.12	J	0.006	J	0.004	J	0.003	U
Upper Lake/Marsh	UL-23	GF-14-Fillet	Rainbow trout-Fillet	7/31/2010	Near UL-23	27.6	0.13	J	0.009	J	0.008	J	0.003	U
Walker Creek (Pond)	WP	GF-18	Rainbow trout-Fillet	8/3/2010		17.1	0.21		0.004	J	0.003	U	0.003	U
Walker Creek (Pond)	WP	GF-19	Rainbow trout-Fillet	8/3/2010		17.7	0.21		0.017		0.013		0.003	U
Walker Creek (Pond)	WP	GF-20	Rainbow trout-Fillet	8/3/2010		17.2	0.38		0.008	J	0.011		0.003	U
Walker Creek (Pond)	WP	GF-21	Rainbow trout-Fillet	8/3/2010		16.3	0.63		0.043		0.03		0.013	
Walker Creek (Pond)	WP	GF-22	Rainbow trout-Fillet	8/3/2010		17.2	0.2	J	0.031		0.012		0.018	

Notes:

U = not detected

J = estimated value

Table B-13. Aquatic Plant Tissue Chemistry Data (Total Metals)

				Aquatic Plant Tissue (mg/kg-wet weight)												
				Solids	**As**		**Cd**		**Cu**		**Pb**		**Se**		**Zn**	
Location	**Sample ID**	**Sample Type**	**Sample Date**	**%**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Canyon Ferry (Ref)	CFR_1	Plant/Alage	10/1/2003	nr	2	U	0.6		5.8		11.4		5	U	18	
Upper Lake/Marsh	ULM_1	Plant/Alage	9/30/2003	nr	2	U	0.4		1.7		3		5	U	8	
Upper Lake/Marsh	UL_comp.	Plant/Alage	9/30/2003	nr	11		1.5		10.4		21.2		5	U	45	
Upper Lake/Marsh	UL_comp.	Plant/Alage	9/30/2003	nr	3		1.8		4.9		29.4		5	U	46	
Upper Lake/Marsh	ULM_11	Plant/Alage	9/30/2003	nr	4		1.2		8.4		37.8		5	U	35	
Upper Lake/Marsh	ULM_2	Plant/Alage	9/30/2003	nr	11		0.9		6.3		10.4		5	U	51	
Upper Lake/Marsh	ULM_5	Plant/Alage	9/30/2003	nr	4		1.4		14.3		50		5	U	73	
Upper Lake/Marsh	ULM_8	Plant/Alage	9/30/2003	nr	15		2.6		7.4		13.4		5	U	63	
Upper Lake/Marsh	ULM_9	Plant/Alage	9/30/2003	nr	17		4.2		18.8		41.8		5	U	94	

Data Source: US EPA (2005)

Notes:

nr = not reported

U = not detected

Table B-14. Amphibian Tissue Chemistry Data (Total Metals)

						Total Metals (mg/kg dry-weight)																																					
				Sample	Solids	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
Location	Sample ID	Species	Comment	Date	%	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Prickly Pear Creek/ Upper Lake Marsh	AP-01	Columbia spotted frog	Individual collected between PPC-22 & ULM-1	7/28/2010	17.2	14.9		0.14	J	0.73		1.87		0.05	U	2.25		0.42		0.038		6.27		39.9		2.63		48.6		0.032		0.08	J	0.47		0.047		0.04	J	0.05	J	36.7	J
Prickly Pear Creek/ Upper Lake Marsh	AP-02	Columbia spotted frog	Individual collected between PPC-22 & ULM-1	7/29/2010	14.9	5.3		0.13	J	0.4		1.64		0.05	U	1.13		0.18	J	0.034		4.06		22.8		3.24		67.9		0.071		0.3	U	0.45		0.044		0.04	J	0.1	U	37.5	J
Prickly Pear Creek/ Upper Lake Marsh	AP-03	Columbia spotted frog	Individual collected between PPC-22 & ULM-1	7/31/2010	17.1	5	J	0.13	J	0.36		1.5		0.08	U	1.88		0.18	J	0.036	J	7.04		21.5		2.22		82		0.046		0.5	U	0.37		0.034	J	0.03	J	0.2	U	44.6	J
Prickly Pear Creek/ Upper Lake Marsh	AP-04	Columbia spotted frog	Individual collected between PPC-22 & ULM-1	8/1/2010	14.8	6.6		0.10	J	0.27	J	1.77		0.08	U	1.19		0.15	J	0.021	J	5.35		26.5		1.17		98.4		0.061		0.13	J	0.36		0.054		0.08	U	0.2	U	32.2	J
Walker Pond	AP-05	Columbia spotted frog	Individual collected from Walker Pond	8/3/2010	16.4	2.7	J	0.08	J	0.53		5.4		0.06	U	0.05	J	0.27	J	0.02	J	2.25		26.9		0.02	J	10.6		0.023		0.4	U	0.16		0.007	J	0.06	U	0.1	U	23.8	J

Notes:

U = not detected

J = estimated value

Table B-15. Terrestrial Invertebrate Tissue Chemistry Data (Total Metals)

							Total Metals (mg/kg dry-weight)																																								
					Sample	Solids	Al		Sb		As		Ba		Be		Cd		Cr		Co		Cu		Fe		Pb		Mn		Hg		Ni		Se		Ag		Tl		V		Zn	
CSM Unit	**Location ID**	**Sample ID**	**Sample Type**	**Comment**	**Date**	**%**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Lower Lake	LL-BK-1/3	SI-01	Soil Inverts	Composite from 2 bank locations	7/30/2010	46.5	901		4.7		16.1		19.6	J	0.05	J	12.7		1.52		0.782		76.5		1370		160		197		0.782		2.3		10.8		2.8		1.16		3.2		151	
Lower Lake	LL-BK-1/2/3/4	SI-02	Soil Inverts	Composite from 4 bank locations	8/1/2010	46.4	2070		6.6	J	29.7		32.5		0.5	U	19		3		1.42		123		2670		275		165		0.989		4.2		9.4		5.69		1.3		6.93		188	
Prickly Pear Creek	PPC-RZ-2	EW-01	Earthworm	East of slag pile	7/31/2010	10.3	261		0.7	J	23.3		5.2		0.2	U	8.83		0.6	J	0.14		9.1	J	543		23.6		75.1		0.146		1	U	2.13		0.28		0.2	U	2.2	J	99	
Prickly Pear Creek	PPC-RZ-2	EW-04	Earthworm	East of slag pile	8/3/2010	12.6	237		1.4	J	41.8		3.53		0.1	U	19.4		0.3	J	0.27		14.9	J	464		28.4		62		0.298		0.3	J	2.69		0.33		0.07	J	0.88	J	132	
Prickly Pear Creek	PPC-RZ-4	SI-03	Soil Inverts		8/1/2010	32.8	329		5.1	J	12.6		17.1		0.4	U	16.1		1.1	J	0.56		51.5		1180		176		405		0.286		1.1	J	1.38		2.3		0.4	U	1.77	J	330	
Prickly Pear Creek	PPC-RZ-2/4/5	SI-07	Soil Inverts	Composite from 3 riparian locations	8/5/2010	18.9	155		2.7		8.1		7.5		0.3	U	19.9		0.4	J	0.36		83.3		336		46.5		902		0.079	J	2	U	1.28		0.92		0.13	J	0.7		343	
Site Perimeter (East)	UOS-SS-17	SI-05	Aerial/Foliar Inverts		8/4/2010	41.3	80		0.47		3.1		2.88		0.05	U	3.32		0.25		0.096		88.3		208		7.42		27.6		0.0127	J	0.16	J	0.89		0.064		0.01	J	0.45		89.5	
Site Perimeter (East)	UOS-SS-17/20	SI-10	Soil Inverts	Composite from 2 locations	8/5/2010	48.2	2360		24		95.7		30.3		0.25		50.5		4.2		2.19		256		4190		931		203		2.52	J	4.3		4.9		10.7		1.7		9.02		533	
Site Perimeter (West)	UOS-SS-2/9	SI-04	Aerial/Foliar Inverts	Composite from 2 locations	8/4/2010	31.2	91.7		2		8.21		2.33		0.06	U	5.16		0.21		0.1		29.7		154		36.8		10.3		0.0843	J	0.29	J	1.59		0.427		0.13		0.33		83.7	
Site Perimeter (West)	UOS-SS-2/9/12	SI-11	Soil Inverts	Composite from 3 locations	8/5/2010	37	882		5		14.7		20.5		0.06	J	26.1		1.4		0.56		47.5		1170		108		93.8		0.234	J	1.5		3.09		1.22		0.32		3.4		173	
Tito Park	UOS-SS-8/10/14/21/22	SI-06	Aerial/Foliar Inverts	Composite from Tito Park Area	8/4/2010	33.5	561		3.11		6.06		7.8		0.04	J	6.55		1.1		0.39		51.4		788		45.8		27.5		0.509	J	0.9		4.04		0.716		0.5		2.17		91.5	
Tito Park	UOS-SS-8/10/14/21/22	SI-09	Soil Inverts	Composite from Tito Park Area	8/5/2010	42.4	576		2.9		11		13.1		0.4	U	15.7		1	J	0.37		35.9		605		43.2		43		0.232	J	2.2	J	7.58		0.46		0.29	J	2.9		152	
Upper Lake/Marsh	ULM-27	EW-02	Earthworm	Near PPC diversion - riparian zone	8/1/2010	16.8	1030		0.5	J	20.6		12.8		0.3	U	6.58		1.2		0.71		13.6	J	1870		31.2		144		0.0836		0.8	J	1.12		0.36		0.3	U	9.25		244	
Upper Lake/Marsh	ULM-27	EW-03	Earthworm	Near PPC diversion - riparian zone	8/3/2010	15.9	401		0.3	J	15.1		5.1		0.1	U	15.3		0.5	J	0.29		7.8	J	692		15.2		57.4		0.0818		0.3	J	0.74		0.2		0.1	U	1.4	J	157	
Upper Lake/Marsh	ULM-27	EW-05	Earthworm	Near PPC diversion - riparian zone	8/3/2010	16.7	593		0.5	J	20.4		7.4		0.2	U	20.5		0.8		0.41		10.6	J	1090		25		79.7		0.101		0.4	J	1.22		0.3		0.2	U	2.61	J	245	
Upper Lake/Marsh	ULM-27	EW-06	Earthworm	Near PPC diversion - riparian zone	8/3/2010	13.4	320		0.3	J	18.1		4.01		0.1	U	18.3		0.4	J	0.22		6.4	J	558		13.7		43.7		0.092		0.2	J	0.9		0.19		0.1	U	1.07	J	148	
Upper Lake/Marsh	UL-BK-1/2/3/4	SI-08	Soil Inverts	Composite from 4 bank locations	8/5/2010	36.7	854		1.8		12.1		11.6		0.11		11.3		0.8		0.41		32.5		909		107		48.7		0.582	J	1		6.06		0.87		0.21		1.85		109	
Walker Creek (Ref)	WPS-2	EW-07	Earthworm		8/4/2010	18.2	783		0.2	J	1.4		13		0.1	U	0.67		1		1.1		6.8		1310		1.13		30.8		0.0338	J	0.7	J	0.48		0.08		0.1	U	3.66		53.8	
Walker Creek (Ref)	WPS-2	EW-08	Earthworm		8/4/2010	17.4	641		0.15	J	0.86		11.1		0.08	U	0.63		0.66		1.23		3.56		1050		0.64		23.5		0.0244	J	0.4	J	0.41		0.019	J	0.08	U	2.6		32.6	
Walker Creek (Ref)	WPS-1	EW-09	Earthworm		8/4/2010	22.2	1020		0.12	J	0.89		20.8		0.04	J	0.98		0.97		1.36		5.06		1720		0.67		65.5		0.053	J	0.8		1.13		0.031	J	0.02	J	3.54		49.5	
Walker Creek (Ref)	WPS-1	EW-10	Earthworm		8/4/2010	18.6	1040		0.15	J	1.2		21.6		0.04	J	0.82		1.13		1.35		6.64		2020		0.82		66.3		0.117	J	0.9		1.16		0.035	J	0.02	J	3.86		52.7	
Walker Creek (Ref)	WPS-3	EW-11	Earthworm		8/4/2010	18.2	1010		0.12	J	1.83		17.3		0.03	J	1.3		0.83		1.05		3.75		1410		1.28		60.9		0.0825	J	0.55		1.63		0.037		0.02	J	2.94		44	
Walker Creek (Ref)	WPS-3	EW-12	Earthworm		8/4/2010	17.2	1120		0.1	J	1.65		18.5		0.03	J	1.14		1.02		0.89		4		1550		1.32		66		0.064	J	0.57		0.99		0.028	J	0.02	J	3.06		40.8	

Notes:

U = not detected

J = estimated value

Table B-16. Total and Methyl Mercury Concentrations in Invertebrate Tissues

						Total Metals (mg/kg dry-weight)					Total Metals (mg/kg wet-weight)			
				Sample	Solids	Hg		MeHg			Hg		MeHg	
CSM Unit	**Location ID**	**Sample ID**	**Sample Type**	**Date**	**%**	**mg/kg**	**Q**	**mg/kg**	**Q**	**% MeHg**	**mg/kg**	**Q**	**mg/kg**	**Q**
Aquatic Invertebrates														
Lower Lake	LL-22	BI-23	Benthic Inverts	7/31/2010	24.1	0.199		0.0698		35%	0.048		0.0168	
Lower Lake	LL-25	BI-24	Benthic Inverts	7/31/2010	19.4	0.756	J	0.0597		8%	0.147	J	0.0116	
Lower Lake	LL-22/25	OA-10	Other Inverts	7/31/2010	27.3	0.634	J	0.0047		1%	0.173	J	0.0013	
Prickly Pear Creek	PPC-103	BI-09	Benthic Inverts	7/28/2010	16.5	0.0706		0.0230		33%	0.012		0.0038	
Prickly Pear Creek	PPC-5	BI-07	Benthic Inverts	7/28/2010	16.1	0.0418		0.0075		18%	0.007		0.0012	
Prickly Pear Creek	PPC-103	OA-02	Other Inverts	7/28/2010	18	0.147		0.009		6%	0.026		0.0016	
Prickly Pear Creek	PPC-24	OA-12	Other Inverts	8/1/2010	28.1	0.083	J	0.0063		8%	0.023	J	0.0018	
Upper Lake	UL-21A	BI-17	Benthic Inverts	7/30/2010	13.9	0.362	J	0.0738		20%	0.050	J	0.0103	
Upper Lake	UL-24	BI-19	Benthic Inverts	7/30/2010	17.2	0.365		0.0529		14%	0.063		0.0091	
Upper Lake	UL-21B	BI-18	Benthic Inverts	7/30/2010	14.7	0.133		0.052		39%	0.020		0.0076	
Upper Lake	UL-23	BI-20	Benthic Inverts	7/30/2010	19.1	0.233		0.0248		11%	0.045		0.0047	
Upper Lake	UL-21B/23	OA-05	Other Inverts	7/30/2010	17.2	0.422		0.0032		1%	0.073		0.0006	
Upper Lake	UL-23/21A/21B/24	OA-06	Other Inverts	7/30/2010	18.8	0.962		0.0122		1%	0.181		0.0023	
Upper Lake Marsh	ULM-1	BI-12	Benthic Inverts	7/29/2010	16.1	0.0509		0.0289		57%	0.008		0.0047	
Upper Lake Marsh	ULM-3	BI-14	Benthic Inverts	7/29/2010	19.8	0.0382		0.0094		25%	0.008		0.0019	
Upper Lake Marsh	ULM-5	BI-16	Benthic Inverts	7/29/2010	16.5	0.0367		0.0153		42%	0.006		0.0025	
Terrestrial Invertebrates														
Lower Lake	LL-BK-1/3	SI-01	Soil Inverts	7/30/2010	46.5	0.782		0.0912		12%	0.364		0.0424	
Lower Lake	LL-BK-1/2/3/4	SI-02	Soil Inverts	8/1/2010	46.4	0.989		0.0347		4%	0.459		0.0161	
Prickly Pear Creek	PPC-RZ-2	EW-04	Earthworm	8/3/2010	12.6	0.298		0.0247		8%	0.038		0.0031	
Prickly Pear Creek	PPC-RZ-4	SI-03	Soil Inverts	8/1/2010	32.8	0.286		0.0104		4%	0.094		0.0034	
Site Perimeter (East)	UOS-SS-17	SI-05	Aerial/Foliar Inverts	8/4/2010	41.3	0.0127	J	0.0029	J	23%	0.005	J	0.0012	J
Site Perimeter (West)	UOS-SS-2/9	SI-04	Aerial/Foliar Inverts	8/4/2010	31.2	0.0843	J	0.0071		8%	0.026	J	0.0022	
Tito Park	UOS-SS-8/10/14/21/22	SI-06	Aerial/Foliar Inverts	8/4/2010	33.5	0.509	J	0.0069		1%	0.171	J	0.0023	
Upper Lake/Marsh	ULM-27	EW-05	Earthworm	8/3/2010	16.7	0.101		0.0199		20%	0.017		0.0033	

Notes:

U = not detected

J = estimated value

Table B-17. Sediment Toxicity Testing Results

Exposure Area	Station ID	Year	Duration	Method	Species	Mean Survival	Mean Biomass (mg/organism)
Laboratory Control	Control	2003 [a]	10 days	Not reported	*H. azteca*	93%	0.16
Canyon Ferry Reference	CFR_1	2003	10 days	Not reported	*H. azteca*	95%	0.148
Canyon Ferry Reference	CFR_2	2003	10 days	Not reported	*H. azteca*	90%	0.16
Lower Lake	LL_1	2003	10 days	Not reported	*H. azteca*	75% [b]	0.174
Upper Lake	ULM_4	2003	10 days	Not reported	*H. azteca*	98%	0.201
Upper Lake	ULM_10	2003	10 days	Not reported	*H. azteca*	98%	0.22
Upper Lake	ULM_7	2003	10 days	Not reported	*H. azteca*	95%	0.242
Upper Lake	ULM_3	2003	10 days	Not reported	*H. azteca*	90%	0.278
Upper Lake/Marsh Area	ULM_6	2003	10 days	Not reported	*H. azteca*	95%	0.171
Upper Lake/Marsh Area	ULM_12	2003	10 days	Not reported	*H. azteca*	98%	0.247
Laboratory Control	Control	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	99%	0.12
Prickly Pear Creek (upstream)	Ref-PPC-4	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	98%	0.12
Prickly Pear Creek (upstream)	Ref-PPC-6	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	94%	0.12
Prickly Pear Creek (upstream)	Ref-PPC-5	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	93%	0.11
Prickly Pear Creek (upstream)	Ref-PPC-2	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	90%	0.13
Prickly Pear Creek (site)	PPC-24	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	91%	0.12
Prickly Pear Creek (site)	PPC-7	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	89%	0.12
Prickly Pear Creek (site)	PPC-5	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	94%	0.11
Prickly Pear Creek (site)	PPC-103	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	90%	0.11
Prickly Pear Creek (site)	PPC-102	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	45% [b,c]	0.06
Prickly Pear Creek (site)	PPC-22	2010	10 days	EPA 100.1/ASTM E1706-95b	*H. azteca*	95%	0.11
Laboratory Control	Control	2010	10 days	EPA 100.2	*C. dilutus*	94%	0.93
Prickly Pear Creek (upstream)	Ref-PPC-4	2010	10 days	EPA 100.2	*C. dilutus*	95%	0.98
Prickly Pear Creek (upstream)	Ref-PPC-6	2010	10 days	EPA 100.2	*C. dilutus*	93%	0.97
Prickly Pear Creek (upstream)	Ref-PPC-5	2010	10 days	EPA 100.2	*C. dilutus*	95%	0.85
Prickly Pear Creek (upstream)	Ref-PPC-2	2010	10 days	EPA 100.2	*C. dilutus*	93%	1.27
Prickly Pear Creek (site)	PPC-24	2010	10 days	EPA 100.2	*C. dilutus*	96%	1.14
Prickly Pear Creek (site)	PPC-7	2010	10 days	EPA 100.2	*C. dilutus*	95%	0.92
Prickly Pear Creek (site)	PPC-5	2010	10 days	EPA 100.2	*C. dilutus*	91%	1.01
Prickly Pear Creek (site)	PPC-103	2010	10 days	EPA 100.2	*C. dilutus*	89%	1.03
Prickly Pear Creek (site)	PPC-102	2010	10 days	EPA 100.2	*C. dilutus*	89%	1.27
Prickly Pear Creek (site)	PPC-22	2010	10 days	EPA 100.2	*C. dilutus*	86%	1.06

Notes:

(a) 2003 toxicity data as reported by US EPA (2005).

(b) Statistically significant difference from controls ($p<0.05$).

(c) Statistically significant difference from pooled upstream reference sites.

Table B-18. Benthic Invertebrate Community Analysis of Prickly Pear Creek

Order	Taxa	Species	Feeding Group[1]	Species Tolerance Ranking[2]			Relative Abundance Ranking[3]					Comments
				RBP HBI	MT HBI	MT Metals	PPC-1 (Ref)	PPC-2	PPC-3	PPC-4	PPC-5	
Ephemeroptera	Leptohyphidae	Tricoythodes sp.	CG	5	4	4	0	0	0	0	2	
Ephemeroptera	Ephermerellidae	Caudalella sp.	GC	1	0	--	1	0	0	0	0	
Ephemeroptera	Ephermerellidae	Drunetla sp. (I)	SC, PR	0	0	0	2	1	1	0	0	
Ephemeroptera	Ephermerellidae	Drunella sp. (II)	SC, PR	0	0	0	1	0	0	0	0	*D. spinifera*
Ephemeroptera	Ephermerellidae	Ephemeralla sp.	GC	1	1.5	--	2	0	0	0	1	
Ephemeroptera	Leptophlebiidae	Paraleptophlebia sp.	GC	1	1	1	1	1	0	0	1	
Ephemeroptera	Baetidae	Baetis sp.	GC, SC	5	5	4	1	1	2	2	0	
Ephemeroptera	Heptageniidae	Slenonema sp.	SC	2	3.5	--	1	0	0	0	1	
Plecoptera	Pteronarcyidae	Pteronarcella badia	SH	0	3	4	0	1	1	1	1	
Plecoptera	Pteronarcyidae	Pteronarcys califomica	SH	0	2	1	1	2	2	1	0	
Plecoptera	Nemouridae	Malenka sp.	SH	2	1	1	1	0	0	0	0	
Plecoptera	Nemouridae	Zapada cinctipes	SH	2	3	3	2	0	1	0	0	
Plecoptera	Nemouridae	Zapada sp.	SH	2	2	--	1	0	0	0	0	
Plecoptera	Perlidae	Claassenia sabulosa	PR	3	3	3	0	2	2	1	0	
Plecoptera	Perlidae	Hesperoperla pacifica	PR	1	1	3	1	2	1	0	0	
Plecoptera	Perlidae	Doroneuris theodora	PR	1	0	2	2	0	0	0	0	
Plecoptera	Chloroperlidae	Sweltsa sp.	PR	1	0	--	1	0	0	0	0	
Plecoptera	Perlodidae	Megarcys sp.	PR	2	1	1	1	0	0	0	0	
Plecoptera	Perlodidae	Skwala sp.	PR	2	3	3	0	0	2	0	3	
Tricoptera	Helicopsychidae	Helicopsyche borealis	SC	3	3	3	0	3	2	1	2	
Tricoptera	Helicopsychidae	Arctopsyche sp.	FC	1	2	3	2	1	0	0	0	
Tricoptera	Helicopsychidae	Hydropsyche sp.	FC	4	5	5	1	3	4	4	2	
Tricoptera	Helicopsychidae	Cheumatopsyche sp.	FC	5	5	5	0	0	0	0	1	
Tricoptera	Leptoceridae	Oecetis sp.	PR	8	8	3	0	1	1	1	2	
Tricoptera	Lepidostomatidae	Lepidostoma sp.	SH	1	1	1	0	0	0	0	1	
Tricoptera	Rhyacophilidae	Rhyacophila brunnea (I)	PR	1	0	1	2	0	1	0	0	
Tricoptera	Rhyacophilidae	Rhyacophila sp. (II)	PR	0	1	--	1	1	1	1	0	*R. rotunda*
Tricoptera	Rhyacophilidae	Rhyacophifa sp. (Ill)	PR	0	1	--	1	0	1	0	0	*R. narvae*
Tricoptera	Philopotamidae	Dolophilodes sp.	GC	1	0	1	3	0	0	0	0	
Tricoptera	Brachycentridae	Brachycentrus sp. (I)	FC, SC	1	1	4	2	0	3	0	0	*B. americanus*
Tricoptera	Brachycentridae	Brachycentrus sp. (II)	FC, SC	1	2	3	0	2	0	0	0	*B. occidentalis*
Tricoptera	Brachycentridae	Brachycentrus sp. (III)	FC, SC	1	1	--	0	1	0	0	0	Species unknown
Tricoptera	Brachycentridae	Micrasema sp.	SH, GC	1	1	2	2	0	0	2	0	
Tricoptera	Glossosomatidae	Glossosoma sp.	SC	0	0	2	1	0	2	0	2	
Odonata	Gomphidae	Ophiogomphus sp.	PR	1	5	4	0	0	0	1	0	
Hemiptera	Corixidae	Sigara sp.	GC	9	5	3	1	0	0	0	2	ID uncertain
Hemiptera	Gerridae	Trepobates sp.	PR	10	--	--	0	0	0	0	1	
Coleoptera	Dytiscidae	Unknown	PR	5	7	5	0	1	0	0	1	
Coleoptera	Elmidae	Lara sp. (L)	SH	4	1	1	1	0	0	0	0	
Coleoptera	Elmidae	Stenelmis occidentalis (A)	SC, OM	7	5	3	1	0	1	0	0	
Coleoptera	Elmidae	Cleptelmis ornata (L)	GC	4	4	4	2	1	0	0	0	
Coleoptera	Elmidae	Cleptelmis ornata (A)	GC	4	4	4	1	0	0	0	1	
Coleoptera	Elmidae	Optioservus quadrimaculatus (L)	SC	4	5	5	2	2	2	1	2	
Coleoptera	Elmidae	Optioservus quadrimaculatus (A)	SC	4	5	5	3	2	1	0	2	
Coleoptera	Elmidae	Zaitzevia parvula (L)	GC	4	4	3	0	2	2	2	2	
Coleoptera	Elmidae	Zaitzevia parvula (A)	GC	4	4	3	1	3	2	2	2	
Coleoptera	Elmidae	Heterlimnius corpulentus (L)	GC	4	3	3	3	0	0	0	0	
Coleoptera	Elmidae	Heterlimnius corpulentus (A)	GC	4	3	3	1	0	0	0	0	

Table B-18. Benthic Invertebrate Community Analysis of Prickly Pear Creek

			Feeding	**Species Tolerance Ranking**[2]			**Relative Abundance Ranking**[3]					
Order	**Taxa**	**Species**	**Group**[1]	**RBP HBI**	**MT HBI**	**MT Metals**	**PPC-1 (Ref)**	**PPC-2**	**PPC-3**	**PPC-4**	**PPC-5**	**Comments**
Coleoptera	Chrysomelidae	Donacia sp.	SH	--	--	--	0	0	1	0	0	
Diptera	Tipulidae	Tipula sp.	SH	4	4	4	0	0	0	1	3	
Diptera	Tipulidae	Antocha sp.	GC	3	3	4	3	1	1	0	0	
Diptera	Tipulidae	Dicranota sp.	PR	3	3	2	1	0	0	0	0	
Diptera	Tipulidae	Hexatoma sp.	PR	2	2	2	0	3	2	3	1	
Diptera	Simuliidae	Prosimulium sp.	FC	3	4	2	0	1	0	0	0	
Diptera	Simuliidae	Simulium sp.	FC	6	5	5	1	1	1	1	0	
Diptera	Simuliidae	Simulium sp. (P)	FC	6	5	5	0	1	1	1	0	
Diptera	Ceratopogonidae	Probezzia sp.	PR	6	6	5	1	0	0	0	0	
Diptera	Chironomidae	Unknown	PR, GC	6	10	--	0	0	1	1	1	
Diptera	Chironomidae	Nostocoladius sp.	SH	7	10	--	1	0	0	0	0	
Diptera	Psychodidae	Pericoma sp.	GC	4	4	4	1	0	0	0	0	
Diptera	Ahericidae	Atherix sp.	PR	2	5	5	0	0	2	2	0	
Diptera	Pelecorhynchidae	Glutops sp.	PR	3	--	--	1	0	1	0	0	
Diptera	Dolichopodidae	Dolichopus sp.	PR	4	4	4	1	0	0	0	0	
Diptera	Muscidae	Lispoides sp.	PR	6	6	7	0	0	0	0	3	
Gastropoda	Lymnaeidae	unknown	SC	6	6	3	0	0	1	0	0	
Gastropoda	Physidae	Physella sp.	SC	8	8	4	1	3	1	3	2	
Gastropoda	Ancylidae	Ferrissia rivularis	SC	6	6	1	0	1	0	0	0	
Gastropoda	Planorbidae	Unknown	SC	7	6	3	0	1	0	0	0	
Gastropoda	Plelcypoda	Pisidium sp.	FC	8	8	3	0	0	0	1	1	
Amphipoda	Talilridae	Hyalella azteca	GC	8	8	3	1	0	0	0	0	
Oligochaeta	Unknown	Unknown	GC	5	10	--	2	0	0	0	0	
Acari	Unknown	Unknown	PR	--	5	5	1	0	0	0	0	
							46	*28*	*31*	*21*	*26*	*# species total*
							24	*14*	*16*	*9*	*12*	*# EPT species*
							65	*45*	*47*	*33*	*43*	*relative abundance*

Source: US EPA (2005)
(P) = pupal life stage
(L) = larval life stage
(A) = adult life stage

RBP HBI = Rapid Bioassessment Protocol, Hilsenhoff Biotic Index - indicates degree of tolerance towards organic pollution
MT HBI = Montana-specific, Hilsenhoff Biotic Index (Bukantis, 1998) - indicates degree of tolerance towards organic pollution
MT Metals = Montana-specific, Metals Index (Bukantis, 1996) - indicates degree of tolerance towards metals pollution

[1] *Functional Feeding Groups:*
GC = gatherer/collector
SC = scraper
SH =shredder
F = filterer
PR = predator
OM = omnivore
PC = piercer

[2] *Relative Tolerance Ranking:*
0 = intolerant
>>>>
10 = tolerant

[3] *Relative Abundance Ranking:*
0 = absent
1 = rare
2 = common
3 = abundant
4 = dominant

Table B-19. Benthic Invertebrate Community Analysis of Upper Lake and Upper Lake Marsh

			Feeding Group[1]	**Species Tolerance Ranking**[2]			**Relative Abundance Ranking**[3]			
Order	**Taxa**	**Species**		**RBP HBI**	**MT BHI**	**MT Metals**	**Upper Lake**	**Marsh Area**	**Canyon Ferry**	**Comments**
Oligochaeta	Unknown	Unknown	GC	5	10	--	1	0	1	
Hirundinea	Unknown	Unknown	PR	--	8	--	1	0	0	
Acari	Unknown	Unknown	PR	--	5	5	0	0	1	
Cladocera	Daphnia	Unknown	FC	8	--	--	2	0	0	
Decapoda	Unknown	Unknown	SH, OM	8	6	3	1	0	0	
Amphipoda	Talitridae	Hyalella azteca	GC	8	8	3	3	2	0	
Amphipoda	Talitridae	Gammarus sp.	OM	8	4	1	2	0	0	
Epemeroptera	Caenidae	Caenis sp.	GC	7	7	3	0	0	1	
Epemeroptera	Siphlonuridae	Siphlonorus sp.	GC	7	2	1	2	1	0	
Tricoptera	Hydroptilidae	Agraylea sp.	PI, GC	8	8	2	1	0	0	
Tricoptera	Leptoceridae	Oecetis sp.	PR	8	8	3	0	0	1	
Odonata	Coenagrionidae	Enallagma sp.	PR	9	7	3	2	0	0	
Odonata	Aeshnidae	Boyeria sp.	PR	--	--	--	2	0	0	
Odonata	Aeshnidae	Aeshna sp.	PR	5	--	--	1	1	0	
Hemiptera	Corixidae	Sigara sp.	GC	9	5	3	3	2	3	ID uncertain
Hemiptera	Notonectidae	Notonecta sp.	PR	--	5	3	3	0	0	
Coleoptera	Dytiscidae	Unknown	PR	5	5	7	1	0	0	
Coleoptera	Haliplidae	Haliplus sp. (L)	PI, SH	--	--	--	1	0	0	
Coleoptera	Haliplidae	Haliplus sp. (A)	PI, SH	--	--	--	3	0	0	
Diptera	Tipulidae	Tipula sp.	SH	4	4	4	0	0	1	
Diptera	Chironomidae	Unknown	PR, GC	6	10	--	2	1	1	
Gastropoda	Physidae	Physella sp.	SC	8	8	4	3	1	0	
Gastropoda	Planorbidae	Unknown	SC	7	6	3	3	0	0	
Gastropoda	Ancylidae	Ferrissia rivularus	SC	6	6	1	0	0	1	
Source: US EPA (2005)							*19*	*6*	*8*	*# species total*
(L) = larval life stage							*2*	*1*	*2*	*# EPT species*
(A) = adult life stage							*37*	*8*	*10*	*relative abundance*

RBP HBI = Rapid Bioassessment Protocol, Hilsenhoff Biotic Index - indicates degree of tolerance towards organic pollution
MT HBI = Montana-specific, Hilsenhoff Biotic Index (Bukantis, 1998) - indicates degree of tolerance towards organic pollution
MT Metals = Montana-specific, Metals Index (Bukantis, 1996) - indicates degree of tolerance towards metals pollution

[1] *Functional Feeding Groups:*
GC = gatherer/collector
SC = scraper
SH =shredder
F = filterer
PR = predator
OM = omnivore
PC = piercer

[2] *Relative Tolerance Ranking:*
0 = intolerant
>>>>
10 = tolerant

[3] *Relative Abundance Ranking:*
0 = absent
1 = rare
2 = common
3 = abundant
4 = dominant

Table B-20. Avian Egg Chemistry Results (ug/g)

						Ag				Al		As		B		Ba		Be				Cd				Co	
Sample ID	Date	Species	Lat	Long	% Moisture	DW	Q	WW	Q	DW	WW	DW	WW	DW	WW	DW	WW	DW	Q	WW	Q	DW	Q	WW	Q	DW	WW
EHTPNB1	7/6/2010	Tree Swallow	46.5805	-111.91788	81.9	0.0173	U	0.00313	U	5.8	1.05	0.063	0.0114	0.709	0.128	10.8	1.95	0.0173	U	0.00313	U	0.0173	U	0.00313	U	0.0904	0.0164
EHTPNB4	7/8/2010	Violet-green swallow	46.58068	-111.91936	82.9	0.0166		0.0053		6.23	1.07	0.275	0.047	1.72	0.294	6.27	1.07	0.0166	U	0.00284	U	0.0166	U	0.00284	U	0.139	0.0238
EHUMN2	6/21/2010	Yellow-headed blackbird	46.57991	-111.91797	84.1	0.0156	U	0.00248	U	6.86	1.09	0.0794	0.0126	0.162	0.0258	1.12	0.178	0.0156	U	0.00248	U	0.0156	U	0.00248	U	0.0925	0.0147
EHUMN3-1	6/21/2010	Violet-green swallow	46.58008	-111.92094	80.9	0.0165	U	0.00315	U	8.89	1.7	0.278	0.0531	0.519	0.0991	8.09	1.55	0.0165	U	0.00315	U	0.0326		0.00623		0.0733	0.014
EHUMN3-2	6/21/2010	Violet-green swallow	46.58008	-111.92094	76.2	0.0166	U	0.00395	U	9.26	2.2	0.137	0.0326	0.576	0.137	7.68	1.83	0.0166	U	0.00395	U	0.0235		0.00559		0.0765	0.0182
EHUMN4	6/25/2010	Red-winged blackbird	46.57836	-111.91663	83.1	0.0171	U	0.00289	U	7.41	1.25	0.0363	0.00613	0.628	0.106	4.61	0.779	0.171	U	0.00289	U	0.171	U	0.00289	U	0.0604	0.0102

Notes:
U - Undetected
DW - dry weight
WW - wet weight

Table B-20. Avian Egg Chemistry Results (ug/g)

						Cr				Cu		Fe		Hg		Li		Mg		Mn		Mo				Ni				Pb		Se	
Sample ID	Date	Species	Lat	Long	% Moisture	DW	Q	WW	Q	DW	WW	DW	WW	DW	WW	DW	WW	DW	WW	DW	WW	DW	Q	WW	Q	DW	Q	WW	Q	DW	WW	DW	WW
EHTPNB1	7/6/2010	Tree Swallow	46.5805	-111.91788	81.9	0.0347	U	0.00628	U	2.99	0.541	139	25.2	0.441	0.0798	0.0593	0.0107	437	79.1	3.95	0.715	0.193		0.0349		0.347	U	0.0628	U	1.58	0.286	4.32	0.782
EHTPNB4	7/8/2010	Violet-green swallow	46.58068	-111.91936	82.9	0.115		0.0197		4.33	0.74	124	21.2	0.44	0.0752	0.157	0.0268	509	87	3.81	0.652	0.22		0.0376		21.3		3.64		3.1	0.53	5.32	0.91
EHUMN2	6/21/2010	Yellow-headed blackbird	46.57991	-111.91797	84.1	0.0968		0.0154		2.21	0.351	146	23.2	0.12	0.0191	0.0439	0.00698	366	58.2	4.85	0.771	0.156	U	0.771	U	0.402		0.0639		0.203	0.0323	4.21	0.669
EHUMN3-1	6/21/2010	Violet-green swallow	46.58008	-111.92094	80.9	0.0331		0.00632		2.68	0.512	136	26	0.316	0.0604	0.0326	0.00623	346	66.1	4.62	0.882	0.237		0.0453		0.439		0.0838		5.54	1.06	4.49	0.858
EHUMN3-2	6/21/2010	Violet-green swallow	46.58008	-111.92094	76.2	0.0732		0.0174		2.01	0.478	144	34.3	0.22	0.0524	0.0493	0.0117	335	79.7	4.18	0.995	0.216		0.0514		0.331	U	0.0788	U	2.36	0.562	4.58	1.09
EHUMN4	6/25/2010	Red-winged blackbird	46.57836	-111.91663	83.1	0.0366		0.00619		3.28	0.554	193	32.6	0.0701	0.0118	0.0979	0.0165	421	71.1	3.83	0.647	0.248		0.0419		0.342	U	0.0578	U	2.09	0.353	5.66	0.957

Notes:
U - Undetected
DW - dry weight
WW - wet weight

Table B-20. Avian Egg Chemistry Results (ug/g)

						Sr		Tl		U				V				Zn	
Sample ID	Date	Species	Lat	Long	% Moisture	DW	WW	DW	WW	DW	Q	WW	Q	DW	Q	WW	Q	DW	WW
EHTPNB1	7/6/2010	Tree Swallow	46.5805	-111.91788	81.9	17.2	3.11	0.992	0.18	0.0173	U	0.00313	U	0.0173	U	0.00313	U	127	23
EHTPNB4	7/8/2010	Violet-green swallow	46.58068	-111.91936	82.9	12.3	2.1	5.07	0.867	0.0166	U	0.00284	U	0.0166	U	0.00284	U	88.9	15.2
EHUMN2	6/21/2010	Yellow-headed blackbird	46.57991	-111.91797	84.1	8.11	1.29	0.0988	0.0157	0.0156	U	0.00248	U	0.0156	U	0.00248	U	58.2	9.25
EHUMN3-1	6/21/2010	Violet-green swallow	46.58008	-111.92094	80.9	7.79	1.49	1.87	0.357	0.0165	U	0.00315	U	0.0165	U	0.00315	U	117	22.3
EHUMN3-2	6/21/2010	Violet-green swallow	46.58008	-111.92094	76.2	7.64	1.82	2.28	0.543	0.0166	U	0.00395	U	0.0166	U	0.00395	U	115	27.4
EHUMN4	6/25/2010	Red-winged blackbird	46.57836	-111.91663	83.1	5.6	0.946	0.134	0.0226	0.0171	U	0.00289	U	0.0171	U	0.00289	U	80.6	13.6

Notes:

U - Undetected

DW - dry weight

WW - wet weight

Appendix C

Toxicity Reference Values

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List of Tables

List of Abbreviations

∑SEM	Sum of Molar Concentrations of Simultaneously Extracted Metal
AVS	Acid Volatile Sulfide
AWQC	Ambient Water Quality Criteria
BERA	Baseline Ecological Risk Assessment
BLM	Biotic Ligand Model
BW	Body Weight
$CaCO_3$	Calcium Carbonate
CBR	Critical Body Residue
CFR	Canyon Ferry Reservoir
CDPHE	Colorado Department of Public Health and Environment
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
EC	Effect Concentration
EC_{50}	Median Effect Concentration
EcoSSL	Ecological Soil Screening Level
EPT	*Ephemeroptera*, *Plecoptera*, and *Tricoptera*
ERA	Ecological Risk Assessment
ER-L	Effects Range Low
ER-M	Effects Range Median
FETAX	Frog Embryo Teratogenesis Assay—Xenopus
f_{oc}	Fraction of Organic Carbon
IR	Ingestion Rate
LC_{50}	Median Lethal Concentration
LD_{50}	Median Lethal Dose
LEL	Lowest Effect Level
LOAEL	Lowest Observed Adverse Effect Level
LOEC	Lowest Observed Effect Concentration
MDEQ	Montana Department of Environmental Quality
NOAEL	No Observable Adverse Effect Level
NOEC	No Observed Effect Concentration
ORNL	Oak Ridge National Laboratory
PEC	Probable Effect Concentration
PEL	Probable Effect Level
PPC	Prickly Pear Creek
RBP	Rapid Bioassessment Protocol
SEL	Severe Effect Level
SLERA	Screening Level Ecological Risk Assessment
SMAV	Species Mean Acute Value
SQG	Sediment Quality Guideline
TEC	Threshold Effect Concentration
TEL	Threshold Effect Level
TRV	Toxicity Reference Value
UL	Upper Lake
ULM	Upper Lake Marsh
US EPA	United States Environmental Protection Agency

1 Introduction

This appendix presents the approach for the identification and selection of measures of effect [*i.e.*, toxicity reference values (TRVs)] and measures of ecosystem characteristics for use in the Baseline Ecological Risk Assessment (BERA). Measures of exposure (*i.e.*, metal concentrations in abiotic and biotic media) are presented in Appendix B. The general approach for the effects characterization was described in the BERA Work Plan (Gradient, 2010) and is expanded herein. The primary chemicals of potential concern (COPCs) at the site are metals/metalloids from historic smelting operations. Ecological receptor groups that may be exposed to these constituents include aquatic and terrestrial plants, aquatic and terrestrial invertebrates, fish, amphibians, birds, and mammals. Exposure to metals in site media (*e.g.*, soils, sediments, water, and prey items) may result in adverse health effects (*e.g.*, survival, growth, and reproduction). This appendix establishes the benchmarks that are used in this BERA to evaluate the potential for adverse effects to ecological receptors. The lines of evidence that will be used to evaluate the potential for adverse effects are described for each ecological receptor group in the following sections.

2 Benthic Invertebrates

Benthic invertebrates include those organisms that dwell, feed, and reproduce in benthic habitats on or near the Facility. Exposures to sediment, sediment porewater, or overlying surface water provides the primary exposure pathways for benthic invertebrates to COPCs. Several lines of evidence are available to evaluate the potential for adverse effects of COPCs to benthic invertebrates. A description of each of these metrics is provided in the following sections.

2.1 Surface Water Benchmarks

Surface water benchmarks used in this BERA are presented in Table C-1. These benchmarks represent concentrations of COPCs in fresh water that are considered protective of aquatic life (*e.g.*, plankton, macrophytes, benthic macroinvertebrates, and fish). The primary sources of benchmarks are the United States Environmental Protection Agency's (US EPA, 2009) acute and chronic Ambient Water Quality Criteria (AWQC) and the State of Montana Department of Environmental Quality's (MDEQ, 2008) water quality standards. US EPA's AWQC are designed to protect ≥ 95% of aquatic species against adverse effects on growth, reproduction, and survival following acute or long-term chemical exposures (weeks to months). The AWQC for several metals are dependent on water hardness (*i.e.*, the lower the hardness, the more bioavailable the metal and, hence, the lower the AWQC concentration); equations are provided by US EPA for calculating site-specific hardness-corrected AWQC (Table C-1). The AWQC for most metals are expressed in terms of the dissolved fraction in the water based on a conversion from total recoverable concentrations (US EPA, 2009). Montana water quality standards (MDEQ, 2008) are primarily based on US EPA's (2009) AWQC and are intended to be applied to the total recoverable fraction of metals in surface water. The criteria for both the dissolved and total recoverable fractions are presented in Table C-1. In the BERA, dissolved surface water concentrations are compared to the dissolved criteria. If a dissolved criterion is unavailable, then the total recoverable criterion will be used for risk comparisons, and vice versa. Total and total recoverable surface water concentrations are compared to total recoverable criteria.

Several metals lacked US EPA or MDEQ water quality criteria. However, in 1995, US EPA published a water quality guidance document outlining a two-tiered methodology for the development of water quality criteria (Tier I) or values (Tier II) for contaminants in the Great Lakes (US EPA, 1995):

- *The Tier I aquatic life methodology* includes data requirements very similar to those used in current guidelines for developing AWQC. For example, both require that acceptable toxicity data for aquatic species in at least eight different families representing differing habitats and taxonomic groups must exist before a Tier I numeric criterion can be derived.
- *The Tier II aquatic life methodology* is used to derive Tier II values, which can be calculated with fewer toxicity data than Tier I. The Tier II methodology generally produces more stringent values than the Tier I methodology, to reflect greater uncertainty in the absence of additional toxicity data. As more data become available, the derived Tier II values tend to become less conservative. That is, they more closely approximate Tier I numeric criteria.

Following issuance of US EPA's guidance in 1995, several Great Lakes states developed their own water quality criteria using US EPA's two-tiered methodology. A public database of water quality criteria developed using this methodology is available through the Great Lakes Initiative Clearinghouse website (US EPA, 2010a). The Oak Ridge National Laboratory (ORNL) also followed this protocol and published aquatic life benchmarks for several metals (Suter and Tsao, 1996). Thus, when federal or Montana state criteria were lacking, the most recently available secondary acute and chronic values were adopted from US EPA (2010a) or from Suter and Tsao (1996) (Table C-1).

Finally, a hardness-based criterion is available from the State of Colorado, which is based on more recent toxicity information, and followed US EPA's guidance for the development of AWQC (US EPA, 1985). The Colorado Department of Public Health and Environment (CDPHE, 2010) water quality criteria were updated in 2010 and the acute and chronic dissolved criteria for manganese are 2,986 and 1,650 µg/L (based on a hardness of 100 mg/L), as shown in Table C-1.

2.2 Sediment Quality Benchmarks

The primary sediment benchmarks used in the BERA were the threshold effect concentrations (TECs) and probable effect concentrations (PECs) developed by MacDonald *et al*. (2000) (Table C-2). The TECs represent consensus-based sediment quality guidelines (SQGs) and were calculated as the geometric means of published SQGs from a variety of sources (*i.e.,* Persaud *et al*., 1993; Smith *et al*., 1996; Long and Morgan, 1990; Ingersoll *et al*., 1996; EC and MENVIQ, 1992; Zarba, 1992; US EPA 1996, 1997b). TECs are defined as contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected. PECs represent a concentration threshold above which effects are expected to occur more often than not (MacDonald *et al*., 2000). TECs and PECs are only available for a subset of the COPCs. Therefore, additional benchmarks were identified from US EPA (1996), Long and Morgan (1990), and Persaud *et al*. (1993) (Table C-2):

- US EPA (1996). Threshold effect and probable effect levels (TELs and PELs) were developed from sediment toxicity tests using *Hyalella azteca* and *Chironomus riparius*. The TEL is a concentration that represents the upper limit of the range dominated by no effects data. Concentrations above the TEL may result in adverse effects to these organisms; concentrations below the TEC are unlikely to result in adverse effects. The PEL represents the concentration above which adverse effects on survival or growth of the amphipod *H. azteca* are expected to occur frequently (in 28-day tests).
- Persaud *et al*. (1993). The lowest effect level (LEL) indicates a level of sediment contamination that can be tolerated by the majority of benthic organisms. The severe effect level (SEL) indicates the level at which pronounced disturbance of the sediment-dwelling community can be expected.
- Long and Morgan (1990). An effects range low (ER-L) is a concentration at the low end of the range in which effects have been observed. An effects range median (ER-M) is a concentration approximately midway in the range of reported values associated with biological effects.

To identify COPCs in the Screening Level Ecological Risk Assessment (SLERA), maximum sediment concentrations were compared to TECs or equivalent sediment benchmarks (TELs, LELs, or ER-Ls). In the BERA, sediment COPC concentrations in each sampled location were compared to PECs or equivalent sediment benchmarks (PEL, SEL, or ER-M). To evaluate the potential joint toxicity of COPCs, the mean PEC quotient method was utilized following procedures reported by Ingersoll *et al*. (2000, 2001):

$$Mean\ PEC - Q_{metals} = \frac{\sum individual\ metal\ PEC - Qs}{Number\ of\ metals\ for\ which\ individual\ PEC - Qs\ calculated}$$

Ingersoll *et al*. (2000, 2001) assessed the predictive ability of this approach and reported the incidence of sediment toxicity within ranges of mean PEC quotients (Table C-3). For metals, toxicity was observed in invertebrate tests with mean PEC quotients of <0.5 in 8-23% of the samples; for mean PEC quotients of 0.5 to <1.0, toxicity was observed in 25-62% of the samples; for mean PEC quotients of >1.0 to <5.0, toxicity was observed in 39-63%; and for mean PEC quotients of >5, toxicity was observed in 57-62% of the samples. This metric is one of several lines of evidence used to evaluate potential sediment toxicity.

2.3 Sediment Metal Partitioning

The bioavailability of metals is an important factor to consider when evaluating their potential toxicity in sediments (US EPA, 2005, 2007). US EPA (2005) developed an equilibrium partitioning sediment benchmark procedure that accounts for the bioavailability of metals in sediments and relates this measure to biological responses observed in benthic organisms. Equilibrium partitioning theory predicts that metals partition in sediment between acid volatile sulfide (AVS, principally iron monosulfide), interstitial (pore) water, benthic organisms, and other sediment phases such as organic carbon (US EPA, 2005). The difference between the sum of the molar concentrations of simultaneously extracted metal (ΣSEM, metal simultaneously extracted during the AVS extraction procedure) minus the molar concentration of AVS is a predictor of sediment toxicity for certain divalent metals (cadmium, copper, lead, nickel, silver, chromium, and zinc) (US EPA, 2005). The use of $(\Sigma SEM\text{-}AVS)/f_{oc}$ (f_{oc} is the fraction of organic carbon) further reduces variability associated with predicting sediment toxicity by accounting for the additional partitioning of metals to organic carbon (US EPA, 2005). The metals benchmark with respect to cadmium, copper, lead, nickel, silver, zinc, and chromium is driven by four assumptions:

1. Any sediment with AVS > 0.0 is not expected to cause adverse biological effects due to chromium or silver;
2. Any sediment in which $(\Sigma SEM\text{-}AVS)/f_{oc} < 130$ µmols/g_{oc} should pose low risk of adverse biological effects due to cadmium, copper, lead, nickel, and zinc;
3. Any sediment in which 130 µmols/g_{oc} < $(\Sigma SEM\text{-}AVS)/f_{oc}$ < 3,000 µmols/g_{oc} may have adverse biological effects due to cadmium, copper, lead, nickel, or zinc; and
4. Any sediment in which $(\Sigma SEM\text{-}AVS)/f_{oc} > 3{,}000$ µmols/g_{oc} may cause adverse biological effects due to cadmium, copper, lead, nickel, or zinc.

2.4 Sediment Toxicity Testing

Evaluation of sediment toxicity on the basis of bulk chemistry can be unreliable because this metric does not account for bioavailability, chemical partitioning, regulatory/compensatory mechanisms, or mixture toxicity (US EPA, 2000). Sediment toxicity testing can be used to determine relationships between toxic effects and bioavailability; investigate interactions among chemicals; compare the sensitivities of different organisms; determine spatial and temporal distribution of contamination; and set cleanup goals and estimate the effectiveness of remediation or management practices (US EPA, 2000). Sediment toxicity testing (*i.e.*, 10-day whole sediment *H. azteca* and *C. dilutus*) has been conducted in several Conceptual Site Model (CSM) units (see Appendix B for data summary). By using two different test species, both an epibenthic and benthic species (*H. azteca* and *C. dilutus*, respectively*)*, additional information is obtained regarding exposure routes and differences in species-specific sensitivity. Additionally, the use of both sublethal (*i.e.*, growth) and acute endpoints (*i.e.*, mortality) provides further information to characterize risks to benthic invertebrates from sediment exposure.

2.5 Community Metrics

A benthic community analysis using a rapid bioassessment protocol (RBP) was performed by US EPA (2005) on certain areas of the Facility (see Appendix B for data summary). An RBP is a fast and cost-effective technique to evaluate species diversity and richness by examining the density and taxonomy of benthic organisms in a given area (Barbour *et al*., 1999). As various organisms have different niches and sensitivities (*i.e.*, tolerances) to aquatic contamination or degradation, the types and abundance of taxonomic groups can help elucidate the integrity of the aquatic system. For instance, species that are known as EPT species (*Ephemeroptera*, *Plecoptera*, and *Tricoptera*) are known to be rather sensitive to metal contamination. Areas in which EPT species are abundant would indicate a reduced concern for metals contamination, while an abundance of *Oligochaeta* and *Chironomidae* species would suggest potential degradation due to metals contamination. The limitation of this index is that benthic communities are impacted by a variety of factors, including resource availability, seasonality, and habitat quality. Thus, it is important to define a threshold for comparison purposes, which can be done by examining reference locations that possess similar characteristics to the sites in question. In 2005, US EPA examined Prickly Pear Creek (PPC) and Upper Lake (UL)/Upper Lake Marsh (ULM) and compared the benthic biota present in these systems to reference locations near, but outside, the potentially impacted area (Prickly Pear Creek upstream [PPC1] and Canyon Ferry Reservoir [CFR] stations, respectively). Benthic community data provide *in situ* results, which, when combined with bulk chemistry, bioavailability and sediment toxicity data, can provide a stronger weight-of-evidence-based risk characterization for benthic invertebrates.

3 Fish

Fish are primarily exposed to contaminants in the overlying surface water through gill uptake. In addition, exposure may occur through the diet or through contact with sediments or sediment porewater. Several lines of evidence were available in the BERA to characterize risks to fish from exposure to site COPCs. A description of each of these metrics is provided in the following sections.

3.1 Surface Water Benchmarks

The surface water benchmarks used in the BERA are the same as those presented for benthic invertebrates and rely primarily on the US EPA's (2009) AWQC and MDEQ's (2008) water quality standards (Table C-1). US EPA's AWQC are designed to protect ≥ 95% of aquatic species against adverse effects on growth, reproduction, and survival following acute or long-term chemical exposures (weeks to months). The AWQC for several metals are dependent on water hardness (*e.g.*, the lower the hardness, the more bioavailable the metal and, hence, the lower the AWQC concentration), and equations are provided by US EPA for calculating the site-specific hardness-corrected AWQC (Table C-1). The AWQC for most metals are expressed in terms of the dissolved fraction in the water based on a conversion from total recoverable concentrations (US EPA, 2009). Montana water quality standards (MDEQ, 2008) are primarily based on US EPA's (2009) AWQC and are intended to be applied to the total recoverable fraction of metals in surface water. The criteria for both the dissolved and total recoverable fractions are presented in Table C-1. In the BERA, dissolved surface water concentrations are compared to the dissolved criteria. If a dissolved criterion is unavailable, then the total recoverable criterion will be used for risk comparisons, and vice versa. Total and total recoverable surface water concentration are compared to total recoverable criteria.

Several metals lacked US EPA or MDEQ water quality criteria primarily due to the lack of sufficient toxicity data to develop a criterion according to the methods used by US EPA. Alternative surface water criteria have been compiled by US EPA (2010a) and ORNL (Suter and Tsao, 1996) (see Section 2.1 for discussion). Thus, when federal or Montana state criteria were lacking, the most recently available secondary acute and chronic values were adopted from US EPA (2010a) or from Suter and Tsao (1996) (Table C-1). Finally, a hardness-based criterion is available from the State of Colorado, which is based on more recent toxicity information and followed US EPA's guidance for the development of AWQC (US EPA, 1985).

3.2 Biotic Ligand Model (BLM)

The current US EPA acute copper criterion was developed using the Biotic Ligand Model (BLM) (US EPA, 2007). The BLM has been developed for other metals; however, copper is the only metal for which the BLM has been incorporated into AWQC. The BLM is based on the assumption that toxicity of a chemical to an aquatic organism requires the transfer of the chemical from the external environment to biochemical receptors on or in the organism at which the toxic effects are elicited (US EPA, 2007). This transfer is not simply proportional to the total chemical concentration in the environment, but rather varies according to attributes of the organism, chemical, and exposure environment so that the chemical is more or less "bioavailable" (US EPA, 2007). Copper toxicity is affected by various physicochemical characteristics of the exposure water that influence bioavailability, including temperature, dissolved organic compounds, suspended particles, pH, and various inorganic cations and anions, including those related to hardness and alkalinity (US EPA, 2007). The copper BLM allows for a more rigorous analysis of the bioavailability and toxicity of copper based on site-specific water quality conditions. However, the BLM requires that a number of water quality parameters be measured in order to fully parameterize the model. Current site-specific data do not fully characterize the water quality parameters needed to run the BLM (*i.e.*, dissolved organic carbon and humic acid content). Therefore, evaluation of risks from exposure to copper were evaluated using the previous hardness-based criteria equations, instead of the acute copper BLM.

3.3 Tissue Residue Benchmarks

The tissue residue (or Critical Body Residue, CBR) approach provides a process to identify a critical concentration in tissue (*i.e.*, whole body or specific organ) that is associated with an adverse ecological effect. The CBR approach has been applied through use of the BLM in US EPA's copper criterion (US EPA, 2007) and for selenium in fish tissue in the draft US EPA criterion (US EPA, 2004). The application of the CBR approach to cationic metals is currently being debated in the scientific community, which considers the approach to be problematic due to a number of factors: varying regulation/detoxification mechanisms, nutritional essentiality, and sequestration in tissues (Adams *et al.*, 2010; Sappington *et al.*, 2010; McElroy *et al.*, 2010; US EPA, 2007). In addition, the lack of standardization of toxicity data for this approach has resulted in limited datasets (Sappington *et al.*, 2010). The CBR approach has been suggested to be more viable for organo-metallics (*e.g.*, selenium and methylmercury) due to the propensity for these compounds to associate with lipids and other organic molecules and thus more readily bioaccumulate in tissues (McElroy *et al*., 2010; Adams *et al*., 2010). Consequently, this approach was only considered for selenium and methylmercury in the BERA. For selenium, the draft US EPA (2004) whole body fish tissue criterion is 7.91 mg/kg dry weight (1.58 mg/kg wet weight assuming 80% moisture in fish tissue). This criterion is undergoing scientific debate and some issues have been identified (Skorupa *et al.* 2004; Lemly and Skorupa, 2007); including the appropriateness of the underlying toxicity database and species or tissues investigated. An alternative value of 5.85 mg/kg (1.17 mg/kg wet weight) has been proposed based on an alternative analysis (Lemly and Skorupa, 2007). Both benchmarks were considered in the BERA for fish.

Several groups have conducted dose-response analyses for growth, survival, and reproductive effects of methylmercury based on freshwater fish whole body tissue residues (Beckvar *et al*., 2005; Dillon *et al*., 2010; McElroy *et al*., 2010; US EPA, 2009). Results from these analyses suggest that a whole body tissue residue concentration of 0.2 mg/kg wet weight mercury (including methylmercury) would be protective of survival, growth, and reproduction of juvenile and adult fish. These CBRs for selenium and methylmercury were used to evaluate for site-specific fish tissue residue data in the BERA.

Tissue residue thresholds were considered for other metals and data were compiled from the US Army Corps of Engineers and US EPA's Environmental Residue Effects Database.[1] This database contains data on tissue residue effects data for a number of aquatic and terrestrial species. The available data for the COPCs was downloaded and summarized (Table C-5). All studies describing whole-body tissue residue effects levels in fish were included in this summary, unless results were for mixtures. Effects data were for growth, survival, or reproduction, and included no observable adverse effect levels (NOAELs), lowest observed adverse effect levels (LOAELs), or effect concentrations (ECs) (*e.g.*, EC_{10}, EC_{20}). ECs at 20% or less were included, while ECs above 20% (*e.g.*, median lethal dose [LD_{50}]) were not included in the dataset because these effects levels are not considered appropriately conservative for estimating risks in the BERA. The effect levels (Table C-5) are similar to those used by US EPA (2005) in the 2005 Supplemental Ecological Risk Assessment (ERA) for this site. These thresholds are included as a line of evidence; however, uncertainties with this method are recognized.

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[1] http://el.erdc.usace.army.mil/ered/.

3.4 Dietary Benchmarks

The dietary pathway is an important exposure route for fish. Dietary TRVs were identified for arsenic, cadmium, copper, lead, and zinc from the US EPA (2005) supplemental ERA from the Clark Fork River, Montana ERA. The NOAELs and LOAELs from trout dietary studies are summarized in Table C-4 and will be compared to the metal concentrations in the diet of fish (*e.g.*, aquatic invertebrates and plants). In addition, a dietary threshold of 3 mg/kg dry weight for selenium has been suggested to affect reproduction in some fish (Lemly 1996; US DOI, 1998). Concentrations below 2 mg/kg are not expected to adversely affect fish (Lemly 1996; US DOI, 1998). These thresholds were recommended by Lemly (1996) following a review of selenium effects on fish.

4 Aquatic Plants

The primary exposure pathway for aquatic plants is through contact or uptake of COPCs in surface water or porewater. Therefore, the primary measures of effect utilized in the BERA are surface water benchmarks. The surface water benchmarks are the same as those presented for benthic invertebrates and fish and rely primarily on US EPA's (2009) acute and chronic AWQC and MDEQ's (2008) water quality standards (Table C-1). For metals without AWQC or MDEQ water quality criteria, benchmarks from US EPA (2010a), ORNL (Suter and Tsao, 1996) or CDPHE (2010) were adopted (see Section 2.1 for a discussion).

These surface water benchmarks may over- or underestimate risks to aquatic plants since they are primarily based on toxicological data obtained for invertebrate, fish, and amphibian species. In general, fish and invertebrates are more sensitive to the effects of contaminants than plants (Kenaga and Moolenaar, 1979). However, limited plant and algae toxicity data are included in some of the metal criteria databases. Algae toxicity data are commonly used as a surrogate for aquatic plant data (*e.g.*, Suter and Tsao, 1996); however, the sensitivity of plants to toxicants may vary widely among species and chemicals, so use of algae toxicity data to assess plant community risks is uncertain.

5 Amphibians

Amphibians have complex life cycles, and therefore may be exposed to contaminants in both aquatic and terrestrial environments at various life stages. Standard toxicity benchmarks are not readily available for amphibians, however, additional literature describing the toxicity of metals to amphibian species has been published recently (Sparling *et al*., 2010). In order to develop TRVs for amphibians for various exposure pathways, a literature search and data compilation was performed. Several recent publications have compiled toxicity data for amphibians and these were reviewed for relevant information:

- Sparling *et al*. (2010). Ecotoxicology of Amphibians and Reptiles.
- Pauli *et al*. (2000). Environment Canada's Reptile and Amphibian Toxicology Database.
- Bleiler *et al*. (2004). Development of a Standardized Approach for Assessing Potential Risks to Amphibians Exposed to Sediment and Hydric Soils.
- US EPA (2010b). US EPA's ECOTOX database.

In addition to the above references, the general scientific literature was searched for appropriate literature. Online databases (Pubmed, Toxline, Scopus, Science Direct) were searched for toxicological literature and reference sections of relevant citations were reviewed to identify additional sources of data. A compilation of relevant data from all of these sources is presented in Table C-6. A discussion of relevant toxicity data is provided for exposure to surface water, sediment, soil, and diet.

5.1 Surface Water Benchmarks

Available surface water toxicity data for amphibian species are presented in Table C-7. Acute and chronic toxicity data were compiled from the general literature and were reviewed following the general guidelines used by the US EPA for developing AWQC (US EPA, 1985). A relevant acute exposure duration was considered to be 96 hours, while shorter-term (*e.g.*, 48 hours) exposures were considered if no other data were available for that particular species. Some acute toxicity data were based on non-standard durations (*e.g.*, 5-8 days) and therefore represent longer exposures than the standard 96-hour studies. Therefore, studies of eight days or less were considered acute and studies of longer duration were considered chronic. Relevant acute endpoints were mortality (median lethal concentration [LC_{50}]) and development (median effect concentration [EC_{50}]), while chronic endpoints included survival, growth, development, and reproduction [no observed effect concentration (NOEC) or lowest observed effect concentration (LOEC)]. A species mean acute value (SMAV) was calculated for each amphibian species, as is routinely done for AWQC (US EPA, 1985). For AWQC development, genus mean acute values are calculated; however, due to limited data, only SMAVs were estimated for comparisons with US EPA AWQC. The amphibian SMAVs and lowest available chronic LOEC or highest available chronic NOEC (if a LOEC was not available) are presented in Table C-6 and summarized in Table C-7. A discussion of the results for each metal is provided below.

- **Aluminum**: Aluminum toxicity is highly dependent on pH levels (Pauli *et al.*, 2000; US EPA, 2003a); therefore, any amphibian data outside the normal neutral pH range (6-8 standard units) were excluded from this data analysis. The aluminum acute SMAVs for four species ranged from 50 to 2,280 µg/L. The most sensitive species (SMAV = 50 µg/L) was the Eastern Narrow-Mouthed Toad (*Gastrophryne carolinensis*) in a seven-day study (Birge *et al.*, 1979; Birge, 1978). Two of the species tested have acute SMAVs less than the current acute AWQC for aluminum (750 µg/L), and therefore it is possible that some amphibian species are more sensitive to the acute effects of aluminum than a variety of other freshwater species tested. No chronic amphibian toxicity data were available for aluminum.
- **Antimony**: Two amphibian studies were identified for antimony. These studies were based on a seven-day study of the Eastern Narrow-Mouthed Toad (*G. carolinensis*) (Birge *et al.*, 1979; Birge, 1978). The amphibian acute SMAV (300 µg/L) is greater than the acute and chronic surface water benchmark developed for aquatic organisms in Table C-1. No chronic amphibian toxicity data were available for antimony.
- **Arsenic**: Amphibian acute SMAVs (40-310,971 µg/L) were calculated for eight species. The most sensitive species (SMAV = 40 µg/L) was the Eastern Narrow-Mouthed Toad (*G. carolinensis*) in a seven-day study (Birge *et al.*, 1979; Birge, 1978). The next lowest acute SMAV (249 µg/L) was for the common frog (*Rana hexadactyla*) (Khangarot *et al.*, 1985). All other acute SMAVs were above the current acute AWQC (340 µg/L), and thus the current acute arsenic criteria is likely to be protective of most amphibian species. Three chronic studies have been conducted (Birge and Just, 1973; Brodeur *et al.*, 2009; Chen *et al.*, 2009) and no effects were observed at concentrations below the chronic AWQC (150 µg/L).
- **Beryllium**: Acute toxicity data for two amphibian species were identified for beryllium and both of the SMAVs were > 9,000 µg/L. These values are several orders of magnitude above the acute and chronic surface water benchmark developed for aquatic organisms in Table C-1 (93 and 11 µg/L, respectively). Therefore, the current beryllium AWQC is likely to be protective of most amphibian species. No chronic amphibian toxicity data were identified for beryllium.
- **Cadmium**: Amphibian acute SMAVs were identified for 17 species and ranged from 0.1-71,800 µg/L. Only two acute SMAVs were below the current acute AWQC for cadmium (2 µg/L), with the others being well above the acute AWQC. Several chronic studies (10-131 days) were also identified for amphibian species exposed to cadmium (Table C-7). With the exception of one study (Sharma and Patino, 2008), the available

chronic data suggests that the current chronic aquatic life cadmium criterion is protective of most amphibians species.

- **Chromium**: Amphibian toxicity data were identified for both chromium(III) and chromium(VI). Eleven amphibian species were found to have acute toxicity data, with SMAVs ranging from 30 to 224,910 µg/L. The most sensitive species (SMAV = 30 µg/L) was the Eastern Narrow-Mouthed Toad (*G. carolinensis*) in a seven-day study (Birge *et al.*, 1979; Birge, 1978). All other acute SMAVs were at least an order of magnitude above the acute chromium AWQC [570 and 16 µg/L for chromium(III) and chromium(VI), respectively]. Two chronic studies were identified, and no effects on growth, survival, or development were found at concentrations at or below 750 µg/L (Slooff and Canton, 1983; Natale *et al.*, 2006), which is greater than the chronic chromium AWQC [74 and 11 µg/L for chromium(III) and chromium(VI), respectively]. The current acute and chronic AWQC appear to be protective of most amphibian species.

- **Cobalt**: Cobalt SMAVs were identified for two species of frogs (*R. hexadactyla* and *Xenopus laevis*) and one species of toad (*G. carolinensis*). As with other metals, the Eastern Narrow-Mouthed Toad was found to be the most acutely sensitive species (Birge *et al.*, 1979; Birge, 1978); its acute SMAV (50 µg/L) was below the cobalt acute surface water benchmark developed for aquatic organisms in Table C-1 (220 µg/L). One chronic study was identified and a LOEC for *X. laevis* was identified for growth at 5,948 µg/L after 91 days of exposure (Table C-6; Plowman *et al.*, 1994), which is well in exceedance of the chronic surface water benchmark developed for aquatic organisms in Table C-1 (24 µg/L). With the exception of the Eastern Narrow-Mouthed Toad, the surface water benchmarks in Table C-1 appear to be protective of most amphibian species.

- **Copper**: Twenty-two amphibian species were evaluated in acute toxicity studies, with SMAVs ranging from 30-31,149 µg/L. Several chronic studies were performed and generally results suggested that most amphibian species were not uniquely sensitive to copper. The most recent study, by Chen *et al.* (2007), identified that chronic exposure (154 days) to 25 µg/L copper resulted in changes to growth and development. This concentration is above the chronic US EPA AWQC (14 µg/L at hardness of 170 mg/L calcium carbonate ($CaCO_3$). Therefore, available data suggest that current AWQC are protective of amphibian species.

- **Iron**: One acute iron SMAV (17,620 µg/L) was identified for *R. hexadactyla*. This frog species appears to be relatively insensitive to iron. No chronic data were identified for iron. The chronic iron surface water benchmark developed for aquatic organisms in Table C-1 is 1000 µg/L.

- **Lead**: Lead SMAVs were identified for six amphibian species (SMAVs 40 µg/L to > 1,585 mg/L). As with other metals, the Eastern Narrow-Mouthed Toad was found to be the most acutely sensitive species to lead (SMAV = 40 µg/L) (Birge *et al.*, 1979; Birge, 1978). Chronic studies for lead indicate that concentrations as low as 430 µg/L can affect growth and development of some amphibian species (Table C-6). Current acute and chronic AWQC for lead appear to be protective of most amphibian species (65 µg/L and 2.5 µg/L at hardness of 100 mg/L $CaCO_3$).

- **Manganese**: Two species (*G. carolinensis* and *Microhyla ornata*) were identified as having acute toxicity data. SMAVs ranged from 1,420 to 14,583 µg/L. These concentrations bracketed the acute surface water benchmark developed for aquatic organisms in Table C-1 (2,986 µg/L). No chronic studies were identified for amphibians.

- **Mercury**: Amphibian SMAVs were identified for 16 species exposed to inorganic mercury and three species exposed to methylmercury. The SMAVs ranged from 1.1-17,164 µg/L and 56-68 µg/L for mercury and methylmercury, respectively. No chronic studies were identified. Acute AWQC (1.4 µg/L) appear to be protective of most amphibians species.
- **Nickel**: Acute toxicity following nickel exposure ranged from 205-25,320 µg/L for the six amphibian species tested. SMAVs for *G. carolinensis* and *Ambystoma opacum* were more sensitive than the current acute AWQC (468 µg/L at hardness of 100 mg/L $CaCO_3$), while all other species were less sensitive. No chronic data were identified for amphibians exposed to nickel.
- **Selenium**: For selenium(IV), a single SMAV is available for the frog *X. laevis*. For selenium(VI), no 96-hour acute toxicity data were identified for amphibians, but, for comparative purposes, a seven-day LC_{50} for the Eastern Narrow-Mouthed Toad (*G. carolinensis*) was included in the dataset. The results of these studies suggest that amphibians are not uniquely sensitive to selenium and the current acute AWQC (20 µg/L) is protective of the species tested. Chronic data is lacking for this metal.
- **Silver**: Acute SMAVs were derived for eight amphibian species (4.1-240 µg/L), which were all above the current acute AWQC (3.2 µg/L at hardness of 100 mg/L $CaCO_3$). No sources of chronic toxicity data were identified for silver.
- **Thallium**: One study was identified for thallium (SMAV = 110 µg/L), which was conducted using the Eastern Narrow-Mouthed Toad (*G. carolinensis*) (Birge *et al.*, 1979; Birge, 1978). This value is above the acute surface water benchmark developed for aquatic organisms in Table C-1 (79 µg/L).
- **Vanadium**: One study was identified for vanadium (SMAV = 250 µg/L), which was conducted using the Eastern Narrow-Mouthed Toad (*G. carolinensis*) (Birge *et al.*, 1979; Birge, 1978). This value is above the acute surface water benchmark developed for aquatic organisms in Table C-1 (150 µg/L).
- **Zinc**: Thirteen amphibian species were evaluated in acute toxicity studies; SMAVs ranged from 10-70,000 µg/L. Several chronic studies were performed and, generally, results suggested that most amphibian species were not uniquely sensitive to zinc, with the exception of the Eastern Narrow-Mouthed Toad (*G. carolinensis*). Current acute and chronic AWQC appear to be protective of most amphibian species (< 120 µg/L at hardness of 100 mg/L $CaCO_3$).

Aquatic toxicity data for amphibians were compared to the acute and chronic surface water benchmarks developed for aquatic organisms in section 2.1 for each of the COPCs (Table C-1). For the majority of the species tested, these benchmarks appear to be sufficiently protective. Notable exceptions were studies conducted using the Eastern Narrow-Mouthed Toad (*G. carolinensis*) (Birge *et al.*, 1979; Birge, 1978). The studies conducted by Birge *et al.* were not conducted according to current standard protocols [*e.g.*, Frog Embryo Teratogenesis Assay—Xenopus (FETAX)] and methodological details are lacking (*e.g.*, water concentrations in test solutions or control solutions were not measured) (Fort *et al.*, 2006). Furthermore, a study by Fort *et al.* (2006) was not able to reproduce the results of Birge *et al.* for nickel using standard protocols (*e.g.*, FETAX, ASTM E1439-98). In addition, the longer exposure duration (seven days) in these studies may have increased the sensitivity as compared to four-day (96-hour) exposures. Therefore, the results from the studies by Birge *et al.* are uncertain. The preponderance of the toxicity data evaluated here suggests that amphibians are not more sensitive to metals than other aquatic organisms. Therefore, AWQC are considered sufficiently protective of amphibian populations and these criteria will be used to evaluate potential risks to amphibians exposed to metals in surface water at the site.

5.2 Sediment Benchmarks

Sediment toxicity tests for amphibian species are relatively limited in the current literature. Toxicity data were only identified for cadmium, copper, lead, mercury, and zinc in sediments; the LOEC or the highest NOEC (if no LOEC was available) are shown in Table C-8. A comparison of available amphibian sediment toxicity data to benthic invertebrate sediment benchmarks (*i.e.*, MacDonald consensus-based TEC and PEC) is presented in Table C-8. For copper and lead, amphibian effect thresholds are higher than those for benthic invertebrates. Amphibian effect thresholds for cadmium, mercury, and zinc were either slightly below the TEC (mercury, zinc) or between the TEC and the PEC (cadmium). It is important to note that the data for cadmium, mercury, and zinc are based on a study by Birge *et al.* (1977) using the Eastern Narrow-Mouthed Toad (*G. carolinensis*). As discussed Section 5.1 above, data were generated by Birge *et al.* (1977) using non-standard methods and the reported effect concentrations are typically orders of magnitude below those reported in more recent studies (Table C-6). It is possible that the study conditions used by Birge *et al.* (1977) led to an increased sensitivity of the tested species; however, methods are not reported in sufficient detail to evaluate this assumption. The preponderance of the sediment toxicity data evaluated here suggests that amphibians are not more sensitive to metals than benthic organisms. Therefore, sediment COPC concentrations below the Macdonald consensus-based SQG are expected to result in minimal or no effects to amphibian populations at the site.

5.3 Soil Benchmarks

Soil toxicity assays for amphibians are rarely reported in the literature and only three studies for COPCs were identified (James *et al.*, 2004; Bazar *et al.*, 2009, 2010). Soil toxicity tests using toads (*Bufo americanus*) and salamanders (*Plethodon cinereus*) were conducted for cadmium, copper, and lead.

NOECs for these metals were 120 (cadmium), 246 (copper), and 1,700 (lead) mg/kg for growth, survival, and development (Table C-9), respectively. Comparison of these soil concentrations to US EPA's wildlife ecological soil screening levels (EcoSSLs) shows that the EcoSSLs are an order of magnitude (or more) lower than the available amphibian soil NOECs. Therefore, soil COPC concentrations below the EcoSSL are expected to result in minimal or no effects to amphibian populations at the site.

5.4 Dietary Toxicity Reference Values

Dietary toxicity studies using amphibian species are limited and only a few studies were identified for use in the BERA. A summary of the available studies are provide below for COPCs where data exist.

- **Cadmium**: Few studies have investigated dietary exposure to cadmium with amphibians. Salamanders fed pellets containing 982 to 5,701 mg cadmium/kg wet weight for 22 days all survived and had no differences in growth relative to controls (Nebeker *et al*., 1995). *X. laevis* fed earthworms containing 609 mg cadmium/kg dry weight for 28 days did not suffer any mortality, but did accumulate cadmium in their livers and eggs (Linder *et al*., 1998). *X. laevis* fed earthworms containing 72 mg cadmium/kg wet weight accumulated a mean of 0.5 mg/kg dry weight in their eggs (Linder *et al*., 1998). Fort *et al*. (2001) fed adult *X. laevis* beef liver containing cadmium concentrations of 1, 2.5, or 10 mg/kg-day for 30 days. Cadmium accumulation was reported in reproductive organs; however, adverse effects on reproduction were not examined. James *et al*. (2004) fed juvenile American toads (*Bufo americanus*) cadmium in mealworms containing 4.7 or 16.1 mg cadmium/kg dry weight for 50 days. Survival was reduced compared to controls in toads fed 4.7 mg cadmium/kg in food (LOAEL 4.7 mg/kg dry weight or 0.94 mg/kg wet weight assuming 80% moisture).
- **Mercury**: Southern leopard frogs (*Rana sphenocephala*) were fed dietary concentrations of total mercury [54, 423, 1,409, or 3,298 ng/g dry weight (or 14, 110, 366, 858 ng/g wet weight, at 74% moisture)] for 254 days (Unrine *et al*., 2004). The diet was also analyzed for methylmercury; the dietary concentrations were 12, 14, 27, and 47 ng/g dry weight (or 3, 3.6, 7, 12.2 ng/g wet weight, at 74% moisture). Dietary exposure at the two highest doses were found to significantly affect survival and development (total mercury NOAEL = 0.11 mg/kg wet weight and LOAEL = 0.366 mg/kg wet weight; methylmercury NOAEL = 0.00036 mg/kg wet weight and LOAEL = 0.007 mg/kg wet weight).
- **Lead**: Ireland (1977) examined adult *X. laevis* fed earthworms containing 10, 307, or 816 mg/kg wet weight lead (79% moisture) for 56 days. Corresponding available tissue lead concentrations were reported as 5.63, 93.3, and 65.04 mg/kg wet weight. No effects on growth or survival were observed up to the highest concentration tested.
- **Selenium**: Treefrogs (*Hyla versicolor*) were fed selenium-enriched foods at 1.0, 7.5. or 32.7 mg/kg dry weight for 120 days (Rowe *et al*., 2010). No effects on survival, growth,

or development were observed at any dose tested (NOAEL = 32.7 mg/kg dry weight or 6.54 mg/kg wet weight, assuming 80% moisture).

- **Vanadium**: Treefrogs (*Hyla versicolor*) were fed vanadium-enriched foods at 3.0, 132.1, or 485.7 mg/kg dry weight for 120 days (Rowe *et al*., 2010). No effects on survival, growth, or development were observed at any dose tested (NOAEL = 485.7 mg/kg dry weight). Southern leopard frogs (*Rana sphenocephala*) were found to be more sensitive to vanadium (Rowe *et al*., 2009). Dietary vanadium exposure at 10, 109, or 363 mg/kg dry weight was studied for a period of 120 days (Rowe *et al*., 2009). Dietary concentrations of 109 mg/kg dry weight were reported to reduce growth compared to controls (Rowe *et al*., 2009). The NOAEL and LOAEL from this study are 2 and 21.8 mg/kg wet weight (assuming 80% moisture), respectively.

The dietary studies reviewed here only represents a limited number of amphibians species and exposure durations. Therefore, comparison of dietary items to these benchmarks should be considered uncertain.

6 Terrestrial Plants and Soil Invertebrates

Terrestrial plants and soil invertebrates are primarily exposed through direct contact with COPCs in soils. The primary benchmarks available for assessing these receptors are US EPA's EcoSSLs. Plant and invertebrate EcoSSLs are concentrations in soil that are not expected to affect survival, growth, or reproduction of plant or invertebrate communities. EcoSSLs are developed using a standardized peer-reviewed process and only use studies that are found eligible based on several quality control/quality assurance criteria (US EPA, 2003a). Available EcoSSLs are presented in Table C-9. When EcoSSLs were not available, alternative soil screening levels reported by Efroymson *et al*., (1997a,b) were used. The soil screening levels in Table C-9 were used in both the screening and baseline ERA. In addition, bioavailability was considered in the BERA by relying on additional information regarding soil grain size, total organic carbon content, and soil pH (US EPA, 2007).

No soil benchmarks were available from these sources for terrestrial invertebrates exposed to thallium in soils. Therefore, a literature search was conducted. Few soil invertebrate toxicity tests have been reported for thallium (Heim *et al*., 2002; Fischer and Molnar, 1997). An earthworm (*Eisenia fetida*) reproduction test was conducted using a standard test method (ISO-011268-2), in which earthworms were exposed to thallium carbonate in an artificial test soil (pH = 6.0) for a period of four weeks, then growth, survival, and reproduction were measured (Heim *et al*., 2002). The LOECs for mortality, growth, and reproduction were 500, 100, and 5 mg/kg, respectively (Heim *et al*., 2002). A similar reproduction test was conducted with a land snail (*Arianta arbustorum*) exposed to thallium carbonate in soil for 28 days (Heim *et al*., 2002). The LOEC for hatching success was 1 mg/kg and the LOEC for growth was 100 mg/kg (Heim *et al*., 2002). In another experiment, earthworms (*Eisenia fetida*) were exposed to 1, 5, or 10 mmol/kg thallium chloride for 10 weeks in a peaty marshland soil (Fischer and Molnar, 1997). Significant mortality was observed at the lowest concentration tested (LOEC = 1 mmol/kg or 240 mg/kg). Based on these studies, the lowest concentration resulting in adverse effects to soil invertebrates is 1.0 mg/kg; this value will be used to evaluate soil invertebrates in the BERA.

7 Birds and Mammals

Birds and mammals are primarily exposed through the dietary pathway. Two types of benchmarks are available for assessing risks to wildlife: media-based screening levels and dietary-based TRVs. A description of each of these benchmarks is provided below.

7.1 Ecological Soil Screening Levels (EcoSSLs)

US EPA's EcoSSLs are concentrations in soil that are not expected to result in adverse health effects in birds or mammals feeding on organisms exposed to contaminants in soil. EcoSSLs are developed using a standardized peer-reviewed process and only use studies that are found eligible based on several quality control/quality assurance criteria (US EPA, 2003a). The available EcoSSLs for birds and mammals are presented in Table C-9. EcoSSLs for birds and mammals were not available for mercury and thallium, and alternative screening values were obtained from US EPA Region 5 Resource Conservation and Recovery Act (RCRA) soil screening levels (US EPA, 2003b). EcoSSLs were used in screening level risk assessment for wildlife. A refined risk characterization for wildlife, using dietary analyses and comparison to TRVs, was subsequently performed in the BERA, as described in the next section.

7.2 Toxicity Reference values (TRVs)

Sources of the TRVs for avian and mammalian species include US EPA's EcoSSLs, Sample *et al.* (1996), and the scientific literature. US EPA recently developed EcoSSLs for a number of metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc), as well as other chemicals. In developing the EcoSSLs, US EPA extensively reviewed the toxicological literature and selected eligible studies to form the basis for wildlife TRVs. The key studies that form the basis of the EcoSSLs were reviewed for possible use in developing the wildlife TRVs used the BERA.

The selection of TRVs requires the use of professional judgment. Because the intent of the BERA is to assess risk to wildlife populations (US EPA, 1997a), laboratory studies reviewed for TRV derivation were evaluated for those measures of effect that are relevant to population-level impacts (*i.e.*, growth, reproduction, and survival). Chronic dietary exposure studies were preferred because they best represent wildlife exposure conditions. For some chemicals with little or no published toxicological information, studies measuring alternative endpoints or with shorter exposure durations were used for TRV derivation, as discussed below.

A number of considerations were used when selecting a study for TRV derivation:

- *Test species relevance to receptor species*: Ideally, studies on wildlife species are preferred for TRV development; however, few toxicological studies on wildlife species have been conducted. Therefore, studies on laboratory rodents (*e.g.*, rats and mice) and common avian test species (*e.g.*, Japanese quail) were reviewed and considered for TRV development. Studies on domesticated species, such as chickens, cattle, pigs, and dogs, were also considered for TRV development when studies for wildlife species or common laboratory test species were not available.
- *Relevance of exposure route*: The preferred route of exposure for TRV derivation is *via* food. Exposure in food provides a better estimate of wildlife exposure to chemicals in the environment than exposure by gavage, oral capsule, or in drinking water. Chemicals dissolved in drinking water or a capsule are typically in forms that are much more bioavailable (*e.g.*, inorganic salts) than chemical forms typically found in the environment, and thus do not produce realistic toxicity estimates. Given that metals and organic chemicals partition from water to food, soil, or sediment in the environment, these exposure routes (soil or sediment) are not as relevant as in food. Other exposure routes, such as gavage or drinking water, were considered for TRV derivation only in cases where no appropriate feeding studies were available.
- *Chemical form*: As described above, readily bioavailable inorganic salts are typically used in wildlife toxicity tests. Metals in the environment, however, are typically bound to soil minerals and organic matter and are generally less bioavailable. The chemical form used in the underlying study are described below for each metal, when available. Therefore, use of the derived TRVs in the BERA is considered to provide a conservative estimate of potential risk when compared to concentrations measured in environmental media. Uncertainties with the chemical forms underlying the TRVs and potential risks will be discussed in the BERA, as appropriate.
- *Test duration*: Studies of chronic duration are preferred over short-term or acute studies for TRV derivation. For mammals, a study is considered chronic if the exposure was at least one-half of the test animal's lifespan or occurred during a critical life stage, such as reproduction and development. For birds, a study was considered chronic if the exposure was at least 10 weeks or occurred during reproduction or development.
- *Adequate controls*: Laboratory studies without adequate controls were not considered for TRV development. Laboratory studies with a control group exposed to an exposure medium without chemicals added were preferred over field studies where such controls did not exist.
- *Statistical methods*: Studies that relied on appropriate statistical analyses to determine significant differences between the control and treatment groups were preferred.
- *Sample size*: A minimum sample size of three was required for consideration in the TRV development. Studies with larger sample sizes were preferred.

- *Daily dose or adequate dosing information*: Studies that reported the ECs as daily doses [*e.g.*, milligrams chemical per kilogram body weight (BW) per day, mg/kg-day] or reported the information necessary to calculate the daily dose (*e.g.*, test-animal ingestion rate or BW and food consumed) were preferred over studies lacking this information.
- *Reproductive, growth, or survival endpoints*: Studies that reported effects on ecologically relevant endpoints, including reproduction, growth, and survival, were considered for TRV development. Behavioral, pathological, biochemical, or physiological endpoints were not considered for TRV development unless they were linked to the ecologically relevant endpoints. Reproductive endpoints were preferred to growth and survival.
- *Confounding factors*: Studies that controlled for confounding factors were preferred. For example, studies that exposed test organisms to multiple chemicals were not used for TRV development.
- *Dose-response*: Studies that demonstrated increasing chemical levels related to increasing severity of effect were preferred because they provide evidence that the treatment was the cause of the observed effect.
- *Report threshold effect concentration*: Studies that reported both a NOAEL and LOAEL were preferred because these studies (1) reported the statistically significant effect level and (2) bound the adverse-effect level, thus reducing uncertainty in the use of the study to develop TRVs.
- *Ingestion rate and body weight*: If ingestion rate (IR) and BW were not provided in the source study, they were estimated from data in other published sources. IRs can be calculated using appropriate allometric equations, such as those reported in Calder and Braun (1983), Nagy (1987), or US EPA (1993).
- *Wet weight/dry weight*: Concentration in the diet and the IR must be expressed on the same mass basis (*e.g.*, either wet weight or dry weight).
- *Acute-to-chronic and LOAEL to NOAEL conversions*: If only subchronic studies were available for selecting chronic TRVs, an acute-to-chronic ratio of 10 (Sample *et al.*, 1996) was applied. If only a LOAEL was provided by the authors of the selected study, then the LOAEL was divided by a factor of 10 to derive the NOAEL benchmark.
- *Chemical purity*: Doses of metal salts of less than 100% purity were adjusted by multiplying the dose by the percent molecular weight. This is consistent with US EPA's EcoSSL TRV development methodology.

Below are descriptions of the studies used to develop the wildlife TRVs, including discussions regarding US EPA's EcoSSL for each metal. The NOAEL- and LOAEL-based TRVs derived from these studies are presented in Table C-10. The NOAEL is the highest concentration of a chemical at which no adverse effects are observed in the test species. Because the NOAEL represents a body-weight-normalized daily intake rate of a chemical that did not elicit any adverse responses in the test organism, exceedance of this value does not necessarily imply that adverse effects would occur for ecological receptors. The LOAEL is the lowest concentration of a particular chemical at which adverse effects are observed in the test species. Thus, an exposure dose in excess of the LOAEL-based TRV indicates a greater potential for adverse effects.

Aluminum

Birds: Very few studies on the ecologically relevant effects of aluminum in birds have been published, and US EPA does not provide an EcoSSL for aluminum for birds. The TRV for the BERA was derived from a study by Carriere *et al*. (1986), in which ringed doves were dosed with aluminum sulfate in food for four months. Because there were no significant reproductive differences observed at a dose of 1,000 mg/kg over the critical life stage (reproduction), this dose was considered to be an avian no-effect dose. The 1,000-mg/kg dose was based on wet weight in food and equates to 1,111 mg/kg dry weight, assuming a 10% moisture content for prepared laboratory food. Based on a ringed dove food IR of 0.0173 kg-day [calculated with an allometric equation from Nagy (1987)] and a BW of 0.155 kg (Terres, 1980), a NOAEL TRV was calculated to be 124 mg/kg-day. No appropriate study could be found to identify an avian LOAEL TRV.

Mammals: No studies on aluminum toxicity in mammalian wildlife were found, and US EPA does not provide an EcoSSL for aluminum for mammals. The mammalian TRV for aluminum in the BERA is based on a study by Ondreicka *et al*. (1966), in which mice were exposed to aluminum chloride (a soluble salt) in drinking water at 19.3 mg/kg-day for 390 days (three generations). No significant effect was noted with regard to the number of litters or number of offspring. However, the treatment group did manifest reductions in weight gain in the second and third litters of the second generation and the first and second litters of the third generation. This significant reduction in pup growth was considered the LOAEL. Because no lower-dose level was tested, an uncertainty factor of 10 was applied to estimate the NOAEL TRV at 1.93 mg/kg-day.

Antimony

Birds: No avian studies suitable for antimony TRV derivation were found in the literature. US EPA does not provide an EcoSSL for antimony for birds because all of the studies it reviewed were rejected as inappropriate for TRV derivation. Therefore, no avian TRV could be developed for antimony.

Mammals: The US EPA EcoSSL for antimony was derived from a reproductive study on rats by Rossi *et al*. (1987), which was also selected to derive the mammalian TRVs for the BERA. In this study, Rossi *et al*. (1987) exposed pregnant rats to 1 and 10 mg/L antimony trichloride (53.38% antimony by molecular weight) in drinking water for 31 days. Pups were also exposed postnatally *via* nursing. A significant decrease in pup BW was observed at 10 mg/L in drinking water (LOAEL). This study was considered appropriate because animals were exposed during critical life stages (gestational females and nursing pups). Although this study did not provide the daily dose or the water IR, maternal BW data were provided so that the daily dose could be estimated. Using a rat BW of 0.33 kg and intake rate of 0.13 L/kg-day, and adjusting for 53.83% antimony by molecular weight, the resulting NOAEL is 0.07 mg/kg-day, and the LOAEL is 0.72 mg/kg-day for mammals.

Arsenic

Birds: The selected avian TRVs for arsenic are 10 mg/kg-day (NOAEL) and 40 mg/kg-day (LOAEL), based on mallard reproductive effects from exposure to sodium arsenate (As^{3+}) and derived from a study by Stanley *et al*. (1994). The US EPA EcoSSL TRV (2.24 mg/kg-day) for arsenic for birds is from a study on chickens by Holcman and Stibilj (1997). This study was not considered in the TRV derivation process for this BERA because chickens are not the most appropriate surrogate species for wildlife receptors and other studies on more suitable species are available, including the study by Stanley *et al*. (1994) described here. In this study, mallards were fed feed mixed with sodium arsenate for 115-128 days during reproduction at arsenic concentrations in feed of 0, 25, 100, or 400 mg/kg. Arsenic did not affect hatching success or embryo deformity rates at any dose level; however, the highest dose resulted in an increase in the number of days between pairing and laying of the first egg, and a decrease in whole-egg weight and shell thickness. Duckling production and growth decreased when diets were supplemented with 400 mg/kg arsenic (LOAEL). At 100 mg/kg in the feed, there was no effect on duckling production (NOAEL). Assuming a mallard BW of 1.0 kg and an IR of 0.100 kg-day (Heinz *et al*., 1989), the arsenic NOAEL TRV was calculated to be 10 mg/kg-day and the LOAEL to be 40 mg/kg-day.

Mammals: Nemec *et al*. (1998) evaluated the developmental toxicity of arsenic to rabbits (New Zealand white strain). This study was considered more appropriate for TRV derivation for the BERA than the study used by US EPA for the EcoSSL because it was conducted during a critical life stage and assessed both reproductive and survival endpoints. The US EPA EcoSSL mammalian TRVs (1.04 mg/kg-day) for arsenic was from a study by Neiger and Osweiler (1989) conducted on beagle dogs based on the growth endpoint, fraction of initial BW. In this study, inorganic arsenic (sodium arsenite) in feed resulted in feed rejection, which resulted in reduced BW. In the study used for TRV derivation for the BERA, Nemec *et al*. (1998) provided rabbits with arsenic acid (As^{5+}) by oral gavage on gestation days six through 18 at 0, 0.19, 0.75, or 3.0 mg/kg-day. The rabbits were sacrificed on gestation day 29. Maternal effects, including mortality, slight decreases in BW, and clinical signs of toxicity, occurred only at the highest dose level. There were no statistically significant effects on embryos or fetuses at this dose, although there was a slight decrease in the number of viable fetuses per litter. No maternal or offspring effects were seen at 0.75 mg/kg-day (NOAEL). The 3.0 mg/kg-day dose represents a chronic LOAEL. Although this study was of subchronic duration, no uncertainty factor was applied because the exposure was to fetuses during gestation, which is a sensitive life stage (Sample *et al*., 1996).

Barium

Birds: US EPA does not provide EcoSSL TRVs for birds for barium, and all of the studies except one (Johnson *et al*., 1960) were rejected for use in deriving an avian TRV. This study was used to develop the barium TRVs for birds in this evaluation. Johnson *et al*. (1960) fed one-day-old chicks 0, 250, 500, 1,000, 2,000, 4,000, 8,000, 16,000, or 32,000 mg barium/kg as barium hydroxide in feed to groups of 20 female chicks for four weeks. The 2,000-mg barium/kg diet had no effect on mortality. There was a slight depression in growth of chicks that ate the 2,000-mg barium/kg diet, but this was not significant. The 4,000- to 32,000-mg barium/kg diets resulted in 5% to 100% mortality. This study did not provide information needed to develop a daily dose, and BW and IR were assumed. This study, at four weeks long, is considered to be a subchronic exposure, and a subchronic-to-chronic uncertainty factor of 0.1 was applied to the NOAEL and LOAEL. The resulting NOAEL TRV is 21 mg/kg-day, and the LOAEL TRV is 42 mg/kg-day.

Mammals: The US EPA EcoSSL TRV for barium for mammals is a NOAEL of 51.8 mg/kg-day. US EPA stated that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth, and is lower than the lowest bounded NOAEL for reproduction, growth, and survival. The US EPA EcoSSL is based on two studies: Borzelleca *et al*. (1988) and Dietz *et al*. (1992). Borzelleca *et al*. (1988) administered barium chloride to juvenile rats for 10 days and observed reduced survival at 209 mg/kg-day. Dietz *et al*. (1992) exposed juvenile rats to barium chloride by gavage for 92 days and observed reduced growth in developing male rats at 121 mg/kg-day. The study by Dietz *et al*. (1992) was selected to develop the TRVs because it was a longer study and reported effects on a more sensitive endpoint than the study by Borzelleca *et al*. (1988). The study by Dietz *et al*. (1992) is considered subchronic, so an uncertainty factor of 0.1 is applied to the NOAEL and LOAEL. The resulting NOAEL is 6.1 mg/kg-day and the LOAEL is 12 mg/kg-day.

Beryllium

Birds: No studies were found on ecologically relevant effects of beryllium in birds, and US EPA does not provide an EcoSSL for birds. Therefore, no avian TRVs could be developed for birds for beryllium.

Mammals: The US EPA EcoSSL TRV for beryllium is based on a life-term study conducted on rats by Schroeder and Mitchener (1975), which was also selected for TRV derivation for the BERA. In this study, a slight depression on growth was observed in rats given drinking water with 5 mg/L beryllium from two to six months of age, but this was not a lasting effect, even though exposure continued up to six months. At the next time periods tested (12 and 18 months of age), there was no depression in growth in beryllium-treated rats. Therefore, this can be considered a chronic no-effect concentration. No other effects on rats from beryllium exposure were observed. There is low confidence in this TRV, because a LOAEL was not determined, only one control and one treatment group were used, and daily dose information was not provided. However, the endpoint was ecologically relevant and the exposure duration was chronic. The resulting NOAEL TRV for this BERA is 0.66 mg/kg-day.

Cadmium

Birds: The selected avian TRVs for cadmium for the BERA are based on mallard reproductive effects (egg production) observed by White and Finley (1978). In this study, adult mallards were fed breeder mash with cadmium chloride for 90 days. Egg production was significantly suppressed in the mallards fed 210 mg cadmium/kg (LOAEL), whereas mallards fed 1.6 to 15.2 mg cadmium/kg were not affected (NOAEL). The test species had a BW of 1.153 kg and a food consumption rate of 0.110 kg-day. Therefore, 15.2 mg cadmium/kg (1.45 mg/kg-day) was considered the chronic NOAEL TRV, and 210 mg cadmium/kg (20 mg/kg-day) was considered the LOAEL TRV for birds. The US EPA EcoSSL avian NOAEL TRV for cadmium is 1.47 mg/kg-day. This value is the geometric mean of NOAELs for reproduction and growth, mostly derived from studies with chickens. Chickens are generally not a good surrogate species for mallard or other wildlife species. In fact, for some chemicals (such as polychlorinated biphenyls), chickens have been shown to be among the most sensitive bird species.

Therefore, when data for a more relevant avian wildlife species are available, as in the case of cadmium, chicken studies were eliminated from consideration in the TRV derivation process for the BERA.

Mammals: The mammalian TRVs for cadmium were developed from a study by Sutou *et al.* (1980) on rats. Sutou *et al.* (1980) exposed rats to cadmium, as cadmium chloride, at four dose levels (0, 0.1, 1.0, and 10 mg/kg-day) by oral gavage through the mating and gestation period (six-week exposure period). Adverse reproductive effects (*i.e.*, reduced fetal implantations, reduced fetal survivorship, and increased fetal resorption) were observed in the rats exposed to 10 mg/kg-day (LOAEL TRV). Applying an uncertainty factor of 10, 1.0-mg/kg-day dose was considered to be the chronic NOAEL TRV for mammals. This Sutou *et al.* (1980) feeding study with reproductive endpoints was determined to be more appropriate for TRV derivation than the study used as the basis of the US EPA EcoSSL, because the EcoSSL TRV (0.77 mg/kg-day) is from a study by Yuhas *et al.* (1979), in which rats were dosed *via* drinking water and the endpoint was growth.

Chromium

Birds: The avian TRV for chromium was based on a study by Haseltine *et al.* (1985), in which black ducks were exposed to chromium(III) [as $CrK(SO_4)_2$] at two dose levels – 10 and 50 mg/kg in food for 10 months through reproduction. No effects on reproduction were observed at the lower dose of 10 mg chromium/kg (11 mg/kg dry weight). The assumptions used in the TRV calculations included a BW of 1.25 kg (Dunning, 1993) and a food consumption rate of 0.0785 mg/kg-day for the test species [based on a reasonable maximum energy requirement of 200 kcal/kg-day derived from Nagy (1987), an assimilation efficiency of 80%, and an energy content of 3,190 kcal/kg dry weight). Therefore, the NOAEL TRV was determined to be 0.86 mg/kg-day. The LOAEL was determined to be 4.32 mg/kg-day based on the 50-mg/kg treatment. The Haseltine *et al.* (1985) study on black ducks was considered more relevant for TRV derivation than the US EPA EcoSSL NOAEL TRV (2.66 mg/kg-day), which is based on the geometric mean of NOAELs for reproduction and growth. The collection of studies used the derive the avian EcoSSL consisted mostly of chicken and turkey studies, which are not considered as ecologically relevant as black ducks.

Mammals: A study by Zahid *et al.* (1990) was the source of the lowest LOAEL used by US EPA in developing the EcoSSL TRV for chromium(III) for mammals. In this study, mice were fed 100, 200, or 400 mg/kg chromium sulfate (38.02% chromium by molecular weight) for 35 days. Dietary chromium sulfate decreased sperm count at all doses tested. This study provided information needed to calculate the daily dose; the resulting LOAEL for chromium is 5.96 mg/kg-day. To estimate a NOAEL, the LOAEL was divided by 10, resulting in a NOAEL of 0.596 mg/kg-day.

Cobalt

Birds: The US EPA EcoSSL TRV for cobalt for birds is a NOAEL of 7.61 mg/kg-day. US EPA stated that the NOAEL is based on the geometric mean of NOAELs for growth, which are mostly based on studies on chickens; there were no studies on reproduction. Chickens are not always a good surrogate species for mallards or other wildlife species, as discussed above. Therefore, chicken studies were eliminated from consideration in this TRV derivation process when data for a more relevant species were available. The only other study from the US EPA EcoSSL list that was relevant was a study by Paulov (1971), which reported both a NOAEL and LOAEL for the effects of cobalt on the growth of mallards. In this study, juvenile (two-day-old) mallards were fed a commercial diet with cobalt chloride ($CoCl_2$) for eight days. Growth was significantly lower in the mallards fed 2,000 mg cobalt/kg (LOAEL), whereas mallards fed 200 mg cobalt/kg were not affected (NOAEL). Based on this study, the resulting NOAEL and LOAEL TRVs for cobalt are 4.1 mg/kg-day and 41 mg/kg-day, respectively.

Mammals: The US EPA EcoSSL NOAEL TRV for cobalt for mammals is 7.33 mg/kg-day. US EPA stated that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth. A key study used to develop the EcoSSL TRV for cobalt is a study by Nation *et al.* (1983). This study was the source of the lowest NOAEL and LOAEL used by US EPA in the development of the EcoSSL TRV for cobalt. Other studies listed by US EPA used non-preferred routes of exposure, were of shorter duration than Nation *et al.* (1983), or did not report both NOAELs and LOAELs. In the Nation *et al.* (1983) study, mature rats received 0, 5, or 20 mg cobalt/kg-day in food for 69 days. While rats in the 20-mg/kg-day group exhibited testicular atrophy, rats in the 5-mg/kg-day group did not. Because the exposure duration was less than one-half of the lifespan of the rat, a subchronic-to-chronic uncertainty factor of 10 was applied to the daily doses. Therefore, the cobalt NOAEL TRV is 0.5 mg/kg-day, and the LOAEL TRV is 2.0 mg/kg-day.

Copper

Birds: The US EPA EcoSSL NOAEL TRV for copper for birds is 4.05 mg/kg-day. US EPA stated that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The US EPA NOAEL is based on a chicken study (Ankari *et al.*, 1998). Chickens are not always a good surrogate species for mallards or other wildlife species, as discussed above. Therefore, chicken studies were eliminated from consideration in this TRV derivation process when data for a more relevant species were available. The only other study from the US EPA EcoSSL list that was relevant (*i.e.*, a study that used an ecologically relevant species, reported a NOAEL and LOAEL, and was for a relevant endpoint) was a study by Foster (1999). In this study, juvenile ducks were fed 0, 218.5, 420, or 1,024 mg copper/kg in food for 34 days; reduced growth was observed in the 420-mg/kg group, but growth was not affected in the 218.5-mg/kg group. This study reported information needed to calculate daily doses, and the resulting NOAEL is 56.8 mg/kg-day and the LOAEL is 109 mg/kg-day. Because the exposure duration of this study was only 35 days, a subchronic-to-chronic conversion factor of 10 was applied. The final copper NOAEL TRV for birds is 5.68 mg/kg-day, and copper LOAEL TRV for birds is 10.9 mg/kg-day.

Mammals: The US EPA EcoSSL NOAEL TRV for copper for mammals is 5.60 mg/kg-day. US EPA stated that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The US EPA NOAEL is based on a mink study (Aulerich *et al.*, 1982). Other available copper mammalian studies that reported both NOAELs and LOAELs for relevant endpoints were not considered in the TRV selection process because the study durations were shorter than the study by Aulerich *et al.* (1982). Aulerich *et al.* (1982) fed juvenile mink a diet with added amounts of copper (0, 25, 50, 100, or 200 mg/kg) in food for 357 days. The feed without addition of copper contained 60.5 mg/kg; this base level of copper should be added to the copper doses. Kit mortality was observed in the 50-mg/kg group, but not the 25-mg/kg group. This study did not provide necessary information to estimate the daily doses, and BW and IR values were assumed. The NOAEL TRV is 11.7 mg/kg-day (25 mg/kg diet + 60.5 mg/kg in food * 0.137 kg food/kg BW-day), and the LOAEL TRV is 15.1 mg/kg-day (50 mg/kg diet + 60.5 mg/kg in food * 0.137 kg food/kg BW-day).

Lead

Birds: The lead NOAEL-based TRV for birds was developed from a study by Pattee (1984), in which American kestrels were fed lead in food for seven months. Pattee (1984) dosed American kestrels with metallic lead in the diet (0, 10, or 50 mg/kg) for five to seven months prior to and during clutch completion. Key results of this study included no effects on BW, food consumption, clutch initiation, interval between eggs, clutch size, fertility, or eggshell thickness at any dose level. Results indicated that the highest tested dose (50 mg/kg) represented a no-effect level. Because the dosing lasted up to seven months and included a critical life stage (reproduction), the study can be considered a chronic exposure study. Using the BW reported in the study and a food IR of 10 g-day (Sample *et al*., 1996), the resulting lead NOAEL TRV for birds is 3.85 mg/kg-day. The US EPA avian EcoSSL TRV (1.63 mg/kg-day) for lead is based on a study by Edens and Garlich (1983) using chickens. Chickens are not a good surrogate species for mallards or other wildlife species. Therefore, when data for a more relevant species, such as kestrel, were available, chicken studies were eliminated from consideration in the TRV derivation process for the BERA.

The LOAEL-based avian TRV for lead was developed from a study by Edens *et al*. (1976). In this study, Japanese quail received dietary exposure to lead (0, 1, 10, 100, or 1,000 mg/kg as lead acetate) from hatching to 12 weeks of age, through reproduction. The key result of this study was the observation of a significant decrease in percent hatch of settable eggs at 100 mg/kg and higher (59.1% for this dose group *versus* 81.6% for control group and 82.4% for the 10-mg/kg group). Therefore, 100 mg/kg lead was considered to be a chronic LOAEL dose. Assuming a BW of 0.15 kg from Vos *et al*. (1971) and a food consumption rate of 0.0169 kg-day [based on allometric equation from Nagy (1987)], a LOAEL TRV of 11 mg/kg-day was derived.

Mammals: The mammalian TRVs for lead were developed from a study by Azar *et al*. (1973), which examined effects on reproductive performance in rats over three generations. Various dose levels were tested (5, 18, 62, 141, 1,130, and 2,102 mg/kg lead as lead acetate measured in food). None of the lead dose levels affected the number of pregnancies, number of live births, or other reproductive indices. The two highest doses reduced offspring weights and produced kidney damage in young. Therefore, 1,130 mg/kg concentration in food, or 90 mg/kg-day [based on a BW of 0.35 kg and an IR of 0.028 kg-day from US EPA (1988)], was considered the LOAEL TRV. The no-effects dose was 141 mg/kg in food, which corresponds to a NOAEL TRV of 11 mg/kg-day. The US EPA EcoSSL TRV (4.7 mg/kg-day) for lead in mammals is based on a study that dosed rats with lead in drinking water, which is not the preferred exposure route. Therefore, the study by Azar *et al*. (1973) was the preferred study for TRV development.

Manganese

Birds: A study by Vohra and Kratzer (1968) was the source of the avian TRVs for manganese. In this study, turkey poults were fed 0, 510, 1,020, 2,040, 3,000, 3,060, 3,620, 4,080, or 4,800 mg manganese/kg in food for 21 days. Growth was significantly lower in the turkeys fed 4,800 mg manganese/kg (LOAEL), whereas turkeys fed 4,080 mg/kg were not affected (NOAEL). This study provided BW and an IR to calculate the daily doses. Because the exposure duration was three weeks, a subchronic-to-chronic uncertainty factor of 10 was applied to the TRVs. The resulting NOAEL and LOAEL for manganese are 26 mg/kg-day and 30 mg/kg-day, respectively. The US EPA EcoSSL avian TRV for manganese is 179 mg/kg-day (NOAEL). US EPA stated that this value is based on the geometric mean of NOAELs for reproduction and growth, which are mostly based on studies with chickens. US EPA lists only one non-chicken study (*i.e.*, Vohra and Kratzer, 1968), which is the basis for the BERA TRVs. This study used a more-appropriate test species, relied on the preferred route of exposure (oral in food), and reported both a NOAEL and LOAEL for an ecologically relevant endpoint.

Mammals: The mammalian TRVs for manganese were derived from the study by Laskey *et al.* (1982), in which rats were fed 0, 250, 1,050, or 3,500 mg manganese/kg in food for 224 days. This study is appropriate for development of TRVs because the researchers used the preferred exposure route (oral in food), an appropriate test organism (the rat), ecologically relevant endpoints (reproduction), and a sufficient exposure duration. The percentage of pregnant rats was significantly lower in the 3,500-mg/kg (LOAEL) group than in the control group, whereas the percentage of pregnant rats was not significantly different in the 1,050-mg/kg (NOAEL) group from the control group. This study did not provide daily doses or BW and IR to calculate the daily doses; therefore, these values were assumed. Using a BW of 0.35 kg (US EPA, 1995) and IR of 0.028 kg-day [calculated using an allometric equation from US EPA (1988)] for the rat, the resulting NOAEL and LOAEL TRVs for manganese are 88 mg/kg-day and 280 mg/kg-day, respectively. The US EPA EcoSSL TRV for manganese is based on the geometric mean of NOAELs for reproduction and growth. Of the studies that US EPA lists, many of them used less-relevant test species, do not use the preferred route of exposure (oral in food), or do not provide both a NOAEL and LOAEL for an ecologically relevant endpoint.

Total Mercury

Birds: US EPA does not provide a mercury EcoSSL for birds. However, there are sufficient studies on avian species to derive mercury TRVs. A study on Japanese quail by Hill and Schaffner

(1976) was selected for the avian TRV derivation process because this study used the preferred route of exposure, was of adequate duration, and measured appropriate toxicological endpoints. In this study, groups of Japanese quail were fed mercuric chloride in food at 0, 2, 4, 8, 16, or 32 mg/kg for one year during reproduction. Fertility and hatching success decreased at 8 mg/kg and higher dose levels. The NOAEL was considered to be 4 mg/kg in diet, and the LOAEL was considered to be 8 mg/kg in diet. Using a 0.15-kg BW for quail (Vos *et al.*, 1971) and an IR determined by allometric equation (Nagy, 1987), the resulting NOAEL and LOAEL TRVs for total mercury are 0.74 and 1.5 mg/kg-day, respectively.

Mammals: US EPA does not provide a mercury EcoSSL for mammals. However, there are sufficient studies on mammalian species to derive mercury TRVs. Studies using mink by Aulerich *et al.* (1974) and mouse by Dieter *et al.* (1983) were selected for the mammalian TRV derivation process because these studies used the preferred route of exposure, duration, and toxicological endpoints. In the study by Aulerich *et al.* (1974), groups of mink were fed mercuric chloride in food at 0 or 7.39 mg/kg for six months during reproduction and fertility; offspring survival and weight were not significantly reduced (NOAEL). In the study by Dieter *et al.* (1983), mice exposed to mercury in water at 75 mg/kg for seven weeks exhibited significantly lower body mass (LOAEL). Using the BWs and IRs for mink and mouse in Table C-10, the resulting NOAEL and LOAEL TRVs for total mercury based on these studies are 1.0 and 18.8 mg/kg-day, respectively.

Methylmercury

Methylmercury TRVs were included as effect measures for mercury in addition to total mercury because this COPC typically occurs in a methylated form in biological tissues (methylmercury was analyzed in wildlife prey items as part of the BERA), which tends to contribute more mercury to the total exposure than drinking water or incidental ingestion of soil or sediment.

Birds: The TRV used to evaluate the effects of methylmercury in birds was based on a three-generation study by Heinz (1974, 1976a, 1976b, 1979) in mallards. Mallard ducks were exposed to dietary concentrations of methylmercury dicyandiamide ranging from 0.5 to 3.0 mg/kg dry weight for two generations, with the third generation exposed to 0.5 mg/kg. The initial test birds (P1) showed no behavioral or reproductive effects at the lowest methylmercury concentration. However, the second-generation ducklings (F2), demonstrated a 29% reduction in one-week survival rates at 0.5 mg/kg methylmercury (Heinz, 1976a). Neither the first generation (F1) nor the third generation (F3) showed decreased survival at this dose level. The impact over the three generations was reported to be an 18% reduction in productivity overall. Based on a food intake rate of 128 g/kg BW (as reported by Heinz, 1979), and a BW of 1.0 kg for the treated F1 and F2 females, a LOAEL TRV of 0.064 mg/kg BW-day was derived. No long-term studies were identified as suitable for the derivation of a no-effects level for methylmercury exposure to birds. Therefore, an uncertainty factor of 2 was applied to estimate a NOAEL TRV of 0.032 mg/kg-day from the LOAEL, as recommended by US EPA (1995), since the LOAEL appeared to be very near the threshold for effects of mercury on mallards.

Mammals: The TRV for methylmercury for mammals was based on a study by Verschuuren *et al*. (1976). Rats were dosed with three dose levels of 0.1, 0.5, and 2.5 mg/kg of methylmercury chloride in food. The study took place over three generations, and reproduction was used as the toxicity endpoint. Adverse effects were not observed at the two lower doses, although exposure to 2.5 mg/kg reduced pup viability. The 0.5-mg/kg dose was considered the no-effect dose, and with a BW of 0.35 kg (US EPA, 1988) and a food consumption rate of 0.028 kg-day (US EPA, 1988), the NOAEL was calculated to be 0.032 mg/kg-day. The lowest-effect dose was considered to be 2.5 mg/kg, and the LOAEL was calculated to be 0.16 mg/kg-day.

Nickel

Birds: A study by Cain and Paddford (1981) on mallards was used to develop the avian TRVs for nickel. In this study, Cain and Paddford (1981) fed juvenile mallards 0, 200, 800, or 1,200 mg nickel/kg (as nickel sulfate) in food for 90 days. Growth and survival were significantly lower in the 800-mg/kg (774 mg nickel/kg) group, but were unaffected in the 200-mg/kg (176 mg nickel/kg) group. The BW and IR were provided in this study, and daily doses for the 200-mg/kg (NOAEL) and 800-mg/kg (LOAEL) groups were calculated. The resulting NOAEL TRV is 31 mg/kg-day, and the LOAEL TRV is 135 mg/kg-day. The US EPA EcoSSL TRV (6.71 mg/kg-day) is based on the geometric mean of NOAELs for reproduction and growth, which are mostly based on studies on chickens. Therefore, the study by Cain and Paddford (1981), which provides both a NOAEL and LOAEL for mallards, was selected as the preferred study for TRV derivation.

Mammals: A study by Ambrose *et al*. (1976), in which rats were fed nickel in food (0, 250, 500, or 1,000 mg/kg) for three generations, was selected for the mammalian TRV development. While other available studies used relevant test animals, including the study that is the basis of the EcoSSL TRV, those studies used shorter exposure durations than the study by Ambrose *et al.* (1976), did not report both NOAELs and LOAELs, or did not use the preferred exposure route (oral in food). The average weight of weanling rats decreased in the 1,000-mg nickel/kg group, but did not decrease in the 0-, 250-, and 500-mg/kg exposure groups. As this study did not provide the information needed to develop daily doses, BW and IR were assumed (see Table C-10). The resulting nickel NOAEL TRV for mammals is 40 mg/kg-day, and the LOAEL is 80 mg/kg-day.

Selenium

Birds: The study by Stanley *et al.* (1996) used the longest exposure duration and was chosen as the study from which to derive the avian TRVs for selenium. In this study, one-year-old breeding mallards were fed 0, 3.5, or 7 mg selenium/kg as selenium-DL-methionine in food on a dry-weight basis for 122 days. Hatching success was significantly reduced in the 7-mg/kg group (LOAEL), but not in the 3.5-mg/kg group (NOAEL), as compared to the control group (0 mg/kg group). Using a BW of 1.043 kg (US EPA, 1993) and IR of 0.05 kg-day for the mallard [estimated from omnivorous bird dry matter equation (Nagy, 2001)], the resulting NOAEL and LOAEL TRVs are 0.2 mg/kg-day and 0.4 mg/kg-day, respectively. The US EPA EcoSSL TRV (0.29 mg/kg-day) for selenium is based on a study with chickens (El-Begearmi and Combs, 1982), which are not the preferred test species for wildlife TRV derivation.

Mammals: The mammalian TRVs for selenium were based on a rat study by Rosenfeld and Beath (1954). In this study, rats were exposed to 0, 1.5, 2.5, or 7.5 mg/L of selenium as potassium selenate in drinking water for two generations. The treatment group exposed to 2.5 mg/L showed no significant difference with regard to reproduction or number of young reared. However, the second-generation female progeny of this treatment group did show a 50% reduction in the number of young reared. Therefore, the NOAEL TRV was determined based on a dose of 1.5 mg/L. Assuming a water intake rate of 0.046 L-day [based on the scaling function of Calder and Braun (1983)] and an average BW of 0.35 kg (US EPA, 1988), a NOAEL TRV of 0.20 mg/kg-day and a LOAEL TRV of 0.33 mg/kg-day were determined. The US EPA EcoSSL NOAEL TRV (0.143 mg/kg-day) is based on a study with pigs (Mahan and Moxon, 1984), which are not a preferred test species for wildlife TRV derivation.

Silver

Birds: The US EPA EcoSSL NOAEL TRV for silver for birds is 2.02 mg/kg-day. US EPA stated that the NOAEL is the lowest LOAEL for growth and survival divided by 10. This NOAEL is based on a study by Jensen *et al.* (1974), in which turkey poults were fed 0, 100, 300, or 900 mg silver/kg in food for four weeks. Another study in turkeys (Peterson *et al.*, 1973) used a relevant route of exposure and relevant endpoints, but did not provide both a NOAEL and LOAEL and was not considered further in the TRV development process. Jensen *et al.* (1974) found that growth rates were depressed in the 900-mg/kg group, but were unaffected in the 300-mg/kg group. This study did not provide daily doses or information needed to calculate daily doses. The BW and IR used to calculate the daily doses were assumed (Table C-10), and the resulting silver NOAEL TRV is 6.8 mg/kg-day and the LOAEL TRV is 21 mg/kg-day.

Mammals: The US EPA EcoSSL NOAEL TRV for silver for mammals is 6.02 mg/kg-day. US EPA stated that the NOAEL is the lowest LOAEL for growth and survival divided by 10. This NOAEL is based on a study by Van Vleet (1976), which used pigs, a species not considered ecologically relevant in this TRV development process. US EPA lists only one study (Shavlovski *et al.*, 1995) with an ecologically relevant endpoint and test species. In this study, rats were fed 0 or 50 mg silver acetate (75.2% silver by molecular weight) in food/organism-day for 20 days during gestation. The weight of progeny was significantly affected at 50 mg/organism-day (188 mg/kg-day). This is an unbounded chronic LOAEL; thus, an uncertainty factor of 10 is applied to the LOAEL to estimate the NOAEL. The resulting silver NOAEL TRV is 18.8 mg/kg-day and the LOAEL TRV is 188 mg/kg-day.

Thallium

Birds: US EPA does not provide EcoSSL TRVs for birds, and there are few studies on the effects of thallium on birds. A study on ring-necked pheasants by Hudson *et al.* (1984) was used for this avian TRV derivation because very few studies exist. Hudson *et al.* (1984) found that 50% of the dosed animals died at a concentration of 23.7 mg thallium/kg BW. This was considered to be the LOAEL TRV. The NOAEL (0.237 mg/kg-day) was estimated from the LD_{50} by applying an uncertainty factor of 100 to the LD_{50} (10 for extrapolating from a LD_{50} to a LOAEL and 10 for extrapolating from a LOAEL to NOAEL).

Mammals: US EPA does not provide EcoSSL TRVs for mammals for thallium. However, there are sufficient studies on mammalian species to derive thallium TRVs for mammals. A study on rats by Formigli *et al*. (1986) was selected for the mammalian TRV derivation process because this study used preferred toxicological endpoints. In the study by Formigli *et al*., groups of rats were dosed with thallium sulfide in water at 0 or 270 μg thallium/rat-day (0.74 mg/kg-day) for 60 days. Reduced sperm count and motility were observed in rats exposed to 0.74 mg/kg-day (LOAEL). The NOAEL was estimated from the LOAEL by dividing by 10; therefore, the NOAEL is 0.074 mg/kg-day.

Vanadium

Birds: The NOAEL TRV for birds was developed from a study by White and Dieter (1978). In this study, mallard ducks were dosed with 2.84, 10.36, and 110 mg vanadium/kg (as vanadyl sulfate) in food for 12 weeks. The researchers observed endpoints, such as mortality, BW, and blood chemistry, and found that no adverse effects were observed at any of the dose levels. Therefore, a NOAEL of 11 mg/kg-day was calculated based on the dose of 110 mg/kg, a food IR of 121 g-day, and a BW of 1.17 kg. A LOAEL TRV could not be calculated from this study, and no other studies were identified that could be used to derive a LOAEL. The US EPA EcoSSL NOAEL TRV (0.344 mg/kg-day) is based on a chicken study (Hill, 1979). Chickens are not a good surrogate species for mallard or other wildlife species, and when relevant studies on more ecologically relevant test species were available, chicken studies were not used for TRV development.

Mammals: The mammalian TRV for vanadium was developed based on a study by Domingo *et al*. (1986). In this investigation, rats were exposed to sodium metavanadate ($NaVO_3$) at three dose levels (5, 10, and 20 mg/kg-day at 41.78% vanadium) by oral intubation. Exposure started 60 days prior to gestation and continued through gestation, delivery, and lactation. Significant adverse effects (*e.g.*, increased number of stillbirths per litter, decreased offspring size and weight) were observed at all dose levels. Therefore, the lowest dose (2.09 mg vanadium/kg-day by percentage of weight) was considered to be the chronic LOAEL TRV. The NOAEL TRV for mammals was determined by applying a uncertainty factor of 10 to yield a value of 0.209 mg/kg-day.

Zinc

Birds: The avian TRV for zinc was based on a feeding study performed by Stahl *et al*. (1990). In this study, 24- or 56-week-old white leghorn hens were exposed to zinc sulfate in their diet from 28 mg/kg (control) to 2,000 mg/kg in a dehydrated corn and soybean meal diet. After continuous daily exposure until 68 weeks of age, no significant differences were noted in hen weight, feed consumed, egg production, egg fertility, egg hatchability, or progeny growth rates. Therefore, the NOAEL TRV is 130 mg/kg-day (calculated with a dietary concentration of 2,000 mg/kg, a measured intake rate of 0.06 kg dry weight/kg BW, and assuming 10% moisture content of food). No LOAEL was reported.

Mammals: The NOAEL and LOAEL TRVs used to evaluate risks from zinc exposure in mammals were developed from a study by Schlicker and Cox (1968). In this investigation, adult female Sprague-Dawley rats were exposed to 2,000 and 4,000 mg zinc oxide/kg dry weight in their diets. Exposure commenced 21 days prior to mating and continued throughout gestation. Females exposed to 4,000 mg/kg exhibited increases in fetal resorption. No effect on reproduction (measured as percent resorption or difference in rate of fetal growth) was observed at 2,000 mg/kg. Based on an assumed body mass of 0.35 kg (US EPA, 1988) and a food IR of 0.028 kg-day, the LOAEL and NOAEL TRVs were calculated to be 160 and 320 mg/kg-day, respectively.

7.3 Sediment and Tissue Screening Levels for Wildlife

The EcoSSLs (see Section 7.1) generally address only ecological receptors in terrestrial upland habitats and do not incorporate feeding strategies and preferences of aquatic feeding birds and mammals. Therefore, an approach similar to the EcoSSL approach was developed for the refined SLERA. The primary exposure media by which aquatic-dependent wildlife are exposed to contaminants are through ingestion of benthic invertebrates, fish, and incidental ingestion of sediments. A conservative food chain model was developed to calculate screening level concentrations for each of these media. The food-chain model and the resulting screening levels are presented in Table C-11. The screening levels were generated using the NOAEL-based TRVs for wildlife described in Section 7.2. The food-chain model was used as a tool to screen sediment, aquatic invertebrate, and fish tissue chemistry data and to identify COPCs. A refined risk characterization for each of the COPCs identified in the refined SLERA was conducted using more realistic exposure assumptions in the BERA.

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Tables

Table C-1. Surface Water Benchmarks for Aquatic Organisms

	Surface Water Benchmark				US EPA (2009)				MDEQ (2008)		US EPA GLI (2010)		
	Acute (ug/L)		Chronic (ug/L)		Acute (ug/L)		Chronic (ug/L)		Acute (ug/L)	Chronic (ug/L)			
Metal	Dissolved	Total Recoverable	Dissolved	Total Recoverable	Dissolved	Total Recoverable	Dissolved	Total Recoverable	Total Recoverable	Total Recoverable	Acute (ug/L)	Chronic (ug/L)	Reference
Aluminum	750	750	87	87	na	750 (pH 6.5-9.0)	na	87 (pH 6.5-9.0)	750 (pH 6.5-9.0	87 (pH 6.5-9.0)	na	na	
Antimony	900	900	190	190	na	na	na	na	na	na	900	190	Ohio (2006)
Arsenic	340	340	150	150	340	na	150	na	340	150	na	na	
Barium	2000	2000	220	220	na	na	na	na	na	na	2000	220	Ohio (2006)
Beryllium [a]	93	93	11	11	na	na	na	na	na	na	93	11	Ohio (2006) - Tot. Rec.
Cadmium [a]	2.0	2.1	0.25	0.27	2.0	2.1	0.25	0.27	2.1	0.27	na	na	
Chromium (III) [a]	570	1803	74	86	570	1803	74	86	1803	86	na	na	
Chromium (VI)	16	16	11	11	16	16	11	11	16	11	na	na	
Cobalt	220	220	24	24	na	na	na	na	na	na	220	24	Ohio (2006)
Copper [a]	14/BLM	14/BLM	9/BLM	9/BLM	BLM	BLM	BLM	BLM	14	9	na	na	
Iron	na	na	1000	1000	na	na	1000	na	na	1000	na	na	
Lead [a]	65	82	2.5	3.2	65	82	2.5	3.2	82	3.2	na	na	
Manganese [a]	2986	2986	1650	1650	na	na	na	na	na	na	na	na	
Mercury	1.4	1.4	0.77	0.77	1.4	na	0.77	na	1.7	0.91	na	na	
Nickel [a]	468	469	52.0	52.2	468	469	52.0	52.2	469	52	na	na	
Selenium	20	20	4.61	5	20	20	4.61	5	20	5	na	na	
Silver [a]	3.2	3.8	0.36	0.36	3.2	3.8	na	na	4.1	na	-	0.36	Suter and Tsao, 1996
Thallium	79	79	17	17	na	na	na	na	na	na	79	17	Ohio (2006)
Vanadium	150	150	44	44	na	na	na	na	na	na	150	44	Ohio (2006)
Zinc [a]	117	120	118	120	117	120	118	120	120	120	na	na	

Notes:

BLM = US EPA recommends using the Biotic ligand model for copper.

na - not available

(a) Hardness-dependant metals' criteria may be calculated from the following (values in table calculated at hardness of 100):

Acute (dissolved) = $\exp\{m_A\ [\ln(\text{hardness})] + b_A\}\ (CF)$

Chronic (dissolved) = $\exp\{m_C\ [\ln(\text{hardness})] + b_C\}\ (CF)$

Chemical	m_A	b_A	m_C	b_C	Acute CF	Chronic CF
Beryllium	1.609	-2.874	1.609	-5.017	-	-
Cadmium	1.0166	-3.924	0.7409	-4.719	1.136672-[(*ln* hardness)(0.041838)]	1.101672-[(*ln* hardness)(0.041838)]
Chromium III	0.819	3.7256	0.819	0.6848	0.316	0.86
Copper	0.9422	-1.7	0.8545	-1.702	0.96	0.96
Lead	1.273	-1.46	1.273	-4.705	1.46203-[(*ln* hardness)(0.145712)]	1.46203-[(*ln* hardness)(0.145712)]
Manganese	0.3331	6.4676	0.3331	5.8743	1.0	1.0
Nickel	0.846	2.255	0.846	0.0584	0.998	0.997
Silver	1.72	-6.59	-	-	0.85	-
Selenium	-	-	-	-	0.966	0.922
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Table C-2. Sediment Benchmarks for Benthic Invertebrates

	Sediment Benchmark (mg/kg)		MacDonald *et al.* (2000)		No or Low Effect Benchmarks		Probable Effect Benchmarks	
Metal	**TEC**	**PEC**	**TEC**	**PEC**	**Vale**	**Source**	**Value**	**Source**
Aluminum	25,519	59,572	na	na	25,519	TEL, US EPA, 1996	59,572	PEL, US EPA, 1996
Antimony	2	25	na	na	2	ER-L, Long and Morgan, 1990	25	ER-M, Long and Morgan, 1990
Arsenic	9.79	33	9.79	33	-	-	-	-
Barium	none	none	na	na	na	na	na	na
Beryllium	none	none	na	na	na	na	na	na
Cadmium	0.99	4.98	0.99	4.98	-	-	-	-
Chromium (III)	43.4	111	43.4 (total Cr)	111 (total Cr)	-	-	-	-
Chromium (IV)	43.4	111	43.4 (total Cr)	111 (total Cr)	-	-	-	-
Cobalt	50	none	na	na	50	LEL, Persaud *et al.* , 1993	-	-
Copper	31.6	149	31.6	149	-	-	-	-
Iron	188,400	247,600	na	na	188,400	TEL, US EPA, 1996	247,600	PEL, US EPA, 1996
Lead	35.8	128	35.8	128	-	-	-	-
Manganese	460	1100	na	na	460	LEL, Persaud *et al.* , 1993	1100	SEL, Persaud *et al.* , 1993
Mercury	0.18	1.06	0.18	1.06	-	-	-	-
Nickel	22.7	48.6	22.7	48.6	-	-	-	-
Selenium	none	none	na	na	na	na	na	na
Silver	1	2.2	na	na	1.0	ER-L, Long and Morgan, 1990	2.2	ER-M, Long and Morgan, 1990
Thallium	none	none	na	na	na	na	na	na
Vanadium	none	none	na	na	na	na	na	na
Zinc	121	459	121	459	-	-	-	-

Notes:

na - not available

TEC - Threshold Effects Concentration represents a concentration below which adverse effects are not expected.

PEC - Probable Effects Concentration represents a concentration above which effects are expected to occur more often than not.

TEL - Threshold Effect Level represents a concentration that represents the upper limit of the range dominated by no effects data.

PEL - Probable Effect Level represents the concentration above which adverse effects on survival or growth are expected to occur frequently.

LEL - Lowest Effect Level represents a level of sediment contamination that can be tolerated by the majority of benthic organisms.

SEL - Severe Effect Level represents the level at which pronounced disturbance of the sediment-dwelling community can be expected.

ER-L - Effects Range Low represents a concentration at the low end of the range in which effects have been observed.

ER-M - Effects Range Median is a concentration approximately midway in the range of reported values associated with biological effects.

Table C-3. Incidence of Sediment Toxicity by Mean PEC Quotient Range

	Observed Toxicity (%) by mean PEC Quotient Range					
	<0.1	**0.1 to <0.5**	**0.5 to <1.0**	**1.0 to <5.0**	**>1.0**	**>5.0**
Hyalella azteca 10-to 14-day tests						
Mean PEC Q - Metals	20%	19%	39%	63%	63%	62%
Hyalella azteca 28-to 42-day tests						
Mean PEC Q - Metals	8%	20%	62%	-	86%	-
Chironomus spp. 10-to 14-day tests						
Mean PEC Q - Metals	22%	23%	25%	39%	44%	57%

Sources: Ingersoll et al. (2000; 2001)

Table C-4. Dietary Benchmarks for Fish

Metal	Threshold TRV	NOAEL TRV	LOAEL TRV	Reference
Arsenic	40	63	137	US EPA, 2005b
Cadmium	na	55	165	US EPA, 2005b
Copper	na	340	660	US EPA, 2005b
Lead	na	170	510	US EPA, 2005b
Selenium	3	2	na	Lemly, 1996; USDOI, 1998
Zinc	na	1500	4500	US EPA, 2005b

Notes:

TRV - Toxicity reference value (in mg/kg, dry weight)

NOAEL - No observed adverse effect level

LOAEL - Low observed adverse effect level

Table C-5. Critical Body Residues for Fish

				NOEC [a]			LOEC [b]		
Metal	**Tissue Type**	**Number of Species**	**Effect Type**	**N**	**High (ug/g ww)**	**Species**	**N**	**Low (ug/g ww)**	**Species**
Al	Whole body	2	GRO, MOR	2	12.5	Brook Trout	0	-	-
As	Whole body	5	GRO, MOR, REP	17	0.53	Bluegill	29	0.62	Rainbow Trout
Be	Whole body	1	MOR	1	5.13	Bluegill	0	-	-
Cd	Whole body	12	DEV, GRO, MOR, REP	79	0.17	Dace	9	0.183	Brook Trout
Cr	Whole body	2	GRO, MOR	12	5.5	Rainbow Trout	2	44.1	Mummichog
Cu	Whole body	5	DEV, GRO, MOR	18	>LOEC	-	17	1.4	Rainbow Trout
Fe	Whole body	1	MOR, REP	2	54	Brown Trout	0	-	-
Hg (MeHg)	Whole body	11	DEV, GRO, MOR, REP	47	0.2	Guppy	15	0.25	Walleye
Pb	Whole body	1	DEV, GRO, MOR	4	4.02	Brook Trout	0	-	-
Se	Whole body	-	US EPA 2004 Draft Criterion	-	-	-	-	1.58	-
Tl	Whole body	1	MOR	1	2.72	Bluegill	0	-	-
V	Whole body	1	GRO	1	0.68	Flagfish	1	2.7	Flagfish
Zn	Whole body	4	GRO, MOR, REP	13	24	Atlantic Salmon	4	50	Flagfish

Data Source: US Army Corp of Engineers and US EPA Environmental Residue Effects Database (ERED) (http://el.erdc.usace.army.mil/ered/).

DEV - development

GRO - growth

MOR - mortality

REP - reproduction

NOEC - no observed effects concentration

LOEC - lowest observed effects concentration

(a) Highest no effect concentration below the lowest low effect concentration, if all NOECs>LOEC than no value is shown.

(b) Lowest effect concentration

Table C-6. Amphibian Toxicity Data

Metal	Form	*Scientific Name*	Common Name	Lifestage	Route	Endpoint	Duration (days)	Temp. (C°)	Hardness (mg/L as CaCO$_3$)	pH (s.u.)	Concentration	Units	SMAV (ug/L)	Primary Source	Secondary Source
Ag	Nitric acid, silver (1+) salt	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	240.00	ug/L	240.00	Birge et al., 1978	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Ambystoma opacum*	Marbled Salamander	Embryo (4 dph)	W	LC50	6-8	NR	100-200	NR	240.00	ug/L	-	Birge and Zuiderveen, 1996	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	4.10	ug/L	4.10	Khangarot and Ray, 1987	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Bufo woodhousei ssp. fowleri*	Fowler's Toad	Embryo (4 dph)	W	LC50	6-8	NR	100-200	NR	230.00	ug/L	230.00	Birge and Zuiderveen, 1996	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	10.00	ug/L	10.00	Birge, 1978	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo (4 dph)	W	LC50	6-8	NR	100-200	NR	10.00	ug/L	-	Birge and Zuiderveen, 1996	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Rana catesbeiana*	Bullfrog	Embryo (4 dph)	W	LC50	6-8	NR	100-200	NR	20.00	ug/L	20.00	Birge and Zuiderveen, 1996	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	25.70	ug/L	25.70	Khangarot et al. 1985	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Rana palustris*	Pickeral Frog	Embryo (4 dph)	W	LC50	6-8	NR	100-200	NR	10.00	ug/L	10.00	Birge and Zuiderveen, 1996	ECOTOX (2010)
Ag	Nitric acid, silver (1+) salt	*Rana pipiens*	Leopard Frog	Embryo (4 dph)	W	LC50	6-8	NR	100-200	NR	10.00	ug/L	10.00	Birge and Zuiderveen, 1996	ECOTOX (2010)
Al	Aluminum chloride (AlCl3)	*Bufo americanus*	American Toad	Tadpole (3 weeks, stage 26)	W	LC50	4	20	NR	7.4	859.00	ug/L	1,364.94	Freda et al. 1990	ECOTOX (2010)
Al	Aluminum chloride (AlCl3)	*Bufo americanus*	American Toad	Tadpole (3 weeks, stage 26)	W	LC50	4	20	NR	7.4	1,379.00	ug/L	-	Freda et al. 1990	ECOTOX (2010)
Al	Aluminum chloride (AlCl3)	*Bufo americanus*	American Toad	Tadpole (3 weeks, stage 26)	W	LC50	4	20	NR	7.4	1,663.00	ug/L	-	Freda et al. 1990	ECOTOX (2010)
Al	Aluminum chloride (AlCl3)	*Bufo americanus*	American Toad	Tadpole (3 weeks, stage 26)	W	LC50	4	20	NR	7.4	1,762.00	ug/L	-	Freda et al. 1990	ECOTOX (2010)
Al	Aluminum	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	50.00	ug/L	50.00	Birge et al., 1979	ECOTOX (2010)
Al	Aluminum chloride (AlCl3)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	50.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Al	Aluminum chloride (AlCl3)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	2,280.00	ug/L	2,280.00	Birge et al., 1978	ECOTOX (2010)
Al	Aluminum	*Ambystoma jeffersonianum*	Jefferson Salamander	Embryo	W	LC50	4	10	NR	NR	380.00	ug/L	380.00	Horne and Dunson, 1994	ECOTOX (2010)
As	Sodium arsenate	*Adelotus brevis*	Tusked Frog	Tadpole (1-2 wk)	W	LC50	4	21-22	NR	NR	70,935.00	ug/L	70,935.00	Johnson, 1976	Pauli et al. 2000
As	Sodium arsenate	*Bufo marinus*	Giant Toad	Tadpole (1-2 wk)	W	LC50	4	21-22	NR	NR	123,000.00	ug/L	123,000.00	Johnson, 1976	Pauli et al. 2000
As	Arsenic	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	40.00	ug/L	40.00	Birge et al., 1979	ECOTOX (2010)
As	Sodium arsenate	*Limnodynastes peronii*	Brown-Striped Frog	Tadpole (1-2 wk)	W	LC50	4	21-22	NR	NR	55,364.00	ug/L	55,364.00	Johnson, 1976	Pauli et al. 2000
As	Arsenic oxide	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	249.00	ug/L	249.00	Khangarot et al., 1985	ECOTOX (2010)
As	Sodium arsenite	*Rhinella arenarum*	South American Toad	Embryo (GS 25)	W	LC50	4	20-22	NR	NR	50,040.00	ug/L	50,040.00	Brodeur et al., 2009	na
As	As (III)	*Rana catesbeiana*	Bullfrog	Tadpoles	W	LC50	4	NR	NR	NR	25,000.00	ug/L	25,000.00	Birge and Just, 1973	na
As	Sodium arsenite	*Xenopus leavis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	100,000.00	ug/L	310,971.31	Bantle et al., 1999	na
As	Sodium arsenite (NaAsO2)	*Xenopus leavis*	African Clawed Frog	Embryo (8 hpf)	W	LC50	4-5	23	NR	NR	115,620.08	ug/L	-	Gornati et al., 2002	na
As	Disodium hydrogen arsenate (Na2HAsO4)	*Xenopus leavis*	African Clawed Frog	Embryo (8 hpf)	W	LC50	4-5	23	NR	NR	1,167,494.00	ug/L	-	Gornati et al., 2002	na
As	Dimethylarsinic acid (CH3)2AsOOH	*Xenopus leavis*	African Clawed Frog	Embryo (8 hpf)	W	LC50	4-5	23	NR	NR	2,198,303.36	ug/L	-	Gornati et al., 2002	na
As	Sodium arsenite	*Xenopus leavis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	NR	NR	NR	98,000.00	ug/L	-	Bantle et al., 1999	na
As	Sodium arsenate	*Rana pipiens*	Northern Leopard Frog	GS 19 through 113 days	W	NOEC (GRO, DEV)	113	22-23	170	7.9	1,000.00	ug/L	Chronic	Chen et al., 2009	na
As	As (III)	*Rana pipiens*	Northern Leopard Frog	Tadpoles	W	LOEC (MOR)	22	NR	NR	NR	5,000.00	ug/L	Chronic	Birge and Just, 1973	na
As	Sodium arsenite	*Rhinella arenarum*	South American Toad	Embryo (GS 25)	W	LC50	17	20-22	NR	NR	34,602.00	ug/L	Chronic	Brodeur et al., 2009	na
Be	Beryllium sulfate	*Ambystoma maculatum*	Spotted Salamander	Adult (41.2 mg, 20.1 mm)	W	LC50	4	23.5	20-25	6.3-6.5	3,150.00	ug/L	11,398.39	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma maculatum*	Spotted Salamander	Adult (298 mg, 35.5 mm)	W	LC50	4	23.5	20-25	6.3-6.5	8,020.00	ug/L	-	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma maculatum*	Spotted Salamander	Adult (508 mg, 44.8 mm)	W	LC50	4	23.5	400-500	7.8-8.2	8,320.00	ug/L	-	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma maculatum*	Spotted Salamander	Adult (298 mg, 35.5 mm)	W	LC50	4	23.5	400-500	7.8-8.2	18,200.00	ug/L	-	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma maculatum*	Spotted Salamander	Adult (508 mg, 44.8 mm)	W	LC50	4	23.5	400-500	7.8-8.2	18,200.00	ug/L	-	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma maculatum*	Spotted Salamander	Adult (41.2 mg, 20.1 mm)	W	LC50	4	23.5	400-500	7.8-8.2	31,500.00	ug/L	-	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma opacum*	Marbled Salamander	Adult (33 mg, 35.9 mm)	W	LC50	4	23.5	20-25	6.3-6.5	3,150.00	ug/L	9,961.17	Slonim and Ray, 1975	ECOTOX (2010)
Be	Beryllium sulfate	*Ambystoma opacum*	Marbled Salamander	Adult (33 mg, 35.9 mm)	W	LC50	4	23.5	400-500	7.8-8.2	31,500.00	ug/L	-	Slonim and Ray, 1975	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3 mo)	W	LC50	4	20	45	6.8	468.40	ug/L	468.40	Nebeker et al., 1995	ECOTOX (2010)
Cd	Nitric acid, Cadmium salt	*Ambystoma mexicanum*	Mexican Axolotl	3-4 wk	W	LC50	2	20	NR	NR	620.00	ug/L	897.78	Slooff and Baerselman, 1980	ECOTOX (2010)
Cd	Nitric acid, Cadmium salt	*Ambystoma mexicanum*	Mexican Axolotl	3-4 wk	W	LC50	2	20	NR	NR	1,300.00	ug/L	-	Slooff, 1982	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	150.00	ug/L	150.00	Birge et al., 1978	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo arenarum*	Toad	Tadpole (GS 26-27)	W	LC50	4	20	NR	NR	2,080.00	ug/L	618.59	Muino et al., 1990	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo arenarum*	Toad	Tadpole (GS 26)	W	LC50	4	20	NR	NR	2,190.00	ug/L	-	Ferrari et al., 1993	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo arenarum*	Toad	Tadpole (GS 26)	W	LC50	4	25	NR	NR	2,650.00	ug/L	-	Ferrari et al., 1993	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo arenarum*	Toad	Tadpole (GS 28-29)	W	LC50	4	20	NR	NR	3,060.00	ug/L	-	Ferrari et al., 1993	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo arenarum*	Toad	Tadpole (GS 28-29)	W	LC50	4	25	NR	NR	6,770.00	ug/L	-	Ferrari et al., 1993	ECOTOX (2010)
Cd	Cadmium chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	W	LC50	10	23	400-600	NR	1,100.00	ug/L	1,100.00	ENSR (2004)	na
Cd	Cadmium	*Bufo maculatus*	Toad	Tadpole (3-28 dph)	W	LC50	4	30-32	NR	NR	0.13	ug/L	0.13	Ezemonye and Enuneku, 2005	ECOTOX (2010)
Cd	Cadmium	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	8,180.00	ug/L	8,180.00	Khangarot and Ray, 1987	Pauli et al. 2000
Cd	Cadmium	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	NR	W	LC50	7	NR	195	7-7.8	40.00	ug/L	40.00	Birge and Black, 1979	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	40.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Microhyla ornata*	Frog	Tadpole (1 wk)	W	LC50	4	25.5-26	143	6.86-6.94	1,580.00	ug/L	1,691.09	Rao and Madhyastha, 1987	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Microhyla ornata*	Frog	Tadpole (4 wk)	W	LC50	4	25.5-26	143	6.86-6.94	1,810.00	ug/L	-	Rao and Madhyastha, 1987	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Pleurodeles waltl*	Iberian ribbed newt	Embryo	W	LC50	7	18	NR	6.8	1,467.00	ug/L	1,011.19	Calevro et al., 1999	na
Cd	Cadmium chloride (CdCl2)	*Pleurodeles waltl*	Iberian ribbed newt	Embryo	W	EC50 (DEV)	7	18	NR	6.8	697.00	ug/L	-	Calevro et al., 1999	na
Cd	Cadmium	*Ptychadena bibroni*	Frog	Tadpole (3-28 dph)	W	LC50	4	30-32	NR	NR	0.10	ug/L	0.10	Ezemonye and Enuneku, 2005	ECOTOX (2010)
Cd	Cadmium	*Rana cyanophlyctis*	Skipping Frog	Adult Female	W	LC50	4	23	60-70	7.38-7.8	56,600.00	ug/L	65,153.66	Mudgall and Patil, 1985	ENSR (2004)
Cd	Cadmium	*Rana cyanophlyctis*	Skipping Frog	Adult Male	W	LC50	4	23	60-70	7.38-7.8	75,000.00	ug/L	-	Mudgall and Patil, 1985	ENSR (2004)
Cd	Nitric acid, Cadmium salt	*Rana luteiventris*	Spotted Frog	Tadpole (GS 22-25)	W	LC50	4	NR	NR	NR	15,810.00	ug/L	15,810.00	Lefcort et al., 1998	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Rana ridibunda*	Water frog	Adult	W	LC50	4	20.8-22.2	NR	8.06-9.48	51,200.00	ug/L	51,200.00	Selvi et al., 2003	na
Cd	Cadmium chloride (CdCl2)	*Rana ridibunda*	Lowland Frog	Tadpole	W	LC50	4	20-25	288	7.4	71,800.00	ug/L	71,800.00	Loumbourdis et al., 1999	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Rana sp.*	Frog	Tadpole	W	LC50	4	NR	NR	NR	3,700.00	ug/L	3,700.00	Zettergren et al., 1991	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Rana temporaria*	Common Frog	Larvae (GS 26-30)	W	LC50	4	20	71-125	7.45-7.55	3,155.00	ug/L	3,155.00	Formicki et al. 2008	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Tadpole (3-4 wk)	W	LC50	2	20	85	NR	3,200.00	ug/L	5,757.13	Canton and Slooff, 1982	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (5 dpf)	W	EC50 (DEV)	4	23-24	NR	6.8	678.00	ug/L	-	Sunderman et al., 1991	ECOTOX (2010)
Cd	Nitric acid, Cadmium salt	*Xenopus laevis*	African Clawed Frog	3-4 wk	W	LC50	2	20	NR	NR	3,200.00	ug/L	-	Slooff, 1982	ECOTOX (2010)
Cd	Nitric acid, Cadmium salt	*Xenopus laevis*	African Clawed Frog	Tadpole (3-4 wk)	W	LC50	2	20	NR	NR	7,360.00	ug/L	-	De Zwart and Slooff, 1987	ECOTOX (2010)
Cd	Nitric acid, Cadmium salt	*Xenopus laevis*	African Clawed Frog	3-4 wk	W	LC50	2	20	NR	NR	15,000.00	ug/L	-	Slooff and Baerselman, 1980	ECOTOX (2010)
Cd	Nitric acid, Cadmium salt	*Xenopus laevis*	African Clawed Frog	Tadpole (3-4 wk)	W	LC50	2	20	NR	NR	20,200.00	ug/L	-	De Zwart and Slooff, 1987	ECOTOX (2010)
Cd	Cadmium	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	850.00	ug/L	-	Linder et al., 1991	ENSR (2004)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (5 hpf)	W	LC50	4	23-24	NR	6.8	5,866.00	ug/L	-	Sunderman et al., 1991	ECOTOX (2010)
Cd	Cadmium	*Xenopus laevis*	African Clawed Frog	Tadpole (Stage 54-58, 2-5 cm)	W	LC50	4	20-23	296	7	90,000.00	ug/L	-	Woodall et al., 1988	ECOTOX (2010)
Cd	Cadmium	*Bufo arenarum*	Toad	Embryo	W	LOEC (DEV)	1	18-21	NR	NR	250.00	ug/L	nap	Herkovits and Perez-Coll, 1993	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Rana pipiens*	Northern Leopard Frog	Embryo	W	LOEC (MOR)	6	16.7-21.1	NR	NR	1,554.00	ug/L	nap	Birge and Just, 1975	Pauli et al. 2000
Cd	Cadmium chloride (CdCl2)	*Rana pipiens*	Northern Leopard Frog	Embryo	W	LOEC (MOR)	7	16.7-21.1	NR	NR	3,068.00	ug/L	nap	Birge and Just, 1975	Pauli et al. 2000

Table C-6. Amphibian Toxicity Data

Metal	Form	*Scientific Name*	Common Name	Lifestage	Route	Endpoint	Duration (days)	Temp. (C°)	Hardness (mg/L as $CaCO_3$)	pH (s.u.)	Concentration	Units	SMAV (ug/L)	Primary Source	Secondary Source
Cd	Cadmium chloride (CdCl2)	*Rana temporaria*	Common Frog	Larvae (GS 26-30)	W	NOEC (MOR)	8	20	71-125	7.45-7.55	320.00	ug/L	nap	Formicki et al. 2008	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 2-47)	W	NOEC (MOR)	3	20	NR	NR	100.00	ug/L	nap	Herkovits et al., 1997	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (5 dpf)	W	EC10 (DVP)	4	23-24	NR	6.8	257.00	ug/L	nap	Sunderman et al., 1991	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (5 dpf)	W	NOEC (GRO)	4	23-24	NR	6.8	1,833.00	ug/L	nap	Sunderman et al., 1991	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (5 dpf)	W	LOEC (GRO)	4	23-24	NR	6.8	3,300.00	ug/L	nap	Sunderman et al., 1991	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3-4 mo)	W	NOEC (GRO)	10	20	45	6.8	12.80	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3-4 mo)	W	LOEC (GRO)	10	20	45	6.8	44.60	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3 mo)	W	NOEC (GRO)	10	20	45	6.8	106.30	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3 mo)	W	LOEC (GRO)	10	20	45	6.8	227.30	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3 mo)	W	NOEC (GRO)	24	20	45	6.8	48.90	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3-4 mo)	W	NOEC (GRO)	24	20	45	6.8	48.90	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3 mo)	W	LOEC (GRO)	24	20	45	6.8	193.10	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Ambystoma gracile*	Northwestern Salamander	Larvae (3-4 mo)	W	LOEC (GRO)	24	20	45	6.8	193.10	ug/L	Chronic	Nebeker et al., 1995	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo americanus*	American Toad	Tadpoles (GS 25)	W	NOEC (MOR, DEV)	60	22.6	51.2	7.91	54.00	ug/L	Chronic	James and Little, 2003	na
Cd	Cadmium chloride (CdCl2)	*Bufo americanus*	American Toad	Tadpoles (GS 25)	W	NOEC (MOR, GRO, DEV)	103	14.4-31.8	32-73	7.2-8.7	5.00	ug/L	Chronic	James et al., 2005	na
Cd	Cadmium	*Notophthalmus viridescens*	Eastern Newt	Adult	W	LC50	80	NR	NR	NR	4,500.00	ug/L	Chronic	Manson and O'Flaherty, 1978	Pauli et al. 2000
Cd	Cadmium chloride (CdCl2)	*Pleurodeles waltl*	Newt	Larvae (GS 42-54)	W	LOEC (DEV)	60	20	NR	NR	1,000.00	ug/L	Chronic	Flament et al., 2003	na
Cd	Cadmium chloride (CdCl2)	*Rana pipiens*	Northern Leopard Frog	Tadpoles (GS 25)	W	NOEC (GRO, DEV)	112	23	170	7.5-7.8	10.00	ug/L	Chronic	Gross et al., 2009	na
Cd	Cadmium chloride (CdCl2)	*Rana pipiens*	Northern Leopard Frog	Tadpoles (GS 25)	W	LOEC (MOR, GRO, DEV)	131	21.7	170	7.5-7.8	7.00	ug/L	Chronic	Gross et al., 2007	na
Cd	Cadmium chloride (CdCl2)	*Rana sphenocephala*	Southern leopard Frog	Tadpoles (GS 25)	W	NOEC (MOR, GRO, DEV)	103	14.4-31.8	32-73	7.2-8.7	5.00	ug/L	Chronic	James et al., 2005	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	48 h	W	LC50	100	20	85	NR	1,500.00	ug/L	Chronic	Canton and Slooff, 1982	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Adult	W	NOEC (REP)	30	NR	NR	NR	500.00	ug/L	Chronic	Fort et al., 2001	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Fertilization through 47 days	W	LOEC (GRO)	47	20.3-21.8	170	7.4-8.2	0.10	ug/L	Chronic	Sharma and Patino, 2008	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Fertilization through 75 days	W	LOEC (GRO, DEV)	75	20.6-21.7	NR	7.5-7.8	10.00	ug/L	Chronic	Sharma and Patino, 2010	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Fertilization through 86 days	W	NOEC (GRO, DEV)	85	20.6-21.7	NR	7.5-8.3	1.00	ug/L	Chronic	Sharma and Patino, 2009	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Fertilization through 86 days	W	LOEC (GRO, DEV)	85	20.6-21.7	NR	7.5-8.3	8.00	ug/L	Chronic	Sharma and Patino, 2009	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	48 h	W	NOEC (DEV)	100	20	85	NR	9.00	ug/L	Chronic	Canton and Slooff, 1982	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	48 h	W	NOEC (GRO)	100	20	85	NR	30.00	ug/L	Chronic	Canton and Slooff, 1982	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	48 h	W	EC50 (DVP)	100	20	85	NR	650,000.00	ug/L	Chronic	Canton and Slooff, 1982	ECOTOX (2010)
Cd	Cadmium chloride (CdCl2)	*Bufo americanus*	American Toad	10-28 g	FD	LOAEL (MOR)	50	23-27	TOC 0.9%	7	4.70	mg/kg-dw	Food	James et al., 2004	na
Cd	Cadmium chloride (CdCl2)	*Xenopus laevis*	African Clawed Frog	Adult	FD	NOAEL (REP)	30	NR	NR	NR	10.00	mg/kg-day	Food	Fort et al., 2001	na
Cd	Cadmium chloride (CdCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	Sed	LOEC (MOR)	6-7	20-21	200	7.5-8.0	1.34	mg/kg	Sediment	Birge et al., 1977	Pauli et al. 2000
Cd	Cadmium chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	Sed	EC25	10	23	400-600	NR	540.00	mg/kg	Sediment	ENSR (2004)	na
Cd	Cadmium chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	Sed	LC50	10	23	400-600	NR	580.00	mg/kg	Sediment	ENSR (2004)	na
Cd	Cadmium chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	Sed	EC25	10	23	400-600	NR	230.00	mg/kg	Sediment	ENSR (2004)	na
Cd	Cadmium chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	Sed	LC50	10	23	400-600	NR	700.00	mg/kg	Sediment	ENSR (2004)	na
Cd	Cadmium	*Rana pipiens*	Northern Leopard Frog	Embryo through 4 dph	Sed	NOEC (MOR)	6-7	NR	NR	NR	1,074.00	mg/kg	Sediment	Francis et al., 1984	Pauli et al. 2000
Cd	Cadmium chloride (CdCl2)	*Bufo americanus*	American Toad	2-15 g	Soil	NOEC (MOR, GRO)	172	23-27	TOC 0.9%	7	120.00	mg/kg-dw	Soil	James et al., 2004	na
Co	Cobalt	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	50.00	ug/L	50.00	Birge et al., 1979	ECOTOX (2010)
Co	Cobalt nitrate	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	50.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Co	Cobalt chloride	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	17,590.00	ug/L	17,590.00	Khangarot et al., 1985	ECOTOX (2010)
Co	Cobalt chloride	*Xenopus laevis*	African Clawed Frog	Embryo (GS 8-11)	W	LC50	4	23	NR	7	384,224.00	ug/L	53,101.19	Saka, 2004	-
Co	Cobalt chloride	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	23	NR	6.8	1,349,920.00	ug/L	-	Sunderman, 1992; Plowman et al. 1991	ECOTOX (2010); Pauli et al. 2000
Co	Cobalt chloride	*Xenopus laevis*	African Clawed Frog	Embryo (GS 8-11)	W	EC50 (DEV)	4	23	NR	7	4,724.00	ug/L	-	Saka, 2004	-
Co	Cobalt chloride	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (GRO)	4	23	NR	6.8	3,245.00	ug/L	-	Sunderman, 1992; Plowman et al. 1991	ECOTOX (2010); Pauli et al. 2000
Co	Cobalt	*Xenopus laevis*	African Clawed Frog	Embryo through 13 weeks	W	LOEC (GRO)	91	NR	NR	NR	5,948.25	ug/L	Chronic	Plowman et al. 1994	Pauli et al. 2000
Cr	Chromium oxide (CrO3)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	2,130.00	ug/L	2,130.00	Birge et al., 1978	ECOTOX (2010)
Cr	Chromium	*Bufo melanostictus*	Common Indian Toad	Tadpole (12-16 mm)	W	LC50	4	28	NR	8.2	2,520.00	ug/L	7,911.23	Anusuya and Christy, 1999	ECOTOX (2010)
Cr	Chromium	*Bufo melanostictus*	Common Indian Toad	Tadpole (6-8 mm)	W	LC50	4	28	NR	8.2	4,990.00	ug/L	-	Anusuya and Christy, 1999	ECOTOX (2010)
Cr	Chromium	*Bufo melanostictus*	Common Indian Toad	Tadpole (8-12 mm)	W	LC50	4	28	NR	8.2	6,320.00	ug/L	-	Anusuya and Christy, 1999	ECOTOX (2010)
Cr	Chromium	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	49,290.00	ug/L	-	Khangarot and Ray, 1987	Pauli et al. 2000
Cr	Chromium	*Bufo melanostictus*	Black Spined Toad	Tadpole	W	LC50	4	NR	NR	NR	224,910.00	ug/L	224,910.00	Pant and Gill, 1982	Pauli et al. 2000
Cr	Chromium	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	NR	W	LC50	7	NR	195	7-7.8	30.00	ug/L	30.00	Birge and Black, 1979	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	30.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Cr	K2Cr2O7 (Cr VI)	*Hyla nana*	Treefrog	Tadpole (GS 25)	W	LC50	4	25	NR	7.5	10,990.00	ug/L	10,990.00	Natale et al., 2000	na
Cr	K2Cr2O7 (Cr VI)	*Hyla pulchella*	Montevideo Treefrog	Tadpole (GS 25)	W	LC50	4	25	NR	7.5	19,670.00	ug/L	19,670.00	Natale et al., 2000	na
Cr	K2Cr2O7 (Cr VI)	*Hypsiboas pulchellus*	Montevideo Treefrog	Tadpole (GS 25)	W	LC50	4	25	250	7.6-8.3	29,600.00	ug/L	42,142.62	Natale et al., 2006	na
Cr	K2Cr2O7 (Cr VI)	*Hypsiboas pulchellus*	Montevideo Treefrog	Embryo (GS 8-10)	W	LC50	4	25	250	7.6-8.3	60,000.00	ug/L	-	Natale et al., 2006	na
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Female	W	LC50	4	NR	10	NR	53,000.00	ug/L	97,721.45	Joshi and Patil, 1992	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Female	W	LC50	4	35	NR	NR	80,000.00	ug/L	-	Joshi and Patil, 1992	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Female	W	LC50	4	NR	NR	7	87,000.00	ug/L	-	Joshi and Patil, 1992	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Female	W	LC50	4	28	NR	NR	105,000.00	ug/L	-	Joshi and Patil, 1992	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Female	W	LC50	4	NR	100	NR	105,000.00	ug/L	-	Joshi and Patil, 1992	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Male (18 g)	W	LC50	4	NR	65	7	135,000.00	ug/L	-	Joshi and Patil, 1994	ECOTOX (2010)
Cr	Chromium oxide (CrO3)	*Rana cyanophlyctis*	Skipping Frog	Female	W	LC50	4	NR	300	NR	155,000.00	ug/L	-	Joshi and Patil, 1992	ECOTOX (2010)
Cr	Chromium	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	10,000.00	ug/L	10,000.00	Khangarot et al., 1985	ECOTOX (2010)
Cr	K2Cr2O7 (Cr VI)	*Scinax squalirostris*	Striped snouted Treefrog	Tadpole (GS 25)	W	LC50	4	25	NR	7.5	4,720.00	ug/L	4,720.00	Natale et al., 2000	na
Cr	Sodium chromate (Cr VI)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	208,287.00	ug/L	112,578.18	Bosisio et al., 2009	na
Cr	Sodium chromate (Cr VI)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DVP)	4	NR	NR	NR	60,848.00	ug/L	nap	Bosisio et al., 2009	na
Cr	Chromium	*Rana tigrina*	Asian Bullfrog	Tadpole	W	LOEC (DEV, MOR)	3	NR	NR	NR	2,000.00	ug/L	nap	Abbasi and Soni 1984	Pauli et al. 2000
Cr	Chromium	*Xenopus laevis*	African Clawed Frog	Tadpole	W	NOEC (DEV, GRO)	100	20	NR	NR	3,200.00	ug/L	Chronic	Slooff and Canton, 1983	Pauli et al. 2000
Cr	K2Cr2O7 (Cr VI)	*Hypsiboas pulchellus*	Montevideo Treefrog	Tadpole (GS 25)	W	NOEC (GRO)	54	25	250	7.6-8.3	750.00	ug/L	Chronic	Natale et al., 2006	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Ambystoma opacum*	Marbled Salamander	Embryo (4 dph)	W	LC50	4	20-24	100	7.2-7.8	3,590.00	ug/L	1,286.35	Birge and Black, 1979	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Ambystoma opacum*	Marbled Salamander	Embryo (4 dph)	W	LC50	8	20-24	100	7.2-7.8	770.00	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	770.00	ug/L	-	Birge et al., 1978	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Bufo arenarum*	Toad	Embryo (GS 25)	W	LC50	1	NR	NR	NR	50.00	ug/L	65.19	Herkovits and Perez-Coll, 2007	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Bufo arenarum*	Toad	Embryo (GS 25)	W	LC50	1	20	NR	NR	85.00	ug/L	-	Herkovits et al., 1998	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Bufo arenarum*	Toad	Embryo (GS 25)	W	LC50	1	20	NR	NR	85.00	ug/L	-	Herkovits et al., 2002	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Bufo arenarum*	Toad	Embryo	W	LC50	7	20	NR	NR	50.00	ug/L	-	Perez-Coll and Herkovits, 2006	ECOTOX (2010)

Table C-6. Amphibian Toxicity Data

Metal	Form	*Scientific Name*	Common Name	Lifestage	Route	Endpoint	Duration (days)	Temp. (C°)	Hardness (mg/L as $CaCO_3$)	pH (s.u.)	Concentration	Units	SMAV (ug/L)	Primary Source	Secondary Source
Cu	Sulfuric acid copper(2+) salt (1:1)	*Bufo boreas*	Western Toad	Tadpole	W	LC50	4	22	167	7.7-8.1	120.00	ug/L	120.00	Dwyer et al., 1999	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Bufo boreas ssp. boreas*	Boreal Toad	Tadpole	W	LC50	4	17	160-180	8	120.00	ug/L	-	Dwyer et al., 1999	ECOTOX (2010)
Cu	Copper sulphate	*Bufo bufo*	Common toad	Larvae (GS 19)	W	LC50	4	20	NR	7.2-7.8	100.00	ug/L	98.92	Garcia-Munoz et al., 2010	na
Cu	Copper sulphate	*Bufo bufo*	Common toad	Larvae (GS 25)	W	LC50	4	20	NR	7.2-7.8	110.00	ug/L	-	Garcia-Munoz et al., 2010	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Bufo bufo ssp. japonicus*	Toad	23 mm, 72 mg	W	LC50	1	17.3-22.6	NR	NR	88.00	ug/L	-	Nichiuchi, 1975	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	320.00	ug/L	1,617.90	Khangarot and Ray, 1987	ECOTOX (2010)
Cu	Sulfuric acid, Cadmium salt (1:1)	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	8,180.00	ug/L	-	Khangarot and Ray, 1987	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Bufo woodhousei ssp. fowleri*	Fowler's Toad	Embryo (4 dph)	W	LC50	3	20-24	100	7.2-7.8	35,990.00	ug/L	31,149.48	Birge and Black, 1979	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Bufo woodhousei ssp. fowleri*	Fowler's Toad	Embryo (4 dph)	W	LC50	7	20-24	100	7.2-7.8	26,960.00	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Cu	Copper sulphate	*Discoglossus jeanneae*	East Iberian Painted Frog	Larvae (GS 19)	W	LC50	4	20	NR	7.2-7.8	100.00	ug/L	104.88	Garcia-Munoz et al., 2010	na
Cu	Copper sulphate	*Discoglossus jeanneae*	East Iberian Painted Frog	Larvae (GS 25)	W	LC50	4	20	NR	7.2-7.8	110.00	ug/L	-	Garcia-Munoz et al., 2010	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (GS 19)	W	LC50	4	20	NR	7.2-7.8	80.00	ug/L	118.36	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Copper sulphate	*Epidalea calamita*	Natterjack Toad	Larvae (GS 19)	W	LC50	4	20	NR	7.2-7.8	100.00	ug/L	-	Garcia-Munoz et al., 2010	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Larve (GS 25)	W	LC50	4	20	NR	7.2-7.8	110.00	ug/L	-	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Copper sulphate	*Epidalea calamita*	Natterjack Toad	Larvae (GS 25)	W	LC50	4	20	NR	7.2-7.8	120.00	ug/L	-	Garcia-Munoz et al., 2010	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (GS 3)	W	LC50	4	20	NR	7.2-7.8	220.00	ug/L	-	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Copper	*Eurycea bislineata*	Northern Two-Lined Salamander	NR	W	LC50	2	20	100-120	NR	1,120.00	ug/L	1,120.00	Dobbs et al., 1994	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo (4 dph)	W	LC50	3	20-24	197	7.2-7.8	50.00	ug/L	42.29	Birge and Black, 1979	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo (4 dph)	W	LC50	7	20-24	197	7.2-7.8	40.00	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Cu	Copper	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	40.00	ug/L	-	Birge et al., 1979	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	40.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Hyla chrysoscelis*	Southern Grey Tree Frog	Embryo (4 dph)	W	LC50	3	20-24	100	7.2-7.8	60.00	ug/L	38.89	Birge and Black, 1979	ECOTOX (2010)
Cu	Copper	*Hyla chrysoscelis*	Gray Treefrog	Larvae (8 days)	W	LC50	4	NR	45	NR	24.50	ug/L	-	Gottschalk, 1995	Pauli et al. 2000
Cu	Sulfuric acid copper(2+) salt (1:1)	*Hyla chrysoscelis*	Southern Grey Tree Frog	Embryo (4 dph)	W	LC50	7	20-24	100	7.2-7.8	40.00	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Cu	Copper sulphate	*Lithobates catesbeianus*	Bullfrog	Larvae (GS 25)	W	LC50	4	21	94.37	8.51	3,960.00	ug/L	3,960.00	Ossana et al., 2010	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Microhyla ornata*	Frog	Tadpole (1 wk)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	5,040.00	ug/L	5,207.23	Rao and Madhyastha, 1987	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Microhyla ornata*	Frog	Tadpole (4 wk)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	5,380.00	ug/L	-	Rao and Madhyastha, 1987	ECOTOX (2010)
Cu	Copper sulphate	*Pelobates cultripes*	Iberian Spadefoot Toad	Larvae (GS 19)	W	LC50	4	20	NR	7.2-7.8	230.00	ug/L	230.00	Garcia-Munoz et al., 2010	na
Cu	Copper sulphate	*Pelobates cultripes*	Iberian Spadefoot Toad	Larvae (GS 25)	W	LC50	4	20	NR	7.2-7.8	230.00	ug/L	-	Garcia-Munoz et al., 2010	na
Cu	Copper sulphate	*Pelophylax perezi*	Iberian Pond Frog	Larvae (GS 19)	W	LC50	4	20	NR	7.2-7.8	390.00	ug/L	475.60	Garcia-Munoz et al., 2010	na
Cu	Copper sulphate	*Pelophylax perezi*	Iberian Pond Frog	Larvae (GS 25)	W	LC50	4	20	NR	7.2-7.8	580.00	ug/L	-	Garcia-Munoz et al., 2010	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana hexadactyla*	Frog	Tadpole (0.6 g, 24 mm)	W	LC50	4	15	20	6.2	39.00	ug/L	39.00	Khangarot et al., 1984	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	39.00	ug/L	-	Khangarot et al., 1985	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana pipiens*	Northern Leopard Frog	Embryo (>36 h)	W	LC50	3	19.4	NR	7.73	150.00	ug/L	137.65	Lande and Guttman, 1981	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana pipiens*	Northern Leopard Frog	Embryo (4 dph)	W	LC50	4	20-24	100	7.2-7.8	60.00	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Cu	Copper	*Rana pipiens*	Northern Leopard Frog	Larvae (8 days)	W	LC50	4	NR	45	NR	77.80	ug/L	-	Gottschalk, 1995	Pauli et al. 2000
Cu	Copper	*Rana pipiens*	Northern Leopard Frog	Tadpole (1 dph)	W	LC50	7	20	104-156	NR	67.00	ug/L	-	Redick and La Point, 2004	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana pipiens*	Northern Leopard Frog	Embryo (4 dph)	W	LC50	8	20-24	100	7.2-7.8	50.00	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Cd	Cadmium chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	W	LC50	10	23	400-600	NR	2,900.00	ug/L	-	ENSR (2004)	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana sphenocephala*	Leopard Frog	Tadpole (3 wph, GS 25)	W	LC50	4	22	171	8.32	230.00	ug/L	230.00	Bridges et al., 2002	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana tigrina*	Tiger Frog, Indian Bullfrog	Larvae (0.09 g, 1.8 mm)	W	LC50	4	26.5	240	7.5	389.00	ug/L	389.00	Khangarot et al., 1981	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (4.2 dpf)	W	EC50 (DEV)	4	23-24	NR	6.8	458.00	ug/L	590.52	Luo et al., 1993	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	24	102-110	7-7.5	740.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	24	102-110	7-7.5	880.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Cu	Copper	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	23	NR	7	300.00	ug/L	-	Fort et al., 2004	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 49)	W	EC50 (DVP)	4	24	NR	7-8	100.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 48.5)	W	EC50 (DVP)	4	24	NR	7-8	380.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 45)	W	EC50 (DVP)	4	24	NR	7-8	920.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 8)	W	EC50 (DVP)	4	24	NR	7-8	950.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Tadpole (3-4 wk)	W	LC50	2	20	NR	NR	677.00	ug/L	-	De Zwart and Slooff, 1987	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Tadpole (3-4 wk)	W	LC50	2	20	NR	NR	1,700.00	ug/L	-	De Zwart and Slooff, 1987	ECOTOX (2010)
Cu	Copper	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	110.00	ug/L	-	Linder et al., 1991	ENSR (2004)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 49)	W	LC50	4	24	NR	7-8	150.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 48.5)	W	LC50	4	24	NR	7-8	420.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	24	102-110	7-7.5	890.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	24	102-110	7-7.5	980.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 45)	W	LC50	4	24	NR	7-8	1,080.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 8)	W	LC50	4	24	NR	7-8	1,250.00	ug/L	-	Fort and Stover, 1996	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (4.2 dpf)	W	LC50	4	23-24	NR	6.8	4,033.00	ug/L	-	Luo et al., 1993	ECOTOX (2010)
Cu	Copper	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	23	NR	7	400.00	ug/L	-	Fort et al., 2004	ECOTOX (2010)
Cu	Copper	*Xenopus tropicalis*	Clawed Frog	Embryo	W	EC50 (DEV)	2	23-27	NR	7	100.00	ug/L	228.94	Fort et al., 2004	ECOTOX (2010)
Cu	Copper	*Xenopus tropicalis*	Clawed Frog	Embryo	W	LC50	2	23	NR	7	300.00	ug/L	-	Fort et al., 2004	ECOTOX (2010)
Cu	Copper	*Xenopus tropicalis*	Clawed Frog	Embryo	W	LC50	2	27	NR	7	400.00	ug/L	-	Fort et al., 2004	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (4.2 dpf)	W	EC10 (DVP)	4	23-24	NR	6.8	165.00	ug/L	nap	Luo et al., 1993	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (GRO)	4	24	102-110	7-7.5	750.00	ug/L	nap	Fort et al., 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (GRO)	4	24	102-110	7-7.5	750.00	ug/L	nap	Fort et al., 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 49)	W	LOEL (GRO)	4	24	NR	7-8	45.00	ug/L	nap	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 48.5)	W	LOEL (GRO)	4	24	NR	7-8	200.00	ug/L	nap	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (GS 45)	W	LOEL (GRO)	4	24	NR	7-8	670.00	ug/L	nap	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 8)	W	LOEL (GRO)	4	24	NR	7-8	1,100.00	ug/L	nap	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Tadpole (GS 66)	W	NOEL (DEV)	4	24	NR	7-8	50.00	ug/L	nap	Fort and Stover, 1996	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (4.52 mm)	W	LOEC (DEV)	4	20	NR	7.2-7.8	50.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (GS 3)	W	LOEC (DEV)	4	20	NR	7.2-7.8	100.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (4.52 mm)	W	LOEC (GRO)	4	20	NR	7.2-7.8	50.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Larve (GS 25)	W	LOEC (GRO)	4	20	NR	7.2-7.8	130.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (GS 3)	W	LOEC (GRO)	4	20	NR	7.2-7.8	200.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Larve (GS 25)	W	NOEC (DEV)	4	20	NR	7.2-7.8	160.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Embryo (GS 3)	W	NOEC (GRO)	4	20	NR	7.2-7.8	100.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Epidalea calamita*	Natterjack Toad	Larve (GS 25)	W	NOEC (GRO)	4	20	NR	7.2-7.8	100.00	ug/L	nap	Garcia-Munoz et al., 2009	ECOTOX (2010)

Table C-6. Amphibian Toxicity Data

Metal	Form	*Scientific Name*	Common Name	Lifestage	Route	Endpoint	Duration (days)	Temp. (C°)	Hardness (mg/L as $CaCO_3$)	pH (s.u.)	Concentration	Units	SMAV (ug/L)	Primary Source	Secondary Source
Cu	Copper chloride (CuCl2)	*Pseudacris crucifer*	Spring Peeper	Embryo (GS 10-11)	W	LOEC (MOR)	7	18	NR	7.5	5,500.00	ug/L	nap	Baud and Beck, 2005	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Pseudacris crucifer*	Spring Peeper	Embryo (GS 10-11)	W	LOEC (MOR)	7	18	NR	7.5	5,500.00	ug/L	nap	Baud and Beck, 2005	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Pseudacris crucifer*	Spring Peeper	Embryo (GS 10-11)	W	LOEC (MOR)	7	18	NR	7.5	5,500.00	ug/L	nap	Baud and Beck, 2005	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Xenopus laevis*	African Clawed Frog	Tadpole (GS 46)	W	NOEC (DEV)	12	20	410	8.2	200.00	ug/L	Chronic	Alsop et al., 2004	ECOTOX (2010)
Cd	Cadmium chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	W	EC25	10	23	400-600	NR	1,000.00	ug/L	Chronic	ENSR (2004)	na
Cu	Copper chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	W	NOEC	10	23	400-600	NR	900.00	ug/L	Chronic	ENSR (2004)	na
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana pipiens*	Leopard Frog	Embryo (GS 25)	W	LOEC (GRO, DEV)	154	21-22	170	7.5-7.9	25.00	ug/L	Chronic	Chen et al., 2007	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana pipiens*	Leopard Frog	Embryo (>36 h)	W	LOEC (MOR)	28	19.4	NR	7.73	80.00	ug/L	Chronic	Lande and Guttman, 1981	ECOTOX (2010)
Cu	Sulfuric acid copper(2+) salt (1:1)	*Rana pipiens*	Leopard Frog	Embryo (GS 25)	W	NOEC (GRO, DEV)	154	21-22	170	7.5-7.9	5.00	ug/L	Chronic	Chen et al., 2007	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Rana ridibunda*	Lowland Frog	Adult (104.6 g, 257 mm)	W	NOEL (DVP)	30	NR	NR	NR	100,000.00	ug/L	Chronic	Papadimitriou and Loumbourdis, 2002	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Rana ridibunda*	Lowland Frog	Adult (91.7 g)	W	NOEL (DVP)	30	NR	288	7.4	100,000.00	ug/L	Chronic	Papadimitriou and Loumbourdis, 2003	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Rana ridibunda*	Lowland Frog	Adult (104.6 g, 257 mm)	W	NOEL (GRO)	30	NR	NR	NR	100,000.00	ug/L	Chronic	Papadimitriou and Loumbourdis, 2002	ECOTOX (2010)
Cu	Copper chloride (CuCl2)	*Rana ridibunda*	Lowland Frog	Adult (91.7 g)	W	NOEL (GRO)	30	NR	288	7.4	100,000.00	ug/L	Chronic	Papadimitriou and Loumbourdis, 2003	ECOTOX (2010)
Cd	Cadmium chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	W	EC25	10	23	400-600	NR	540.00	ug/L	Chronic	ENSR (2004)	na
Cu	Copper chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	W	NOEC	10	23	400-600	NR	280.00	ug/L	Chronic	ENSR (2004)	na
Cu	Copper chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	Sed	NOEC (GRO)	10	23	400-600	NR	200.00	mg/kg	Sediment	ENSR (2004)	na
Cu	Copper chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	Sed	NOEC	10	23	400-600	NR	64.00	mg/kg	Sediment	ENSR (2004)	na
Cu	Copper acetate	*Plethodon cinereus*	Red-Backed Salamanders	Adult	Soil	LOAEC (GRO, MOR)	28	na	na	5.9 (soil)	705.00	mg/kg	Soil	Bazar et al., 2009	-
Cu	Copper acetate	*Plethodon cinereus*	Red-Backed Salamanders	Adult	Soil	NOAEC (GRO, MOR)	28	na	na	5.9 (soil)	246.00	mg/kg	Soil	Bazar et al., 2009	-
Fe	Sulfuric acid, Iron (2+) salt (1:1)	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	17,620.00	ug/L	17,620.00	Khangarot et al., 1985	ECOTOX (2010)
Fe	Sulfuric acid, Iron (2+) salt (1:1)	*Bufo boreas*	Western Toad	Larvae	W	LOEC (MOR)	0.5	NR	NR	5-6	30,000.00	ug/L	-	Porter and Hakanson, 1976	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Ambystoma mexicanum*	Mexican Axolotl	3-4 wk	W	LC50	1	20	NR	NR	560.00	ug/L	388.86	Slooff, 1982	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Ambystoma mexicanum*	Mexican Axolotl	3-4 wk	W	LC50	2	20	NR	NR	300.00	ug/L	-	Slooff and Baerselman, 1980	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Ambystoma mexicanum*	Mexican Axolotl	3-4 wk	W	LC50	2	20	NR	NR	350.00	ug/L	-	Slooff, 1982	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	110.00	ug/L	110.00	Birge et al., 1978	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	43.60	ug/L	89.81	Khangarot and Ray, 1987	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Bufo melanostictus*	Common Indian Toad	Tadpole (1 wk)	W	LC50	4	22-24	220-240	7.4-7.6	185.00	ug/L	-	Paulose, 1988	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Bufo punctatus*	Red-Spotted Toad	Embryo (4 dph)	W	LC50	1	NR	NR	7-7.8	36.80	ug/L	36.80	Birge et al., 1983	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Bufo woodhousei ssp. fowleri*	Fowler's Toad	Embryo (4 dph)	W	LC50	1	NR	NR	7-7.8	65.90	ug/L	65.90	Birge et al., 1983	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo (4 dph)	W	LC50	1	NR	NR	7-7.8	1.30	ug/L	1.09	Birge et al., 1983	ECOTOX (2010)
Hg	Mercury	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	1.00	ug/L	-	Birge et al., 1979	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	1.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Hyla chrysoscelis*	Southern Grey Tree Frog	Embryo (4 dph)	W	LC50	1	NR	NR	7-7.8	2.40	ug/L	2.40	Birge et al., 1983	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Microhyla ornata*	Frog	Tadpole (8-10 d)	W	LC50	4	21-25	54	7.1	87.82	ug/L	365.15	Ghate and Mulherkar, 1980	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Microhyla ornata*	Frog	Embryo	W	LC50	4	21-25	54	7.1	126.40	ug/L	-	Ghate and Mulherkar, 1980	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Microhyla ornata*	Frog	Tadpole (1 wk)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	1,120.00	ug/L	-	Rao and Madhyastha, 1987	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Microhyla ornata*	Frog	Tadpole (4 wk)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	1,430.00	ug/L	-	Rao and Madhyastha, 1987	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Rana breviceps*	Frog	Tadpole (1 wk)	W	LC50	4	22-24	220-240	7.4-7.6	200.00	ug/L	200.00	Paulose, 1988	ECOTOX (2010)
Hg	Mercury	*Rana cyanophlyctis*	Skipping Frog	Adult Female	W	LC50	4	23	60-70	7.38-7.8	2,500.00	ug/L	2,810.69	Mudgall and Patil, 1985	ENSR (2004)
Hg	Mercury	*Rana cyanophlyctis*	Skipping Frog	Adult Male	W	LC50	4	23	60-70	7.38-7.8	3,160.00	ug/L	-	Mudgall and Patil, 1985	ENSR (2004)
Hg	Mercury chloride (HgCl2)	*Rana grylio*	Pig Frog	Embryo (4 dph)	W	LC50	1	NR	NR	7-7.8	67.20	ug/L	67.20	Birge et al., 1983	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Rana heckscheri*	River Frog	Tadpole (GS 27)	W	LC50	4	21	351.3	7.23	680.00	ug/L	680.00	Punzo, 1993	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	51.00	ug/L	51.00	Khangarot et al., 1985	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Rana pipiens*	Leopard Frog	Embryo (4 dph)	W	LC50	1	NR	NR	7-7.8	7.30	ug/L	7.30	Birge et al., 1983	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Rana tigrina*	Tiger Frog, Indian Bullfrog	Male (83.4 g)	W	LC50	4	23	60-70	7.38-7.8	16,100.00	ug/L	17,164.79	Mudgall and Patil, 1988	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Rana tigrina*	Tiger Frog, Indian Bullfrog	Female (110.5 g)	W	LC50	4	23	60-70	7.38-7.8	18,300.00	ug/L	-	Mudgall and Patil, 1988	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Xenopus laevis*	African Clawed Frog	3-4 wk	W	LC50	2	20	NR	NR	70.00	ug/L	35.14	Slooff and Baerselman, 1980	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Xenopus laevis*	African Clawed Frog	Tadpole (3-4 wk)	W	LC50	2	20	NR	NR	74.00	ug/L	-	De Zwart and Slooff, 1987	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Xenopus laevis*	African Clawed Frog	3-4 wk	W	LC50	2	20	NR	NR	100.00	ug/L	-	Slooff, 1982	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 22-24)	W	LC50	4	NR	NR	NR	163.18	ug/L	-	Prati et al., 2002	na
Hg	Mercury chloride (HgCl2)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	7	12.2	102	7.3	0.16	ug/L	-	Birge and Black, 1979	ECOTOX (2010)
Hg	Mercury chloride (HgCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 22-24)	W	EC50 (DEV)	4	NR	NR	NR	139.29	ug/L	-	Prati et al., 2002	na
Hg	Mercury chloride (HgCl2)	*Rana sphenocephala*	Southern leopard Frog	Embryo (GS 25)	FD	NOAEL (MOR, GRO, DEV	254	22	NR	7.86	0.423	mg/kg-dw	Food	Unrine et al., 2004	na
Hg	Mercury chloride (HgCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	Sed	LOEC (MOR)	6-7	20-21	200	7.5-8.0	0.15	mg/kg	Sediment	Birge et al., 1977	Pauli et al. 2000
MeHg	Chloromethylmercury	*Bufo melanostictus*	Common Indian Toad	Tadpole (1 wk)	W	LC50	4	22-24	220-240	7.4-7.6	56.00	ug/L	56.00	Paulose, 1988	ECOTOX (2010)
MeHg	Chloromethylmercury	*Rana breviceps*	Frog	Tadpole (1 wk)	W	LC50	4	22-24	220-240	7.4-7.6	60.00	ug/L	60.00	Paulose, 1988	ECOTOX (2010)
MeHg	Methylmercury chloride	*Xenopus laevis*	African Clawed Frog	Embryo (GS 22-24)	W	LC50	4	NR	NR	NR	78.59	ug/L	68.24	Prati et al., 2002	na
MeHg	Methylmercury chloride	*Xenopus laevis*	African Clawed Frog	Embryo (GS 22-24)	W	EC50 (DEV)	4	NR	NR	NR	59.25	ug/L	-	Prati et al., 2002	na
MeHg	Chloromethylmercury	*Rana pipiens*	Leopard Frog	Tadpole	W	LOEC (MOR)	2	NR	NR	NR	50.00	ug/L	nap	Chang et al., 1974	ECOTOX (2010)
MeHg	Chloromethylmercury	*Rana pipiens*	Leopard Frog	Embryo (GS 9)	W	LOEC (MOR)	5	21	NR	NR	24.00	ug/L	nap	Dial, 1976	ECOTOX (2010)
MeHg	Chloromethylmercury	*Rana pipiens*	Leopard Frog	Embryo (GS 11)	W	LOEC (MOR)	5	21	NR	NR	24.00	ug/L	nap	Dial, 1976	ECOTOX (2010)
MeHg	Chloromethylmercury	*Rana pipiens*	Leopard Frog	Embryo (GS 13)	W	LOEC (MOR)	5	21	NR	NR	24.00	ug/L	nap	Dial, 1976	ECOTOX (2010)
MeHg	Chloromethylmercury	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (MOR)	4	21	NR	NR	100.00	ug/L	nap	Dumpert et al., 1984	ECOTOX (2010)
Mn	Manganese	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	NR	W	LC50	7	NR	195	7-7.8	1,420.00	ug/L	1,420.00	Birge and Black, 1979	ECOTOX (2010)
Mn	Manganese chloride (MnCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	1,420.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Mn	Sulfuric acid, Manganese(3+) salt (3:2)	*Microhyla ornata*	Frog	Tadpole (4 wk)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	14,330.00	ug/L	14,582.77	Rao and Madhyastha, 1987	ECOTOX (2010)
Mn	Sulfuric acid, Manganese(3+) salt (3:2)	*Microhyla ornata*	Frog	Tadpole (1 wk)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	14,840.00	ug/L	-	Rao and Madhyastha, 1987	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	420.00	ug/L	420.00	Birge et al., 1978	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Bufo arenarum*	Toad	Embryo (Stage 25)	W	LC50	1	20	NR	NR	23,430.00	ug/L	5,334.72	Herkovits et al., 2002	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Bufo arenarum*	Toad	Embryo	W	LC50	4	20	NR	NR	3,620.00	ug/L	-	Herkovits et al., 2000	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Bufo arenarum*	Toad	Embryo	W	LC50	7	20	NR	NR	1,790.00	ug/L	-	Herkovits et al., 2000	ECOTOX (2010)
Ni	Sulfuric acid, Nickel(2+)salt (1:1)	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	25,320.00	ug/L	25,320.00	Khangarot and Ray, 1987	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Bufo terrestris*	Southern toad	Embryo (GS 12)	W	LC50	7	21	100	7.7	2,985.00	ug/L	3,425.06	Fort et al., 2006	na
Ni	Nickel chloride (NiCl2)	*Bufo terrestris*	Southern toad	Embryo (GS 12)	W	EC50 (DEV)	7	21	100	7.7	3,930.00	ug/L	-	Fort et al., 2006	na
Ni	Nickel	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	50.00	ug/L	204.64	Birge et al., 1979	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	50.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo (GS 12)	W	LC50	7	21	100	7.7	1,150.00	ug/L	-	Fort et al., 2006	na
Ni	Nickel chloride (NiCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo (GS 12)	W	EC50 (DEV)	7	21	100	7.7	610.00	ug/L	-	Fort et al., 2006	na
Ni	Nickel	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	300.00	ug/L	2,930.98	Linder et al., 1991	ENSR (2004)

Table C-6. Amphibian Toxicity Data

Metal	Form	*Scientific Name*	Common Name	Lifestage	Route	Endpoint	Duration (days)	Temp. (C°)	Hardness (mg/L as $CaCO_3$)	pH (s.u.)	Concentration	Units	SMAV (ug/L)	Primary Source	Secondary Source
Ni	Nickel	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	1,700.00	ug/L	-	Linder et al., 1991	ENSR (2004)
Ni	Nickel chloride (NiCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 10)	W	LC50	4	23	100	7.7	7,950.00	ug/L	-	Fort et al., 2006	na
Ni	Nickel	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	21,429.00	ug/L	-	Hopfer et al., 1991	Pauli et al. 2000
Ni	Nickel chloride (NiCl2)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	23	NR	6.8	86,760.00	ug/L	-	Sunderman, 1992	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (GS 10)	W	EC50 (DEV)	4	23	100	7.7	415.00	ug/L	-	Fort et al., 2006	na
Ni	Nickel chloride (NiCl2)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (GRO)	4	23	NR	6.8	594.00	ug/L	-	Sunderman, 1992	ECOTOX (2010)
Ni	Nickel chloride (NiCl2)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (GRO)	4	23	NR	6.8	1,331.00	ug/L	nap	Sunderman, 1992	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Rana tigrina*	Tiger Frog, Indian Bullfrog	Tadpole (0.97 mg, 7.25 mm)	W	LC50	2	27.9	NR	NR	720,000.00	ug/L	720,000.00	Kumar, 1999	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Bufo arenarum*	Toad	Embryo	W	LC50	2	20-21	NR	NR	470.00	ug/L	470.00	Perez-Coll et al., 1988	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	33,280.00	ug/L	33,280.00	Khangarot et al., 1985	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Rana cyanophlyctis*	Skipping Frog	Male (10.6 g)	W	LC50	4	23	60-70	7.38-7.8	1,540,700.00	ug/L	1,585,838.77	Mudgall and Patil, 1988	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Rana cyanophlyctis*	Skipping Frog	Female (20.5 g)	W	LC50	4	23	60-70	7.38-7.8	1,632,300.00	ug/L	-	Mudgall and Patil, 1988	ECOTOX (2010)
Pb	Lead	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	NR	W	LC50	7	NR	195	7-7.8	40.00	ug/L	40.00	Birge and Black, 1979	ECOTOX (2010)
Pb	Lead chloride	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	40.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Pb	Lead chloride	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	1,460.00	ug/L	1,460.00	Birge et al., 1978	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Rana catesbeiana*	Bullfrog	Larvae (GS 25)	W	NOEC (GRO)	7	23	248	7.96	776.00	ug/L	nap	Rice et al., 1999	ECOTOX (2010)
Pb	Nitric acid, Lead (2+) salt	*Rana catesbeiana*	Bullfrog	Larvae (GS 25)	W	NOEC (GRO)	7	23	244	7.86	786.00	ug/L	nap	Rice et al., 1999	ECOTOX (2010)
Pb	Lead	*Bufo americanus*	American Toad	Tadpole	W	NOEC (MOR)	6	22	NR	NR	1,000.00	ug/L	nap	Steele et al., 1991	Pauli et al. 2000
Pb	Nitric acid, Lead (2+) salt	*Rana clamitans*	Green Frog	Tadpole (GS 24)	W	NOEC (MOR)	6	23	340.5	7.21	1,000.00	ug/L	nap	Taylor et al., 1990	ECOTOX (2010)
Pb	Lead chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (72 hrs)	W	EC25 (GRO, DEV)	10	23	400-600	NR	430.00	ug/L	Chronic	ENSR (2004)	na
Pb	Lead chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (72 hrs)	W	LC50	10	23	400-600	NR	580.00	ug/L	Chronic	ENSR (2004)	na
Pb	Lead	*Rana utricularia*	Southern Leopard Frog	Tadpole (GS 10-20)	W	LOEC (DEV)	106	21	NR	NR	1,000.00	ug/L	Chronic	Yeung, 1978	Pauli et al. 2000
Pb	Lead nitrate	*Rana catesbeiana*	Bullfrog	Larvae (2 wph)	W	LOEC (GRO)	98	25	316	7.97	1,049.00	ug/L	Chronic	Rice et al., 2002	-
Pb	Lead	*Rana utricularia*	Southern Leopard Frog	Tadpole (GS 10-20)	W	NOEC (DEV)	106	21	NR	NR	500.00	ug/L	Chronic	Yeung, 1978	Pauli et al. 2000
Pb	Lead nitrate (Pb(NO3)2)	*Rana pipiens*	Northern Leopard Frog	Larvae (GS 25)	W	NOEC (GRO, MOR, DEV)	66	21-22	170	7.9	3.00	ug/L	Chronic	Chen et al., 2006	na
Pb	Lead	*Xenopus laevis*	African Clawed Frog	Adult	FD	NOAEL (GRO)	56	na	na	na	11.40	mg/kg-d	Food	Ireland, 1977	na
Pb	Lead acetate	*Raba sphenocephala*	Southern Leopard Frog	Larvae (GS 25)	PW	EC50 (DEV)	60	21.6	8.25 (TOC%)	6.92	1,968.00	ug/L	Porewater	Sparling et al., 2006	na
Pb	Lead acetate	*Raba sphenocephala*	Southern Leopard Frog	Larvae (GS 25)	PW	LC50	5	21.6	8.25 (TOC%)	6.92	12,539.00	ug/L	Porewater	Sparling et al., 2006	na
Pb	Lead acetate	*Raba sphenocephala*	Southern Leopard Frog	Larvae (GS 25)	Sed	EC50 (DEV)	60	21.6	8.25 (TOC%)	6.92	579.00	mg/kg	Sediment	Sparling et al., 2006	na
Pb	Lead acetate	*Raba sphenocephala*	Southern Leopard Frog	Larvae (GS 25)	Sed	LC50	5	21.6	8.25 (TOC%)	6.92	3,728.00	mg/kg	Sediment	Sparling et al., 2006	na
Pb	Lead chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (72 hrs)	Sed	LC50	10	23	400-600	NR	4,662.00	mg/kg	Sediment	ENSR (2004)	na
Pb	Lead chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (72 hrs)	Sed	EC25	10	23	400-600	NR	3,490.00	mg/kg	Sediment	ENSR (2004)	na
Pb	Lead nitrate	*Xenopus laevis*	African Clawed Frog	Tadpole	Sed	NOEC (GRO, DEV)	35	21-26	Clay sediment	8.2	90.00	mg/kg	Sediment	Berzins and Bundy, 2002	na
Pb	Lead nitrate	*Xenopus laevis*	African Clawed Frog	Tadpole	Sed	LOEC (GRO, DEV)	35	21-26	Clay sediment	8.2	180.00	mg/kg	Sediment	Berzins and Bundy, 2002	na
Pb	Lead acetate	*Plethodon cinereus*	Red-Backed Salamanders	Adult	Soil	LOAEC (GRO, MOR)	28	na	na	5.9 (soil)	4,600.00	mg/kg	Soil	Bazar et al., 2010	na
Pb	Lead acetate	*Plethodon cinereus*	Red-Backed Salamanders	Adult	Soil	NOAEC (GRO, MOR)	28	na	na	5.9 (soil)	1,700.00	mg/kg	Soil	Bazar et al., 2010	na
Sb	Antimony	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	300.00	ug/L	300.00	Birge et al., 1979	ECOTOX (2010)
Sb	Antimony trichloride	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	300.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Se	Selenium	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	90.00	ug/L	90.00	Birge et al., 1979	ECOTOX (2010)
Se	Selenium (IV)	*Xenopus laevis*	African Clawed Frog	Mixed	W	LC50	5	23	NR	NR	1,200.00	ug/L	1,200.00	Browne and Dumont, 1979	-
Se	SeO2	*Hyla versicolor*	Gray Treefrog	Larvae (GS 25)	FD	NOAEL (GRO, MOR)	120	21-23	NA	NA	32.70	mg/kg-dw	Food	Rowe et al., 2010	na
Tl	Thalliun	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	110.00	ug/L	110.00	Birge et al., 1979	ECOTOX (2010)
V	Vanadium	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	250	22	195	7.4	250.00	ug/L	250.00	Birge, 1978	ECOTOX (2010)
V	Sodium metavanadate	*Rana sphenocephala*	Southern Leopard Frog	Larvae (GS 25-26)	FD	LOAEL (GRO)	120	22-24	NA	NA	108.80	mg/kg-dw	Food	Rowe et al., 2009	na
V	NaVO3	*Hyla versicolor*	Gray Treefrog	Larvae (GS 25)	FD	NOAEL (GRO, MOR)	120	21-23	NA	NA	485.70	mg/kg-dw	Food	Rowe et al., 2010	na
Zn	Zinc chloride (ZnCl2)	*Ambystoma opacum*	Marbled Salamander	Embryo	W	LC50	8	19-22	93-105	7.2-7.8	2,380.00	ug/L	2,380.00	Birge, 1978	ECOTOX (2010)
Zn	Zinc chloride (ZnCl2)	*Bufo arenarum*	Toad	Embryo (Stage 25)	W	LC50	1	20	NR	NR	28,000.00	ug/L	28,000.00	Herkovits et al., 2002	ECOTOX (2010)
Zn	Zinc oxide	*Bufo bufo ssp. japonicus*	Toad	Tadpole (0.34 G, 2.9 CM)	W	LC50	1	17.5	NR	7.56	3,200.00	ug/L	3,200.00	Nichiuchi, 1979	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Bufo melanostictus*	Common Indian Toad	Tadpole (1.95 cm, 100 mg)	W	LC50	4	31	185	7.4	19,860.00	ug/L	19,860.00	Khangarot and Ray, 1987	ECOTOX (2010)
Zn	Zinc	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Fertilization through 4 dph	W	LC50	7	NR	195	7-7.8	10.00	ug/L	10.00	Birge et al., 1979	ECOTOX (2010)
Zn	Zinc chloride (ZnCl2)	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	W	LC50	7	22	195	7.4	10.00	ug/L	-	Birge, 1978	ECOTOX (2010)
Zn	Zinc	*Hyla chrysoscelis*	Gray Treefrog	Larvae (8 days)	W	LC50	4	NR	45	NR	4,696.00	ug/L	4,696.00	Gottschalk, 1995	Pauli et al. 2000
Zn	Sulfuric acid, Zinc salt (1:1)	*Microhyla ornata*	Frog	Tadpole (1 week, 1.2-1.3 cm)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	22,410.00	ug/L	22,742.53	Rao and Madhyastha, 1987	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Microhyla ornata*	Frog	Tadpole (4 weeks)	W	LC50	4	25.5-26	142-145.5	6.86-6.94	23,080.00	ug/L	-	Rao and Madhyastha, 1987	ECOTOX (2010)
Zn	Zinc	*Rana catesbeiana*	Bullfrog	Tadpole	W	LC50	4	NR	NR	NR	70,000.00	ug/L	70,000.00	Zang et al., 1992	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Rana hexadactyla*	Frog	Tadpole (0.4-0.6 g,16-24 mm)	W	LC50	4	15	20	6.2	2,100.00	ug/L	2,100.00	Khangarot et al., 1984	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.1	2,100.00	ug/L	-	Khangarot et al., 1985	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Rana hexadactyla*	Frog	Tadpole (20 mm, 500 mg)	W	LC50	4	15	20	6.2	2,100.00	ug/L	-	Khangarot et al., 1985	ECOTOX (2010)
Zn	Zinc nitrate	*Rana luteiventris*	Spotted Frog	Tadpole (Gosner Stage 22-25)	W	LC50	4	NR	40-100	NR	28,380.00	ug/L	28,380.00	Lefcort et al., 1998	ECOTOX (2010)
Zn	Zinc	*Rana pipiens*	Gray Treefrog	Larvae (8 days)	W	LC50	4	NR	45	NR	10,200.00	ug/L	10,200.00	Gottschalk, 1995	Pauli et al. 2000
Zn	Zinc chloride	*Rhinella arenarum*	South American Toad	GS 25	W	LC50	4	20-22	NR	NR	2,490.00	ug/L	2,490.00	Brodeur et al., 2009	na
Zn	Zinc	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	NR	NR	NR	1,300.00	ug/L	7,627.35	Linder et al., 1991	ENSR (2004)
Zn	Zinc chloride (ZnCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (101 hpf)	W	LC50	4	23-24	NR	6.8	11,846.50	ug/L	-	Luo et al., 1993	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	24	102-110	7-7.5	25,350.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	24	102-110	7-7.5	28,650.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	23	NR	NR	33,800.00	ug/L	-	Fort et al., 1989	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	22-24	100	7	34,500.00	ug/L	-	Dawson et al., 1988	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LC50	4	23	NR	NR	35,000.00	ug/L	-	Fort et al., 1989	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	23	NR	NR	2,220.00	ug/L	-	Fort et al., 1989	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	24	102-110	7-7.5	2,650.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	24	102-110	7-7.5	2,830.00	ug/L	-	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	23	NR	NR	3,150.00	ug/L	-	Fort et al., 1989	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (DEV)	4	23-24	NR	NR	4,800.00	ug/L	-	Bantle et al., 1989	ECOTOX (2010)
Zn	Zinc chloride (ZnCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (101 hpf)	W	EC50 (DEV)	4	23-24	NR	6.8	5,452.00	ug/L	-	Luo et al., 1993	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	EC50 (GRO)	4	22-24	100	7	3,600.00	ug/L	-	Dawson et al., 1988	ECOTOX (2010)
Zn	Zinc chloride (ZnCl2)	*Bufo arenarum*	Toad	Embryo (Stage 25)	W	LOEL (MOR)	1	20	NR	NR	30,000.00	ug/L	nap	Herkovits et al., 2002	ECOTOX (2010)
Zn	Zinc	*Bufo arenarum*	Toad	Embryo (Stage 3)	W	NOEC (DEV, MOR)	1	20	NR	NR	2,000.00	ug/L	nap	Herkovits et al., 1989	ECOTOX (2010)
Zn	Zinc	*Bufo arenarum*	Toad	Larvae	W	NOEC (MOR)	5	20	NR	NR	8,000.00	ug/L	nap	Herkovits and Perez-Coll, 1991	ECOTOX (2010)
Zn	Zinc chloride (ZnCl2)	*Bufo arenarum*	Toad	Embryo (Stage 25)	W	NOEL (MOR)	1	20	NR	NR	30,000.00	ug/L	nap	Herkovits et al., 2002	ECOTOX (2010)

Table C-6. Amphibian Toxicity Data

Metal	Form	*Scientific Name*	Common Name	Lifestage	Route	Endpoint	Duration (days)	Temp. (C°)	Hardness (mg/L as $CaCO_3$)	pH (s.u.)	Concentration	Units	SMAV (ug/L)	Primary Source	Secondary Source
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (GRO)	4	24	102-110	7-7.5	1,750.00	ug/L	nap	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (GRO)	4	24	102-110	7-7.5	2,000.00	ug/L	nap	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Embryo	W	LOEC (GRO)	4	22-24	100	7	4,200.00	ug/L	nap	Dawson et al., 1988	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (<24 hph)	W	LOEC (GRO)	7	24	102-110	7-7.5	750.00	ug/L	nap	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Larvae (<24 hph)	W	LOEC (GRO)	7	24	102-110	7-7.5	750.00	ug/L	nap	Fort et al., 1996	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Xenopus laevis*	African Clawed Frog	Tadpole (Stage 54-58, 2-5 cm)	W	LOEC (MOR)	4	20-23	296	7	10,000.00	ug/L	nap	Woodall et al., 1988	ECOTOX (2010)
Zn	Zinc chloride (ZnCl2)	*Xenopus laevis*	African Clawed Frog	Embryo (101 hpf)	W	EC10 (DVP)	4	23-24	NR	6.8	913.00	ug/L	nap	Luo et al., 1993	ECOTOX (2010)
Zn	Zinc chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	W	EC25	10	23	400-600	NR	28,000.00	ug/L	Chronic	ENSR (2004)	na
Zn	Zinc chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	W	LC50	10	23	400-600	NR	35,000.00	ug/L	Chronic	ENSR (2004)	na
Zn	Sulfuric acid, Zinc salt (1:1)	*Bufo anderssoni*	Toad	Tadpole (Stage 25)	W	NOEC (MOR)	15	30-32	NR	NR	8,000.00	ug/L	Chronic	Saxena and Saxena, 1997	ECOTOX (2010)
Zn	Sulfuric acid, Zinc salt (1:1)	*Bufo fergusonii*	Ferguson's Dwarf Toad	Young	W	LOEC (DEV)	15	30-32	NR	NR	1,000.00	ug/L	Chronic	Saxena and Chaturvedi, 2000	ECOTOX (2010)
Zn	Zinc chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	W	EC25	10	23	400-600	NR	7,200.00	ug/L	Chronic	ENSR (2004)	na
Zn	Zinc chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	W	LC50	10	23	400-600	NR	19,000.00	ug/L	Chronic	ENSR (2004)	na
Zn	Zinc chloride	*Rhinella arenarum*	South American Toad	GS 25	W	LC50	21	20-22	NR	NR	1,300.00	ug/L	Chronic	Brodeur et al., 2009	na
Zn	Zinc nitrate	*Xenopus laevis*	African Clawed Frog	Tadpole (Stage 46)	W	NOEC (DEV)	12	20	410	8.2	1,000.00	ug/L	Chronic	Alsop et al., 2004	ECOTOX (2010)
Zn	Zinc chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	Sed	EC25	10	23	400-600	NR	1,600.00	mg/kg	Sediment	ENSR (2004)	na
Zn	Zinc chloride	*Bufo americanus*	American Toad	Emryo (48-72 hrs)	Sed	LC50	10	23	400-600	NR	2,100.00	mg/kg	Sediment	ENSR (2004)	na
Zn	Zinc chloride	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Embryo	Sed	LOEC (MOR)	6-7	20-21	200	7.5-8.0	104.60	mg/kg	Sediment	Birge et al., 1977	Pauli et al. 2000
Zn	Zinc chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	Sed	EC25	10	23	400-600	NR	980.00	mg/kg	Sediment	ENSR (2004)	na
Zn	Zinc chloride	*Rana pipiens*	Northern Leopard Frog	Emryo (48-72 hrs)	Sed	LC50	10	23	400-600	NR	1,500.00	mg/kg	Sediment	ENSR (2004)	na

Table C-7. Surface Water Benchmarks for Amphibians

	Surface Water Benchmarks for Aquatic Organisms (Table C-1)		Amphibian Acute Surface Water Toxicity (2-8 days)	Amphibian Subchronic and Chronic Surface Water Toxicity (≥10 days)
Metal	Acute (ug/L)	Chronic (ug/L)	SMAV (ug/L) [b]	Lowest LOEC or Highest NOEC (ug/L)
Aluminum	750	87	**50**-2,280 (4)	none
Antimony	900	190	**300 (1)**	none
Arsenic	340	150	**40**-311,456 (8)	1,000
Barium	2000	220	none	none
Beryllium	93	11	9,961-11,398 (2)	none
Cadmium [a]	2	0.25	**0.1**-71,800 (17)	**0.1**
Chromium (III) [a]	570	74	**30**-224,910 (11)	750
Chromium (IV)	16	11	30-224,910 (11)	750
Cobalt	220	24	**50**-53,101 (3)	5,984
Copper [a]	13	9	39-31,149 (22)	25
Iron	na	1000	17,620 (1)	none
Lead [a]	65	2.5	**40**-1,585,839 (6)	430
Manganese [a]	2986	1650	**1420**-14,583 (2)	none
Mercury	1.4	0.77	**1.1**-17,164 (16) (Hg) 56-68 (3) (MeHg)	none
Nickel [a]	468	52	**205**-25,320 (6)	none
Selenium	20	4.61	90-1,200 (2)	none
Silver [a]	3.2	0.36	4.1-240 (8)	none
Thallium	79	17	110 (1)	none
Vanadium	150	44	250 (1)	none
Zinc [a]	117	118	**10**-70,000 (13)	1000

Notes

(a) Hardness based criteria presented at 100 mg/L $CaCO_3$

(b) Species mean acute values (geomean of LC50 and EC50 values for each species). Range and number of species presented. ***bolded*** *values are less than AWQC.*

Table C-8. Sediment Benchmarks for Amphibians

Metal	Sediment Benchmarks (mg/kg) for Benthic Invertebrates TEC	Sediment Benchmarks (mg/kg) for Benthic Invertebrates PEC	Sediment Benchmarks (mg/kg) for Amphibians Value	Sediment Benchmarks (mg/kg) for Amphibians Measure
Aluminum	25,519	59,572	none	
Antimony	2	25	none	
Arsenic	9.79	33	none	
Barium	none	none	none	
Beryllium	none	none	none	
Cadmium	0.99	4.98	1.34	LOEC (mortality)
Chromium (III)	43.4	111	none	
Chromium (IV)	43.4	111	none	
Cobalt	50	none	none	
Copper	31.6	149	200	NOEC (growth)
Iron	188,400	247,600	none	
Lead	35.8	128	180	LOEC (growth, development)
Manganese	460	1100	none	
Mercury	0.18	1.06	0.15	LOEC (mortality)
Nickel	22.7	48.6	none	
Selenium	none	none	none	
Silver	1	2.2	none	
Thallium	none	none	none	
Vanadium	none	none	none	
Zinc	121	459	104.6	LOEC (mortality)

Notes:

TEC - Threshold Effects Concentration represents a concentration below which adverse effects are not

PEC - Probable Effects Concentration represents a concentration above which effects are expected to occur more often than not.

TECs and PECs from MacDonald et al., 2000.

Table C-9. Soil Benchmarks for Terrestrial Plants, Invertebrates, and Wildlife

	Plant Benchmark	Invertebrate Benchmark	Wildlife Benchmark	EPA EcoSSLs (mg/kg)					ORNL (mg/kg)			Soil Benchmarks (mg/kg) for Amphibians	
Metal	(mg/kg)	(mg/kg)	(mg/kg)	Plant	Soil Invertebrate	Bird	Mammal	Date Published	Plant	Soil Invertebrates or Microorganisms	Wildlife	Value	Measure
Aluminum	soil pH<5.5	soil pH<5.5	soil pH<5.5	not considered toxic at soil pH>5.5				November 2003	50	600	na	none	
Antimony	5	78	0.27	na	78	na	0.27	February 2005	5.0	na	na	none	
Arsenic	18	60	43	18	na	43	46	March 2005	10	60	9.9	none	
Barium	500	330	2000	na	330	na	2000	February 2005	500	3000	283	none	
Beryllium	10	40	21	na	40	na	21	February 2005	10	na	na	none	
Cadmium	32	140	0.36	32	140	0.77	0.36	March 2005	4.0	20	4.2	120	NOEC (growth, development)
Chromium(III)	1	0.4	26	na	na	26	34	March 2005	1.0	0.4	16.1	none	
Chromium(VI)	1	0.4	130	na	na	na	130	March 2005	1.0	0.4	16.1	none	
Cobalt	13	1000	120	13	na	120	230	March 2005	20	1000	na	none	
Copper	70	80	28	70	80	28	49	February 2007	100	50	370	246	NOEC (growth, development)
Iron	soil pH <5 or >8	soil pH <5 or >8	soil pH <5 or >8	not considered toxic at a soil pH range of 5 to 8				November 2003	na	200	na	none	
Lead	120	1700	11	120	1700	11	56	March 2005	50	500	40.5	1700	NOEC (growth, development)
Manganese	220	450	4000	220	450	4300	4000	April 2007	500	100	na	none	
Mercury	0.3	0.1	0.1[b]	na	na	na	na	na	0.3	0.1	nr	none	
Nickel	38	280	130	38	280	210	130	March 2007	30	200	121	none	
Selenium	0.52	4.1	0.63	0.52	4.1	1.2	0.63	July 2007	1.0	70	0.21	none	
Silver	560	50	4.2	560	na	4.2	14	September 2006	2.0	50	na	none	
Thallium	1	1[a]	0.057[b]	na	na	na	na	na	1.0	na	2.1	none	
Vanadium	2	20	7.8	na	na	7.8	280	April 2005	2.0	20	55	none	
Zinc	160	120	46	160	120	46	79	June 2007	50	200	8.5	none	

Notes:

EPA EcoSSLs: EPA Ecological Soil Screening Levels (available at http://www.epa.gov/ecotox/ecossl/)

ORNL: Oak Ridge National Laboratory Preliminary Remediation Goals for Ecological Endpoints (Efroymson et al., 1997a,b,c).

na - not available

nr - this value was recommended by Efroymson et al. (1997a) as it was at or below typical background soil concentrations.

(a) A soil invertebrate benchmark was derived from the literature (see text).

(b) Wildlife value from US EPA Region 5 RCRA screening levels.

Table C-10. Wildlife Toxicity Reference Values

Constituent	Class	Test Species	Body Weight	Exposure Route	No-Effects Dose Concentration	Lowest Observed Effects Dose Concentration	Ingestion Rate	Endpoint	Duration of Study	Uncertainty Factor	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference
Aluminum	Birds	Ringed dove	0.155 [a]	oral in diet	1,000 ppm	-	0.0173 kg dw/day[b]	reproduction	4 months	-	124	-	Carriere *et al.* (1986)
	Mammals	Mouse	0.03 [c]	oral in water	-	19.3 mg/kg bw-day	-	reproduction	3 generations	0.1 [d]	1.93	19.3	Ondreicka *et al.* (1966)
Antimony	Mammals	Rat	0.33	oral in water	1 mg/L; 53.83% Sb by MW	10 mg/L; 53.83% Sb by MW	0.13 L/kg/day	reproduction	31 days during gestaion	-	0.07	0.72	Rossi *et al.* (1987)
Arsenic as Arsenate	Birds	Mallard duck	1.0 [h]	oral in diet	100 ppm	400 ppm	0.100 kg/day [h]	reproduction	4 weeks	-	10	40	Stanley *et al.* (1994)
	Mammals	Rabbit	-	oral in food	-	-	-	reproduction	18 days during gestaion	-	0.75	3.0	Nemec *et al.* (1998)
Barium	Birds	Chicks	0.121 [l]	oral in food	2,000 ppm	4,000 ppm	0.0126 kg/day [m]	mortality	4 weeks	0.1 [s]	21	42	Johnson *et al.* (1960)
	Mammals	Mouse	0.307	oral in water	61 mg/kg/day	121 mg/kg/day	-	growth	92 days	0.1 [s]	6.1	12	Dietz *et al.* (1992)
Beryllium	Mammals	Rat	0.35 [c]	oral in water	5 mg/L	-	0.046 L/day [f]	growth	lifespan	-	0.66	-	Schroeder and Mitchener (1975)
Cadmium	Birds	Mallard duck	1.153	oral in diet	15.2 ppm	210 ppm	0.11 kg/day	reproduction	90 days	-	1.45	20	White and Finley (1978)
	Mammals	Rat	0.303	oral gavage	1 mg/kg bw-day	10 mg/kg bw-day	-	reproduction	6 weeks through gestation	-	1.0	10	Sutou *et al.* (1980)
Chromium	Birds	Black duck	1.25	oral in diet	10 ppm	50 ppm	0.0785 kg/kg-day [k]	reproduction	10 months	-	0.86	4.32	Haseltine *et al.* (1985)
	Mammals	Mouse	0.0249	oral in food	-	100 ppm; 38.02% Cr3+	0.16 kg/kg/day	reproduction	35 days	0.1 [b]	0.596	5.96	Zahid *et al.* (1990)
Cobalt	Birds	Peking duck	0.5	oral in food	0.02% of diet	0.2% of diet	0.21 kg/kg/day	growth	8 days	0.1 [s]	4.1	41	Paulov (1971)
	Mammals	Rat	-	oral in diet	5 mg/kg bw-day	20 mg/kg bw-day	-	neurological tests, testicular atrophy	69 days	0.1 [s]	0.5	2.0	Nation *et al.* (1983)
Copper	Birds	Mallard duck	-	oral in food	218.5 ppm	420 ppm	0.26 kg/kg/day	growth	35 days	-	5.68	10.9	Foster (1999)
	Mammals	Mink	1.0 [m]	oral in diet	25 ppm and 60.5 ppm in food	50 ppm and 60.5 ppm in food	0.137 kg/kg bw/day	kit mortality	357 days	-	11.7	15.1	Aulerich *et al.* (1982)
Lead	Birds	American kestrel	0.13	oral in diet	50 ppm	-	0.01 kg/day [o]	reproduction	7 months	-	3.85	-	Pattee (1984)
	Birds	Japanese quail	0.15 [q]	oral in food	-	100 ppm	0.169 kg dw/kg/day	reproduction	12 weeks	-	-	11	Edens *et al.* (1976)
	Mammals	Rat	0.35 [c]	oral in diet	141 ppm	1130 ppm	0.028 kg/day [g]	weight of weanlings	3 generations	-	11	90	Azar *et al.* (1973)
Manganese	Birds	Turkey	0.45	oral in food	4080 ppm	4800 ppm	0.06 kg/kg/day	growth	21 days	0.1 [s]	26	30	Vohra and Kratzer (1968)
	Mammals	Rat	0.35 [e]	oral in diet	1,050 ppm and 50 ppm in food	3,050 ppm and 50 ppm in food	0.028 mg/kg-day [k]	reproduction	224 days	-	88	280	Laskey *et al.* (1982)
Mercury	Birds	Japanese quail	0.15 [q]	oral in diet	4.4 ppm dw	838 ppm dw	0.168 mg/kg-day [k]	reproduction	1 year	-	0.74	1.5	Hill and Shaffner (1976)
	Mammals	Mink	1.0 [m]	oral in diet	7.39 ppm	-	0.137 kg/day [n]	reproduction	6 months over gestation	-	1.0	-	Aulerich *et al.* (1974)
	Mammals	Mouse	0.03 [c]	oral in water	-	75 ppm	0.0075 L/day [f]	body mass, kidney function	7 weeks	-	-	18.8	Dieter *et al.* (1983)
Methylmercury	Birds	Mallard duck	1.0	oral in diet	-	0.5 ppm	0.128 kg/kg/day	duckling survival	3 generations	0.5	0.032	0.5	Heinz (1974, 1976a,b, 1979)
	Mammals		0.35	oral in diet	0.5 ppm	2.5 ppm	0.028 kg/day [c]	reproduction	3 generations	-	0.032	0.16	Vershuuren *et al.* (1976)
Nickel	Birds	Mallard duck	0.782	oral in food	176 ppm	774 ppm	0.17 kg/kg/day	mortality	90 days	-	31	135	Cain and Pafford (1981)
	Mammals	Rat	0.35 [c]	oral in diet	500 ppm	1,000 ppm	0.028 kg/day [g]	offspring body weight	3 generations	-	40	80	Ambrose *et al.* (1976)
Selenium	Birds	Mallard duck	1.043	oral in diet	3.5 ppm dry wt.	7 ppm dry wt.	0.05 kg dw/kg/day	reproduction	122 days	-	0.2	0.4	Stanley *et al.* (1996)
	Mammals	Rat	0.35 [c]	oral in water	1.5 mg/L	2.5 mg/L	0.046 L/day [f]	reproduction	2 generations	-	0.2	0.33	Rosenfeld and Beath (1954)
Silver	Birds	Turkey	0.411	oral in food	300 ppm	900 ppm	0.23 kg/kg/day	growth	4 weeks	0.1 [s]	6.8	21	Jensen *et al.* (1974)
	Mammals	Rat	0.2	oral in food	-	50 mg/organism/day; 75.2% Ag by MW	-	reproduction	20 days during gestation	0.1 [d]	18.8	188	Shavlovski *et al.* (1995)
Thallium	Birds	Ring-necked pheasant	-	acute oral gavage	-	23.7 mg/kg bw	-	mortality	-	0.01 [d], 0.1	0.237	23.7	Hudson *et al.* (1984)
	Mammals	Rat	0.365	oral in water	-	270 ug/rat/day	-	reproduction	60 days	0.1 [d]	0.074	0.74	Formigli *et al.* (1986)
Vanadium	Birds	Mallard duck	1.17	oral in diet	110 ppm	-	0.121 kg/day	mortality, body weight	12 weeks	-	11	-	White and Dieter (1978)
	Mammals	Rat	0.26	oral intubation	-	2.09 mg/kg-day	-	reproduction	>60 days	0.1 [d]	0.209	2.09	Domingo *et al.* (1986)
Zinc	Birds	White leghorn hen	1.766	oral in diet	2,000 ppm	-	0.114 g/day	reproduction	44 weeks	-	130	-	Stahl *et al.* (1990)
	Mammals	Sprague-Dawley rat	0.35 [c]	oral in diet	2,000 ppm	4,000 ppm	0.028 kg/day [g]	reproduction	16 days during gestation	-	160	320	Schlicker and Cox (1968)

Table C-10. Wildlife Toxicity Reference Values

Notes:

Toxicity values will be develop for amphbians during the BERA, depending on the availability of toxicity information (see Section 6.4)

Dose concentrations and ingestion rates are expressed in wet weight unless otherwise noted.

bw - Body weight
dw - Dry weight
ww - Wet weight
UF - Uncertainty factor
TRV - Toxicity reference value
LOAEL - Lowest observed adverse effect level
NOAEL - No observed adverse effect level

[a] *Terres (1980).*

[b] *Nagy (1987).*

[c] *US EPA (1988).*

[d] *LOAEL to NOAEL UF.*

[e] *US EPA (1995).*

[f] *Calder and Braun (1983).*

[g] *Calculated using allometric equation from US EPA (1988).*

[h] *Heinz et al. (1989).*

[i] *US EPA (1988), mean at 14 days.*

[k] *Based on an reasonable maximum exposure of 430 kcal/kg-day derived from Nagy (1987), an assimilation efficiency of 80 percent, and an energy content of 3,190 kcal/kg dry weight.*

[l] *US EPA (1988), mean at 5 weeks.*

[m] *US EPA (1993).*

[n] *Based on the observations of Bleavins and Aulerich (1981).*

[o] *Sample et al. (1996).*

[p] *Shellenberger (1978), for 3-week old male quail.*

[q] *Vos et al. (1971).*

[r] *LOAEL to NOAEL UF, recommended by US EPA (1995).*

[s] *Subchronic to chronic UF.*

Table C-11. Wildlife Screening Benchmarks for Sediment and Aquatic Tissues

			Media =	**Sediment**	**Benthic Invertebrate Tissue**	**Fish Tissue**	**Fish Tissue**
Metal	**Avian NOAEL (mg/kg-d)**	**Mammalian NOAEL (mg/kg-d)**	**Receptor =** **Units =**	**Sandpiper** **mg/kg-dw**	**Sandpiper** **mg/kg-ww**	**Belted Kingfisher** **mg/kg-ww**	**Mink** **mg/kg-ww**
Aluminum	124	1.93		3976	195	218	11
Antimony	none	0.07		none	none	none	0.4
Arsenic	10	0.75		321	16	18	4.2
Barium	21	6.1		673	33	37	34
Beryllium	none	0.66		none	none	none	3.7
Cadmium	1.45	1.0		46	2.3	2.5	5.6
Chromium	0.86	0.596		28	1.4	1.5	3.3
Cobalt	4.1	0.5		131	6.5	7.2	2.8
Copper	5.68	11.7		182	9.0	10	65
Iron	none	none		none	none	none	none
Lead	3.85	11		123	6.1	6.8	61
Manganese	26	88		834	41	46	490
Mercury	0.74	1.0		24	1.2	1.3	5.6
Methylmercury	0.032	0.032		1.0	0.1	0.1	0.2
Nickel	31	40		994	49	54	223
Selenium	0.2	0.2		6.4	0.3	0.4	1.1
Silver	6.8	18.8		218	11	12	105
Thallium	0.237	0.074		7.6	0.4	0.4	0.4
Vanadium	11	0.209		353	17	19	1.2
Zinc	130	160		4168	205	229	890

Notes: *Sediment Screening Level (mg/kg-dw) = NOAEL / (IR x DP / BW)*
Tissue Screening Level (mg/kg-ww) = NOAEL / (IR x DP / BW)

Parameter	*Sandpiper*	*Sandpiper*	*Belted Kingfisher*	*Mink*
BW – Body Weight (g)	*52*	*52*	*150*	*550*
IR - Food Ingestion Rate (g-/day dw)	*9.01*	*9.01*	*23.53*	*29.52*
IR - Food Ingestion Rate (g-/day ww)	*33*	*33*	*85.33*	*98.86*
DP - Assumed Diet Proportion	*18% of food ingestion rate includes sediment*	*100% Benthic Invertebrates*	*100% Fish*	*100% Fish*

Appendix D

Screening Ecological Risk Assessment Tables

Table D-1. Dissolved Metals Surface Water Screening Results

	Dissolved Surface Water Benchmark(b)		Maximum Dissolved Concentration (ug/L) for Each CSM Unit								
	Acute	Chronic	PPC		UL/ULM		WD		LL		COPC
Metal	**(ug/L)**	**(ug/L)**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	750	87	U	50-200	U	50-200	U	50	U	50-200	n
Antimony	900	190	U	1-60	U	3-60	U	3	428	-	**Y**
Arsenic	340	150	50	5-15	8.8	5-15	10.5	-	217	-	**Y**
Barium	2000	220	50	100-200	44	100	U	100	43	100	n
Beryllium	93	11	0.2	1-5	U	1-5	U	1	U	1-5	n
Cadmium[a]	2.0	0.25	0.9	0.1-2.1	1.1	0.1-4	2	0.5	40	1-2.6	**Y**
Chromium (III)[a]	570.0	74	0.9	1-10	2.1	1-10	U	1	0.8	1-10	n
Chromium (IV)	16.0	11	0.9	1-10	2.1	1-10	U	1	0.8	1-10	n
Cobalt	220	24	U	0.5-50	2	0.5-50	U	0.5	U	0.5-50	n
Copper[a]	14	9	5	4-25	12	4	7	4	50	-	**Y**
Iron	na	1000	190	20-200	230	20	90	-	350	20	n
Lead[a]	65	2.5	1.6	0.5-10	8	10	20	5	76	5	**Y**
Manganese[a]	2986	1650	110	-	1940	10	50	-	400	-	**Y**
Mercury	1.4	0.77	0.2	0.1-6	0.01	0.01-1	U	0.01	0.05	0.1-6	n
Nickel[a]	468	52.0	10	10-40	U	10-40	U	10	4.4	10	n
Selenium	20	4.61	9.3	1-35	U	1-35	U	1-10	52	-	**Y**
Silver[a]	3.2	0.36	1.3	0.5-5	1.1	0.5-10	U	0.5	1.4	0.5-10	**Y**
Thallium	79	17	U	0.2-25	U	0.2-25	U	0.2	73	-	**Y**
Vanadium	150	44	3.9	10-100	2.1	10-100	U	100	U	10-100	n
Zinc[a]	117	118	137	20	139	10-60	20	20	200	10-20	**Y**

Notes:
PPC = Prickly Pear Creek
UL/ULM = Upper Lake and Upper Lake Marsh
WD = Wilson Ditch
LL = Lower Lake
U = Undetected
DT = Maximum detected value
ND = Range of detection limits
COPC (Y/N) = Metal is considered a COPC if concentrations exceed acute or chronic dissolved surface water benchmarks (highlighted).
(a) Criterion is shown at a hardness of 100 mg/L as $CaCO_3$, however screening was conducted on a sample-specific basis (see Table D-2).
(b) Benchmarks from Table C-1.

Table D-2. Hardness-Based Dissolved Metals Surface Water Screening Results

			Hardness [a]	Cd		Cd-SWB		Cr			Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]	Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch
Lower Lake	2003	LL_1	190	6.9		3.8	0.4	0.84		-	963.8	125.4	20.2		24.6	15.5	17.5		128.9	5.0	199		3697	2043	2.8		805.9	89.5	1.4		9.7	0.36	70.1		201.9	203.5
Lower Lake	2003	LL_2	200	6.6		3.9	0.4	5	U	-	1005.2	130.8	20.7		25.8	16.2	23.6		136.1	5.3	204		3761	2078	3.7		841.7	93.5	5	U	10.6	0.36	84.8		210.8	212.5
Lower Lake	2003	LL_3	207	6.8		4.1	0.4	5	U	-	1033.9	134.5	21.3		26.7	16.7	22.7		141.2	5.5	207		3804	2102	4.4		866.5	96.2	0.72		11.2	0.36	103		217.1	218.8
Lower Lake	5/10/2000	Lower Lake	608.0	40		11.6	0.9	nm		-	2498.7	325.0	50		73.6	41.9	30		429.0	16.7	400		5447	3010	nm		2156.0	239.5	nm		71.7	0.36	200		540.8	545.3
Lower Lake	10/31/2000	Lower Lake	457.0	20		8.8	0.7	nm		-	1977.8	257.3	20		56.3	32.8	40		321.8	12.5	400		4953	2737	nm		1693.5	188.1	nm		43.9	0.36	100		424.6	428.1
Lower Lake	5/3/2001	Lower Lake	254.8	6		5.0	0.5	nm		-	1225.7	159.4	5		32.4	19.9	10		175.8	6.9	300		4077	2253	nm		1033.0	114.7	nm		16.1	0.36	100		258.8	261.0
Lower Lake	11/16/2001	Lower Lake	278.5	10		5.4	0.5	nm		-	1318.1	171.5	20		35.3	21.5	2.5	U	193.0	7.5	300		4199	2320	nm		1113.6	123.7	nm		18.7	0.36	50		279.1	281.3
Lower Lake	11/7/2002	Lower Lake	229.4	1		4.5	0.4	nm		-	1124.5	146.3	20		29.4	18.2	2.5	U	157.4	6.1	200		3937	2175	nm		945.1	105.0	nm		13.4	0.36	10	U	236.8	238.7
Lower Lake	4/30/2003	Lower Lake	203.6	0.5	U	4.0	0.4	nm		-	1020.0	132.7	8		26.3	16.4	2.5	U	138.7	5.4	400		3784	2090	nm		854.5	94.9	nm		10.9	0.36	10	U	214.0	215.8
Lower Lake	10/22/2003	Lower Lake	211.0	10		4.2	0.4	nm		-	1050.4	136.6	26		27.2	17.0	76		144.1	5.6	250		3829	2116	nm		880.8	97.8	nm		11.6	0.36	88		220.6	222.4
Lower Lake	4/27/2004	Lower Lake	192.7	7		3.8	0.4	nm		-	975.2	126.8	18		24.9	15.7	20	J	130.9	5.1	180		3715	2053	nm		815.7	90.6	nm		9.9	0.36	30		204.3	206.0
Lower Lake	11/4/2004	Lower Lake	161.2	2		3.2	0.3	nm		-	842.2	109.6	10		21.1	13.5	8		108.1	4.2	270		3500	1934	nm		701.1	77.9	nm		7.3	0.36	20		175.6	177.0
Lower Lake	6/9/2005	Lower Lake	157.8	6		3.1	0.3	nm		-	827.7	107.7	12		20.7	13.2	2.5	U	105.7	4.1	20		3475	1920	nm		688.7	76.5	nm		7.0	0.36	5	U	172.4	173.9
Lower Lake	11/21/2005	Lower Lake	147.8	0.5	U	2.9	0.3	nm		-	784.6	102.1	9		19.4	12.5	2.5	U	98.5	3.8	90		3401	1879	nm		651.6	72.4	nm		6.3	0.36	10	U	163.2	164.5
Lower Lake	5/12/2006	Lower Lake	127.8	0.5	U	2.6	0.3	nm		-	696.6	90.6	4		16.9	11.0	2.5	U	84.3	3.3	10		3240	1790	nm		576.3	64.0	nm		4.9	0.36	10	U	144.3	145.4
Lower Lake	6/6/2007	Lower Lake	113.7	0.5	U	2.3	0.3	0.5	U	-	633.0	82.3	8		15.2	10.0	2.5	U	74.3	2.9	10		3116	1722	5	U	522.0	58.0	2.5	U	4.0	0.36	5	U	130.7	131.7
Lower Lake	10/31/2007	Lower Lake	132.8	1		2.7	0.3	nm		-	718.8	93.5	7		17.6	11.4	2.5	U	87.8	3.4	130		3282	1813	nm		595.3	66.1	nm		5.2	0.36	5	U	149.0	150.2
Lower Lake	4/30/2008	Lower Lake	154.4	2		3.1	0.3	0.5	U	-	813.2	105.8	11		20.2	13.0	2.5	U	103.3	4.0	130		3451	1906	5	U	676.2	75.1	2.5	U	6.8	0.36	20		169.3	170.7
Lower Lake	10/24/2008	Lower Lake	125.3	1		2.5	0.3	nm		-	685.4	89.2	10		16.6	10.9	7		82.5	3.2	130		3219	1778	nm		566.7	62.9	nm		4.7	0.36	10	U	141.9	143.0
Lower Lake	5/1/2009	Lower Lake	139.4	2.6	UJ	2.8	0.3	0.5	U	-	748.0	97.3	10		18.4	11.9	2.1		92.6	3.6	70		3335	1843	5	U	620.2	68.9	0.5	J	5.7	0.36	5	U	155.3	156.6
Lower Lake	10/29/2009	Lower Lake	121.9	0.5	U	2.4	0.3	0.5	U	-	670.3	87.2	7		16.2	10.6	2.5	U	80.1	3.1	110		3190	1762	5	U	553.8	61.5	5	UJ	4.5	0.36	5	U	138.6	139.8
Lower Lake	8/3/2010	LL-21	105.3	0.4		2.1	0.3	0.5	U	-	594.6	77.3	6		14.1	9.4	1.4		68.3	2.7	260		3038	1678	5	U	489.3	54.3	0.25	U	3.5	0.36	5	U	122.5	123.5
Lower Lake	8/3/2010	LL-22	107.8	0.6		2.2	0.3	0.5	U	-	606.1	78.8	6		14.4	9.6	1.8		70.1	2.7	280		3062	1692	5	U	499.1	55.4	0.25	U	3.7	0.36	5	U	124.9	125.9
Lower Lake	8/3/2010	LL-23	102.8	0.4		2.1	0.3	0.5	U	-	583.0	75.8	5		13.8	9.2	1.3		66.6	2.6	270		3014	1665	5	U	479.5	53.3	0.25	U	3.4	0.36	5	U	120.0	121.0
Lower Lake	8/3/2010	LL-24	102.8	0.4		2.1	0.3	0.5	U	-	583.0	75.8	5		13.8	9.2	1.3		66.6	2.6	260		3014	1665	5	U	479.5	53.3	0.25	U	3.4	0.36	5	U	120.0	121.0
Lower Lake	8/3/2010	LL-25	105.3	0.4		2.1	0.3	0.5	U	-	594.6	77.3	5		14.1	9.4	1.7		68.3	2.7	280		3038	1678	5	U	489.3	54.3	0.25	U	3.5	0.36	5	U	122.5	123.5
Prickly Pear Creek	2003	PPC_2	114	0.1		2.3	0.3	5	U	-	634.3	82.5	12.5	U	15.2	10.0	5	U	74.5	2.9	34.8		3119	1723	20	U	523.1	58.1	-	R	4.0	0.36	137		130.9	132.0
Prickly Pear Creek	2003	PPC_3	118	0.23		2.4	0.3	0.85		-	652.5	84.9	3.4		15.7	10.3	5	U	77.3	3.0	73.4		3155	1743	20	U	538.6	59.8	0.69		4.3	0.36	130		134.8	135.9
Prickly Pear Creek	2003	PPC_4	118	0.17		2.4	0.3	5	U	-	652.5	84.9	12.5	U	15.7	10.3	5	U	77.3	3.0	37.6		3155	1743	20	U	538.6	59.8	0.69		4.3	0.36	71.3		134.8	135.9
Prickly Pear Creek	2003	PPC_5	141	0.5	U	2.8	0.3	5	U	-	754.9	98.2	12.5	U	18.6	12.0	5	U	93.7	3.7	13.3		3348	1850	20	U	626.2	69.6	1.3		5.8	0.36	113		156.8	158.1
Prickly Pear Creek	5/10/2000	PPC-101	86.3	0.5	U	1.7	0.2	nm		-	505.0	65.7	2	U	11.7	7.9	2.5	U	55.0	2.1	70		2843	1571	nm		413.4	45.9	nm		2.5	0.36	30		103.4	104.3
Prickly Pear Creek	5/10/2000	PPC-102	86.3	0.5	U	1.7	0.2	nm		-	505.0	65.7	2	U	11.7	7.9	2.5	U	55.0	2.1	60		2843	1571	nm		413.4	45.9	nm		2.5	0.36	30		103.4	104.3
Prickly Pear Creek	5/10/2000	PPC-103	86.7	0.5	U	1.8	0.2	nm		-	507.0	65.9	2	U	11.7	7.9	2.5	U	55.3	2.2	50		2847	1573	nm		415.0	46.1	nm		2.5	0.36	30		103.8	104.7
Prickly Pear Creek	5/10/2000	PPC-3A	86.3	0.5	U	1.7	0.2	nm		-	505.0	65.7	2	U	11.7	7.9	2.5	U	55.0	2.1	30		2843	1571	nm		413.4	45.9	nm		2.5	0.36	30		103.4	104.3
Prickly Pear Creek	5/10/2000	PPC-5	86.7	0.5	U	1.8	0.2	nm		-	507.0	65.9	2	U	11.7	7.9	2.5	U	55.3	2.2	70		2847	1573	nm		415.0	46.1	nm		2.5	0.36	40		103.8	104.7
Prickly Pear Creek	5/10/2000	PPC-7	86.3	0.5	U	1.7	0.2	nm		-	505.0	65.7	2	U	11.7	7.9	2.5	U	55.0	2.1	60		2843	1571	nm		413.4	45.9	nm		2.5	0.36	40		103.4	104.3
Prickly Pear Creek	5/10/2000	PPC-8	88.8	0.5	U	1.8	0.2	nm		-	516.9	67.2	2	U	12.0	8.1	2.5	U	56.7	2.2	60		2870	1586	nm		423.4	47.0	nm		2.6	0.36	40		106.0	106.8
Prickly Pear Creek	10/31/2000	PPC-101	100.0	0.5	U	2.0	0.2	nm		-	569.7	74.1	2	U	13.4	9.0	2.5	U	64.6	2.5	90		2986	1650	nm		468.2	52.0	nm		3.2	0.36	10	U	117.2	118.1
Prickly Pear Creek	10/31/2000	PPC-102	104.5	0.5	U	2.1	0.3	nm		-	590.9	76.9	2	U	14.0	9.3	2.5	U	67.8	2.6	100		3030	1674	nm		486.2	54.0	nm		3.5	0.36	10	U	121.7	122.7
Prickly Pear Creek	10/31/2000	PPC-103	100.4	0.5	U	2.0	0.2	nm		-	571.6	74.4	2	U	13.5	9.0	2.5	U	64.9	2.5	80		2990	1652	nm		469.8	52.2	nm		3.2	0.36	20		117.6	118.5
Prickly Pear Creek	10/31/2000	PPC-3A	97.1	0.5	U	2.0	0.2	nm		-	556.1	72.3	2	U	13.1	8.7	2.5	U	62.5	2.4	20		2956	1633	nm		456.6	50.7	nm		3.1	0.36	10	U	114.3	115.2
Prickly Pear Creek	10/31/2000	PPC-5	100.4	0.5	U	2.0	0.2	nm		-	571.6	74.4	2	U	13.5	9.0	2.5	U	64.9	2.5	70		2990	1652	nm		469.8	52.2	nm		3.2	0.36	20		117.6	118.5
Prickly Pear Creek	10/31/2000	PPC-7	100.0	0.5	U	2.0	0.2	nm		-	569.7	74.1	2	U	13.4	9.0	2.5	U	64.6	2.5	60		2986	1650	nm		468.2	52.0	nm		3.2	0.36	40		117.2	118.1
Prickly Pear Creek	10/31/2000	PPC-8	103.3	0.5	U	2.1	0.3	nm		-	585.2	76.1	2	U	13.9	9.2	2.5	U	66.9	2.6	50		3018	1668	nm		481.3	53.5	nm		3.4	0.36	40		120.5	121.4
Prickly Pear Creek	5/3/2001	PPC-101	55.2	0.5	U	1.1	0.2	nm		-	350.4	45.6	2	U	7.7	5.4	2.5	U	33.7	1.3	30		2450	1354	nm		283.4	31.5	nm		1.2	0.36	30		70.9	71.4
Prickly Pear Creek	5/3/2001	PPC-102	50.2	0.5	U	1.0	0.2	nm		-	324.2	42.2	2	U	7.0	5.0	2.5	U	30.3	1.2	30		2374	1312	nm		261.6	29.1	nm		1.0	0.36	30		65.4	65.9
Prickly Pear Creek	5/3/2001	PPC-103	55.2	0.5	U	1.1	0.2	nm		-	350.4	45.6	2	U	7.7	5.4	2.5	U	33.7	1.3	30		2450	1354	nm		283.4	31.5	nm		1.2	0.36	30		70.9	71.4
Prickly Pear Creek	5/3/2001	PPC-3A	55.2	0.5	U	1.1	0.2	nm		-	350.4	45.6	2	U	7.7	5.4	2.5	U	33.7	1.3	20		2450	1354	nm		283.4	31.5	nm		1.2	0.36	30		70.9	71.4
Prickly Pear Creek	5/3/2001	PPC-5	55.2	0.5	U	1.1	0.2	nm		-	350.4	45.6	2	U	7.7	5.4	2.5	U	33.7	1.3	30		2450	1354	nm		283.4	31.5	nm		1.2	0.36	30		70.9	71.4
Prickly Pear Creek	5/3/2001	PPC-7	55.2	0.5	U	1.1	0.2	nm		-	350.4	45.6	2	U	7.7	5.4	2.5	U	33.7	1.3	30		2450	1354	nm		283.4	31.5	nm		1.2	0.36	30		70.9	71.4
Prickly Pear Creek	5/3/2001	PPC-8	55.2	0.5	U	1.1	0.2	nm		-	350.4	45.6	2	U	7.7	5.4	2.5	U	33.7	1.3	30		2450	1354	nm		283.4	31.5	nm		1.2	0.36	40		70.9	71.4
Prickly Pear Creek	11/16/2001	PPC-101	105.0	0.5	U	2.1	0.3	nm		-	592.8	77.1	2	U	14.1	9.3	2.5	U	68.1	2.7	90		3034	1676	nm		487.8	54.2	nm		3.5	0.36	20		122.1	123.1
Prickly Pear Creek	11/16/2001	PPC-102	107.0	0.5	U	2.2	0.3	nm		-	602.4	78.4	2	U	14.3	9.5	2.5	U	69.5	2.7	80		3054	1687	nm		496.0	55.1	nm		3.6	0.36	20		124.1	125.2
Prickly Pear Creek	11/16/2001	PPC-103	107.9	0.5	U	2.2	0.3	nm		-	606.2	78.9	2	U	14.4	9.6	2.5	U	70.1	2.7	80		3062	1692	nm		499.2	55.4	nm		3.7	0.36	10	U	124.9	126.0
Prickly Pear Creek	11/16/2001	PPC-3A	104.5	0.5	U	2.1	0.3	nm		-	590.9	76.9	2	U	14.0	9.3	2.5	U	67.8	2.6	20		3030	1674	nm		486.2	54.0	nm		3.5	0.36	20		121.7	122.7

Table D-2. Hardness-Based Dissolved Metals Surface Water Screening Results

			Hardness [a]	Cd		Cd-SWB		Cr			Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]	Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch
Prickly Pear Creek	11/16/2001	PPC-5	107.9	0.5	U	2.2	0.3	nm		-	606.2	78.9	2	U	14.4	9.6	2.5	U	70.1	2.7	90		3062	1692	nm		499.2	55.4	nm		3.7	0.36	20		124.9	126.0
Prickly Pear Creek	11/16/2001	PPC-7	107.9	0.5	U	2.2	0.3	nm		-	606.2	78.9	2	U	14.4	9.6	2.5	U	70.1	2.7	80		3062	1692	nm		499.2	55.4	nm		3.7	0.36	30		124.9	126.0
Prickly Pear Creek	11/16/2001	PPC-8	110.4	0.5	U	2.2	0.3	nm		-	617.7	80.3	2	U	14.7	9.7	2.5	U	71.9	2.8	70		3085	1705	nm		509.0	56.5	nm		3.8	0.36	20		127.4	128.4
Prickly Pear Creek	11/6/2002	PPC-101	200.0	0.5	U	3.9	0.4	nm		-	1005.0	130.7	2	U	25.8	16.2	2.5	U	136.1	5.3	20		3761	2078	nm		841.5	93.5	nm		10.6	0.36	10	U	210.8	212.5
Prickly Pear Creek	11/6/2002	PPC-102	106.2	0.5	U	2.1	0.3	nm		-	598.6	77.9	2	U	14.2	9.4	2.5	U	69.0	2.7	60		3046	1683	nm		492.8	54.7	nm		3.6	0.36	20		123.3	124.3
Prickly Pear Creek	11/6/2002	PPC-103	103.7	0.5	U	2.1	0.3	nm		-	587.1	76.4	2	U	13.9	9.2	2.5	U	67.2	2.6	60		3022	1670	nm		482.9	53.6	nm		3.4	0.36	20		120.9	121.9
Prickly Pear Creek	11/6/2002	PPC-5	110.0	0.5	U	2.2	0.3	nm		-	615.8	80.1	2	U	14.7	9.7	2.5	U	71.6	2.8	60		3082	1703	nm		507.4	56.4	nm		3.8	0.36	10	U	127.0	128.0
Prickly Pear Creek	11/6/2002	PPC-7	110.0	0.5	U	2.2	0.3	nm		-	615.8	80.1	2	U	14.7	9.7	2.5	U	71.6	2.8	60		3082	1703	nm		507.4	56.4	nm		3.8	0.36	30		127.0	128.0
Prickly Pear Creek	11/6/2002	PPC-8	110.4	0.5	U	2.2	0.3	nm		-	617.7	80.3	2	U	14.7	9.7	2.5	U	71.9	2.8	50		3085	1705	nm		509.0	56.5	nm		3.8	0.36	30		127.4	128.4
Prickly Pear Creek	11/7/2002	PPC-3A	100.4	0.5	U	2.0	0.2	nm		-	571.6	74.4	2	U	13.5	9.0	2.5	U	64.9	2.5	30		2990	1652	nm		469.8	52.2	nm		3.2	0.36	20		117.6	118.5
Prickly Pear Creek	4/30/2003	PPC-103	62.7	0.5	U	1.3	0.2	nm		-	388.9	50.6	2	U	8.7	6.0	2.5	U	38.7	1.5	60		2556	1412	nm		315.6	35.1	nm		1.4	0.36	40		78.9	79.6
Prickly Pear Creek	4/30/2003	PPC-3A	62.7	0.5	U	1.3	0.2	nm		-	388.9	50.6	2	U	8.7	6.0	2.5	U	38.7	1.5	30		2556	1412	nm		315.6	35.1	nm		1.4	0.36	40		78.9	79.6
Prickly Pear Creek	4/30/2003	PPC-5	62.7	0.5	U	1.3	0.2	nm		-	388.9	50.6	2	U	8.7	6.0	2.5	U	38.7	1.5	40		2556	1412	nm		315.6	35.1	nm		1.4	0.36	40		78.9	79.6
Prickly Pear Creek	4/30/2003	PPC-7	62.7	0.5	U	1.3	0.2	nm		-	388.9	50.6	2	U	8.7	6.0	2.5	U	38.7	1.5	40		2556	1412	nm		315.6	35.1	nm		1.4	0.36	40		78.9	79.6
Prickly Pear Creek	4/30/2003	PPC-8	62.7	0.5	U	1.3	0.2	nm		-	388.9	50.6	2	U	8.7	6.0	2.5	U	38.7	1.5	40		2556	1412	nm		315.6	35.1	nm		1.4	0.36	40		78.9	79.6
Prickly Pear Creek	10/22/2003	PPC-103	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	110		3175	1754	nm		547.6	60.8	nm		4.4	0.36	10	U	137.1	138.2
Prickly Pear Creek	10/22/2003	PPC-3A	117.8	0.5	U	2.4	0.3	nm		-	651.7	84.8	2	U	15.7	10.3	2.5	U	77.2	3.0	28		3153	1742	nm		537.9	59.7	nm		4.3	0.36	10	U	134.7	135.8
Prickly Pear Creek	10/22/2003	PPC-5	120.7	0.5	U	2.4	0.3	nm		-	664.8	86.5	2	U	16.0	10.5	2.5	U	79.2	3.1	110		3179	1756	nm		549.2	61.0	nm		4.4	0.36	10	U	137.5	138.6
Prickly Pear Creek	10/22/2003	PPC-7	117.8	0.5	U	2.4	0.3	nm		-	651.7	84.8	2	U	15.7	10.3	2.5	U	77.2	3.0	62		3153	1742	nm		537.9	59.7	nm		4.3	0.36	44		134.7	135.8
Prickly Pear Creek	10/22/2003	PPC-8	121.1	0.5	U	2.4	0.3	nm		-	666.7	86.7	2	U	16.1	10.6	2.5	U	79.5	3.1	47		3183	1758	nm		550.7	61.2	nm		4.5	0.36	50		137.9	139.0
Prickly Pear Creek	4/29/2004	PPC-103	89.6	0.5	U	1.8	0.2	nm		-	520.8	67.8	2	U	12.1	8.2	2.5	U	57.3	2.2	70		2879	1590	nm		426.8	47.4	nm		2.7	0.36	30		106.8	107.7
Prickly Pear Creek	4/29/2004	PPC-3A	87.1	0.5	U	1.8	0.2	nm		-	508.9	66.2	2	U	11.8	8.0	2.5	U	55.6	2.2	30		2852	1576	nm		416.7	46.3	nm		2.5	0.36	20		104.3	105.1
Prickly Pear Creek	4/29/2004	PPC-5	87.1	0.5	U	1.8	0.2	nm		-	508.9	66.2	2	U	11.8	8.0	2.5	U	55.6	2.2	60		2852	1576	nm		416.7	46.3	nm		2.5	0.36	30		104.3	105.1
Prickly Pear Creek	4/29/2004	PPC-7	87.1	0.5	U	1.8	0.2	nm		-	508.9	66.2	5		11.8	8.0	2.5	U	55.6	2.2	60		2852	1576	nm		416.7	46.3	nm		2.5	0.36	40		104.3	105.1
Prickly Pear Creek	4/29/2004	PPC-8	87.1	0.5	U	1.8	0.2	nm		-	508.9	66.2	2	U	11.8	8.0	2.5	U	55.6	2.2	50		2852	1576	nm		416.7	46.3	nm		2.5	0.36	30		104.3	105.1
Prickly Pear Creek	11/4/2004	PPC-103	103.7	0.5	U	2.1	0.3	nm		-	587.1	76.4	2	U	13.9	9.2	2.5	U	67.2	2.6	70		3022	1670	nm		482.9	53.6	nm		3.4	0.36	30		120.9	121.9
Prickly Pear Creek	11/4/2004	PPC-3A	106.2	0.5	U	2.1	0.3	nm		-	598.6	77.9	2	U	14.2	9.4	2.5	U	69.0	2.7	30		3046	1683	nm		492.8	54.7	nm		3.6	0.36	30		123.3	124.3
Prickly Pear Creek	11/4/2004	PPC-5	103.7	0.5	U	2.1	0.3	nm		-	587.1	76.4	2	U	13.9	9.2	2.5	U	67.2	2.6	60		3022	1670	nm		482.9	53.6	nm		3.4	0.36	20		120.9	121.9
Prickly Pear Creek	11/4/2004	PPC-7	101.2	0.5	U	2.0	0.2	nm		-	575.5	74.9	2	U	13.6	9.0	2.5	U	65.4	2.6	60		2998	1656	nm		473.1	52.5	nm		3.3	0.36	50		118.4	119.4
Prickly Pear Creek	11/4/2004	PPC-8	101.2	0.5	U	2.0	0.2	nm		-	575.5	74.9	2	U	13.6	9.0	2.5	U	65.4	2.6	60		2998	1656	nm		473.1	52.5	nm		3.3	0.36	40		118.4	119.4
Prickly Pear Creek	6/9/2005	PPC-103	49.8	0.5	U	1.0	0.2	nm		-	321.9	41.9	2	U	7.0	4.9	2.5	U	30.0	1.2	20		2367	1308	nm		259.6	28.8	nm		1.0	0.36	30		64.9	65.4
Prickly Pear Creek	6/9/2005	PPC-3A	52.3	0.5	U	1.1	0.2	nm		-	335.1	43.6	2	U	7.3	5.1	2.5	U	31.7	1.2	20		2406	1329	nm		270.6	30.1	nm		1.1	0.36	40		67.7	68.2
Prickly Pear Creek	6/9/2005	PPC-5	49.8	0.5	U	1.0	0.2	nm		-	321.9	41.9	2	U	7.0	4.9	2.5	U	30.0	1.2	20		2367	1308	nm		259.6	28.8	nm		1.0	0.36	30		64.9	65.4
Prickly Pear Creek	6/9/2005	PPC-7	52.3	0.5	U	1.1	0.2	nm		-	335.1	43.6	2	U	7.3	5.1	2.5	U	31.7	1.2	30		2406	1329	nm		270.6	30.1	nm		1.1	0.36	40		67.7	68.2
Prickly Pear Creek	6/9/2005	PPC-8	49.8	0.5	U	1.0	0.2	nm		-	321.9	41.9	2	U	7.0	4.9	2.5	U	30.0	1.2	20		2367	1308	nm		259.6	28.8	nm		1.0	0.36	40		64.9	65.4
Prickly Pear Creek	11/21/2005	PPC-103	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	90		3175	1754	nm		547.6	60.8	nm		4.4	0.36	50		137.1	138.2
Prickly Pear Creek	11/21/2005	PPC-3A	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	40		3175	1754	nm		547.6	60.8	nm		4.4	0.36	70		137.1	138.2
Prickly Pear Creek	11/21/2005	PPC-5	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	90		3175	1754	nm		547.6	60.8	nm		4.4	0.36	50		137.1	138.2
Prickly Pear Creek	11/21/2005	PPC-7	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	80		3175	1754	nm		547.6	60.8	nm		4.4	0.36	60		137.1	138.2
Prickly Pear Creek	11/21/2005	PPC-8	122.8	0.5	U	2.5	0.3	nm		-	674.2	87.7	2	U	16.3	10.7	2.5	U	80.7	3.1	70		3197	1766	nm		557.2	61.9	nm		4.6	0.36	60		139.5	140.6
Prickly Pear Creek	5/12/2006	PPC-103	80.5	0.5	U	1.6	0.2	nm		-	477.1	62.1	2	U	11.0	7.4	2.5	U	51.0	2.0	50		2778	1535	nm		389.8	43.3	nm		2.2	0.36	40		97.5	98.3
Prickly Pear Creek	5/12/2006	PPC-3A	78.0	0.5	U	1.6	0.2	nm		-	464.9	60.5	2	U	10.6	7.2	2.5	U	49.2	1.9	30		2749	1519	nm		379.5	42.2	nm		2.1	0.36	40		94.9	95.7
Prickly Pear Creek	5/12/2006	PPC-5	84.6	0.5	U	1.7	0.2	nm		-	496.9	64.6	2	U	11.5	7.8	2.5	U	53.8	2.1	40		2824	1560	nm		406.6	45.2	nm		2.4	0.36	40		101.7	102.6
Prickly Pear Creek	5/12/2006	PPC-7	80.5	0.5	U	1.6	0.2	nm		-	477.1	62.1	2	U	11.0	7.4	2.5	U	51.0	2.0	40		2778	1535	nm		389.8	43.3	nm		2.2	0.36	40		97.5	98.3
Prickly Pear Creek	5/12/2006	PPC-8	80.5	0.5	U	1.6	0.2	nm		-	477.1	62.1	2	U	11.0	7.4	2.5	U	51.0	2.0	40		2778	1535	nm		389.8	43.3	nm		2.2	0.36	40		97.5	98.3
Prickly Pear Creek	12/8/2006	PPC-103	121.2	0.5	U	2.4	0.3	nm		-	666.9	86.8	2	U	16.1	10.6	2.5	U	79.6	3.1	80		3183	1759	nm		550.9	61.2	nm		4.5	0.36	60		137.9	139.0
Prickly Pear Creek	12/8/2006	PPC-3A	118.7	0.5	U	2.4	0.3	nm		-	655.7	85.3	2	U	15.8	10.4	2.5	U	77.8	3.0	40		3161	1747	nm		541.3	60.1	nm		4.3	0.36	70		135.5	136.6
Prickly Pear Creek	12/8/2006	PPC-5	121.2	0.5	U	2.4	0.3	nm		-	666.9	86.8	2	U	16.1	10.6	2.5	U	79.6	3.1	90		3183	1759	nm		550.9	61.2	nm		4.5	0.36	70		137.9	139.0
Prickly Pear Creek	12/8/2006	PPC-7	127.8	0.5	U	2.6	0.3	nm		-	696.6	90.6	2	U	16.9	11.0	2.5	U	84.3	3.3	90		3240	1790	nm		576.3	64.0	nm		4.9	0.36	70		144.3	145.4
Prickly Pear Creek	12/8/2006	PPC-8	121.2	0.5	U	2.4	0.3	nm		-	666.9	86.8	2	U	16.1	10.6	2.5	U	79.6	3.1	80		3183	1759	nm		550.9	61.2	nm		4.5	0.36	70		137.9	139.0
Prickly Pear Creek	6/6/2007	PPC-103	52.3	0.5	U	1.1	0.2	0.5	U	-	335.1	43.6	2	U	7.3	5.1	2.5	U	31.7	1.2	40		2406	1329	5	U	270.6	30.1	2.5	U	1.1	0.36	40		67.7	68.2
Prickly Pear Creek	6/6/2007	PPC-3A	49.8	0.5	U	1.0	0.2	0.5	U	-	321.9	41.9	2	U	7.0	4.9	2.5	U	30.0	1.2	20		2367	1308	5	U	259.6	28.8	2.5	U	1.0	0.36	40		64.9	65.4
Prickly Pear Creek	6/6/2007	PPC-5	52.3	0.2		1.1	0.2	0.5	U	-	335.1	43.6	2	U	7.3	5.1	1.6		31.7	1.2	36		2406	1329	10		270.6	30.1	0.25	U	1.1	0.36	40		67.7	68.2
Prickly Pear Creek	6/6/2007	PPC-7	52.3	0.5	U	1.1	0.2	0.5	U	-	335.1	43.6	2	U	7.3	5.1	2.5	U	31.7	1.2	40		2406	1329	5	U	270.6	30.1	2.5	U	1.1	0.36	50		67.7	68.2
Prickly Pear Creek	6/6/2007	PPC-8	52.3	0.5	U	1.1	0.2	0.5	U	-	335.1	43.6	2	U	7.3	5.1	2.5	U	31.7	1.2	40		2406	1329	5	U	270.6	30.1	2.5	U	1.1	0.36	50		67.7	68.2

Table D-2. Hardness-Based Dissolved Metals Surface Water Screening Results

			Hardness [a]	Cd		Cd-SWB		Cr			Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]	Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch
Prickly Pear Creek	10/31/2007	PPC-103	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	90		3175	1754	nm		547.6	60.8	nm		4.4	0.36	30		137.1	138.2
Prickly Pear Creek	10/31/2007	PPC-3A	115.3	0.5	U	2.3	0.3	nm		-	640.4	83.3	2	U	15.4	10.1	2.5	U	75.4	2.9	20		3131	1730	nm		528.3	58.7	nm		4.1	0.36	40		132.2	133.3
Prickly Pear Creek	10/31/2007	PPC-5	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	90		3175	1754	nm		547.6	60.8	nm		4.4	0.36	30		137.1	138.2
Prickly Pear Creek	10/31/2007	PPC-7	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	80		3175	1754	nm		547.6	60.8	nm		4.4	0.36	30		137.1	138.2
Prickly Pear Creek	10/31/2007	PPC-8	120.3	0.5	U	2.4	0.3	nm		-	663.0	86.2	2	U	16.0	10.5	2.5	U	78.9	3.1	70		3175	1754	nm		547.6	60.8	nm		4.4	0.36	30		137.1	138.2
Prickly Pear Creek	4/30/2008	PPC-103	108.7	0.5	U	2.2	0.3	0.5	U	-	610.1	79.4	2	U	14.5	9.6	2.5	U	70.7	2.8	60		3070	1696	5	U	502.5	55.8	2.5	U	3.7	0.36	30		125.8	126.8
Prickly Pear Creek	4/30/2008	PPC-3A	97.1	0.5	U	2.0	0.2	0.5	U	-	556.2	72.4	2	U	13.1	8.7	2.5	U	62.6	2.4	30		2957	1634	5	U	456.8	50.7	2.5	U	3.1	0.36	30		114.3	115.2
Prickly Pear Creek	4/30/2008	PPC-5	108.7	0.5	U	2.2	0.3	0.5	U	-	610.1	79.4	2	U	14.5	9.6	2.5	U	70.7	2.8	60		3070	1696	5	U	502.5	55.8	2.5	U	3.7	0.36	30		125.8	126.8
Prickly Pear Creek	4/30/2008	PPC-7	108.7	0.5	U	2.2	0.3	0.5	U	-	610.1	79.4	2	U	14.5	9.6	2.5	U	70.7	2.8	50		3070	1696	5	U	502.5	55.8	2.5	U	3.7	0.36	30		125.8	126.8
Prickly Pear Creek	4/30/2008	PPC-8	108.7	0.5	U	2.2	0.3	0.5	U	-	610.1	79.4	2	U	14.5	9.6	2.5	U	70.7	2.8	50		3070	1696	5	U	502.5	55.8	2.5	U	3.7	0.36	30		125.8	126.8
Prickly Pear Creek	10/24/2008	PPC-103	94.6	0.5	U	1.9	0.2	nm		-	544.5	70.8	2	U	12.8	8.5	2.5	U	60.8	2.4	70		2931	1619	nm		446.8	49.6	nm		2.9	0.36	70		111.8	112.7
Prickly Pear Creek	10/24/2008	PPC-3A	92.1	0.5	U	1.9	0.2	nm		-	532.7	69.3	2	U	12.4	8.3	2.5	U	59.1	2.3	30		2905	1605	nm		436.8	48.5	nm		2.8	0.36	50		109.3	110.2
Prickly Pear Creek	10/24/2008	PPC-5	94.6	0.5	U	1.9	0.2	nm		-	544.5	70.8	2	U	12.8	8.5	2.5	U	60.8	2.4	80		2931	1619	nm		446.8	49.6	nm		2.9	0.36	60		111.8	112.7
Prickly Pear Creek	10/24/2008	PPC-7	94.6	0.5	U	1.9	0.2	nm		-	544.5	70.8	2	U	12.8	8.5	2.5	U	60.8	2.4	70		2931	1619	nm		446.8	49.6	nm		2.9	0.36	60		111.8	112.7
Prickly Pear Creek	10/24/2008	PPC-8	97.1	0.5	U	2.0	0.2	nm		-	556.2	72.4	2	U	13.1	8.7	2.5	U	62.6	2.4	80		2957	1634	nm		456.8	50.7	nm		3.1	0.36	60		114.3	115.2
Prickly Pear Creek	5/1/2009	PPC-103	78.0	2	UJ	1.6	0.2	0.5	U	-	464.9	60.5	2		10.6	7.2	0.7		49.2	1.9	40		2749	1519	5	U	379.5	42.2	0.5	J	2.1	0.36	50		94.9	95.7
Prickly Pear Creek	5/1/2009	PPC-103A	78.0	1.6	UJ	1.6	0.2	0.5	U	-	464.9	60.5	3		10.6	7.2	0.25	U	49.2	1.9	30		2749	1519	5	U	379.5	42.2	0.5	J	2.1	0.36	60		94.9	95.7
Prickly Pear Creek	5/1/2009	PPC-5	78.0	1.8	UJ	1.6	0.2	0.5	U	-	464.9	60.5	2		10.6	7.2	0.5		49.2	1.9	40		2749	1519	5	U	379.5	42.2	0.5	J	2.1	0.36	50		94.9	95.7
Prickly Pear Creek	5/1/2009	PPC-7	78.0	2.1	UJ	1.6	0.2	0.5	U	-	464.9	60.5	2		10.6	7.2	0.6		49.2	1.9	40		2749	1519	5	U	379.5	42.2	0.5	J	2.1	0.36	60		94.9	95.7
Prickly Pear Creek	5/1/2009	PPC-8	73.0	2	UJ	1.5	0.2	0.5	U	-	440.4	57.3	3		10.0	6.8	0.6		45.8	1.8	40		2689	1486	5	U	358.9	39.9	0.5	J	1.9	0.36	50		89.8	90.5
Prickly Pear Creek	10/29/2009	PPC-103	103.7	0.5	U	2.1	0.3	0.5	U	-	587.1	76.4	2		13.9	9.2	2.5	U	67.2	2.6	70		3022	1670	5	U	482.9	53.6	2.5	U	3.4	0.36	70		120.9	121.9
Prickly Pear Creek	10/29/2009	PPC-3A	101.2	0.5	U	2.0	0.2	0.5	U	-	575.5	74.9	1		13.6	9.0	2.5	U	65.4	2.6	50		2998	1656	5	U	473.1	52.5	2.5	U	3.3	0.36	80		118.4	119.4
Prickly Pear Creek	10/29/2009	PPC-5	101.2	0.5	U	2.0	0.2	0.5	U	-	575.5	74.9	2		13.6	9.0	2.5	U	65.4	2.6	70		2998	1656	5	U	473.1	52.5	2.5	U	3.3	0.36	70		118.4	119.4
Prickly Pear Creek	10/29/2009	PPC-7	101.2	0.5	U	2.0	0.2	0.5	U	-	575.5	74.9	2		13.6	9.0	2.5	U	65.4	2.6	70		2998	1656	5	U	473.1	52.5	2.5	U	3.3	0.36	70		118.4	119.4
Prickly Pear Creek	10/29/2009	PPC-8	101.2	0.5	U	2.0	0.2	0.5	U	-	575.5	74.9	2		13.6	9.0	2.5	U	65.4	2.6	60		2998	1656	5	U	473.1	52.5	2.5	U	3.3	0.36	70		118.4	119.4
Prickly Pear Creek	8/4/2010	PPC-22 (SG-03A)	92.1	0.05	U	1.9	0.2	0.5	U	-	532.7	69.3	2		12.4	8.3	0.5		59.1	2.3	30		2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	20		109.3	110.2
Prickly Pear Creek	8/4/2010	PPC-102 (SG-06)	89.6	0.05	U	1.8	0.2	0.5	U	-	520.8	67.8	2		12.1	8.2	1.1		57.3	2.2	60		2879	1590	5	U	426.8	47.4	0.25	U	2.7	0.36	30		106.8	107.7
Prickly Pear Creek	8/4/2010	PPC-5 (SG-07)	92.1	0.05	U	1.9	0.2	0.5	U	-	532.7	69.3	1		12.4	8.3	1.1		59.1	2.3	60		2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	30		109.3	110.2
Prickly Pear Creek	8/4/2010	PPC-23 (SG-08)	87.1	0.05	U	1.8	0.2	0.5	U	-	508.9	66.2	2		11.8	8.0	1.2		55.6	2.2	60		2852	1576	5	U	416.7	46.3	0.25	U	2.5	0.36	30		104.3	105.1
Prickly Pear Creek	8/4/2010	PPC-7 (SG-09)	83.0	0.05	U	1.7	0.2	0.5	U	-	489.1	63.6	2		11.3	7.6	1.1		52.7	2.1	50		2806	1550	5	U	400.0	44.4	0.25	U	2.3	0.36	30		100.1	100.9
Prickly Pear Creek	8/4/2010	PPC-8 (SG-10)	80.5	0.05	U	1.6	0.2	0.5	U	-	477.1	62.1	2		11.0	7.4	1.1		51.0	2.0	50		2778	1535	5	U	389.8	43.3	0.25	U	2.2	0.36	30		97.5	98.3
Prickly Pear Creek	8/4/2010	SG-11	85.5	0.05	U	1.7	0.2	0.5	U	-	501.2	65.2	2		11.6	7.8	1.2		54.4	2.1	50		2834	1566	5	U	410.1	45.6	0.25	U	2.5	0.36	30		102.6	103.5
Upper Lake/Marsh	2003	ULM_1	139	0.5	U	2.8	0.3	0.77		-	746.1	97.1	3.2		18.3	11.9	5	U	92.3	3.6	25.1		3332	1841	20	U	618.7	68.7	1.1		5.7	0.36	30	U	154.9	156.2
Upper Lake/Marsh	2003	ULM_10	121	0.25		2.4	0.3	5	U	-	666.0	86.6	4.1		16.1	10.5	6.1		79.4	3.1	71.1		3181	1758	20	U	550.2	61.1	5	U	4.5	0.36	57.3		137.7	138.8
Upper Lake/Marsh	2003	ULM_3	119	0.12		2.4	0.3	5	U	-	657.0	85.5	3.2		15.8	10.4	3.9		78.0	3.0	66.1		3164	1748	20	U	542.5	60.3	0.77		4.3	0.36	30.8		135.8	136.9
Upper Lake/Marsh	2003	ULM_4	116	0.5	U	2.3	0.3	5	U	-	643.4	83.7	3.4		15.5	10.2	3.6		75.9	3.0	83.2		3137	1733	20	U	530.9	59.0	5	U	4.2	0.36	45.6		132.9	134.0
Upper Lake/Marsh	2003	ULM_7	118	0.13		2.4	0.3	5	U	-	652.5	84.9	3.3		15.7	10.3	5	U	77.3	3.0	51.6		3155	1743	20	U	538.6	59.8	5	U	4.3	0.36	37.6		134.8	135.9
Upper Lake/Marsh	2003	ULM_11	117	0.5	U	2.3	0.3	5	U	-	647.9	84.3	3.1		15.6	10.2	5	U	76.6	3.0	39.3		3146	1738	20	U	534.7	59.4	5	U	4.2	0.36	56.4		133.9	134.9
Upper Lake/Marsh	2003	ULM_12	119	0.5	U	2.4	0.3	5	U	-	657.0	85.5	4.8		15.8	10.4	6.6		78.0	3.0	66.1		3164	1748	20	U	542.5	60.3	5	U	4.3	0.36	30	U	135.8	136.9
Upper Lake/Marsh	2003	ULM_2	127	0.43		2.5	0.3	2.1		-	693.0	90.1	11.7		16.8	11.0	5	U	83.7	3.3	1940		3233	1786	20	U	573.2	63.7	5	U	4.9	0.36	123		143.5	144.7
Upper Lake/Marsh	2003	ULM_5	117	0.5	U	2.3	0.3	5	U	-	647.9	84.3	3.5		15.6	10.2	5	U	76.6	3.0	164		3146	1738	20	U	534.7	59.4	5	U	4.2	0.36	139		133.9	134.9
Upper Lake/Marsh	2003	ULM_6	117	0.5	U	2.3	0.3	5	U	-	647.9	84.3	3.7		15.6	10.2	5	U	76.6	3.0	15.3		3146	1738	20	U	534.7	59.4	5	U	4.2	0.36	45.9		133.9	134.9
Upper Lake/Marsh	2003	ULM_8	163	0.37		3.2	0.3	1		-	850.1	110.6	7.7		21.3	13.6	5	U	109.5	4.3	899		3513	1941	20	U	707.9	78.6	5	U	7.5	0.36	119		177.3	178.7
Upper Lake/Marsh	2003	ULM_9	116	0.29		2.3	0.3	5	U	-	643.4	83.7	5.1		15.5	10.2	5	U	75.9	3.0	35.1		3137	1733	20	U	530.9	59.0	5	U	4.2	0.36	73.1		132.9	134.0
Upper Lake/Marsh	11/7/2002	Upper Lake	127.0	2	U	2.5	0.3	nm		-	692.8	90.1	2	U	16.8	11.0	7		83.7	3.3	100		3233	1786	nm		573.0	63.6	nm		4.9	0.36	40		143.5	144.6
Upper Lake/Marsh	5/6/2009	Upper Lake	75.5	1.1		1.5	0.2	0.5	U	-	452.7	58.9	3		10.3	7.0	5.3		47.5	1.9	30		2719	1502	5	U	369.2	41.0	0.25	U	2.0	0.36	40	J	92.4	93.1
Upper Lake/Marsh	10/29/2009	Upper Lake	103.7	0.5	U	2.1	0.3	0.5	U	-	587.1	76.4	2		13.9	9.2	8		67.2	2.6	40		3022	1670	5	U	482.9	53.6	5	UJ	3.4	0.36	50		120.9	121.9
Upper Lake/Marsh	8/3/2010	UL-21	87.1	0.2		1.8	0.2	0.5	U	-	508.9	66.2	2		11.8	8.0	3.5		55.6	2.2	30		2852	1576	5	U	416.7	46.3	0.25	U	2.5	0.36	5	U	104.3	105.1
Upper Lake/Marsh	8/5/2010	UL-22	92.1	0.05	U	1.9	0.2	0.5	U	-	532.7	69.3	1		12.4	8.3	1		59.1	2.3	80		2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	20		109.3	110.2
Upper Lake/Marsh	8/5/2010	UL-23	92.1	0.05	U	1.9	0.2	0.5	U	-	532.7	69.3	1		12.4	8.3	2.1		59.1	2.3	120		2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	20		109.3	110.2
Upper Lake/Marsh	8/5/2010	UL-24	92.1	0.2		1.9	0.2	0.5	U	-	532.7	69.3	2		12.4	8.3	3.3		59.1	2.3	5	U	2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	5	U	109.3	110.2
Upper Lake/Marsh	8/5/2010	UL-25	107.1	0.05	U	2.2	0.3	0.5	U	-	602.7	78.4	1		14.3	9.5	1.2		69.6	2.7	80		3055	1688	5	U	496.2	55.1	0.25	U	3.6	0.36	10		124.2	125.2
Upper Lake/Marsh	8/5/2010	ULM-1	94.6	0.5		1.9	0.2	0.5	U	-	544.5	70.8	4		12.8	8.5	4.3		60.8	2.4	190		2931	1619	5	U	446.8	49.6	0.25	U	2.9	0.36	30		111.8	112.7
Upper Lake/Marsh	8/5/2010	ULM-2	85.5	0.05	U	1.7	0.2	0.5	U	-	501.2	65.2	2		11.6	7.8	0.6		54.4	2.1	30		2834	1566	5	U	410.1	45.6	0.25	U	2.5	0.36	20		102.6	103.5
Upper Lake/Marsh	8/5/2010	ULM-3	97.1	0.05	U	2.0	0.2	0.5	U	-	556.2	72.4	1		13.1	8.7	0.9		62.6	2.4	60		2957	1634	5	U	456.8	50.7	0.25	U	3.1	0.36	20		114.3	115.2

Table D-2. Hardness-Based Dissolved Metals Surface Water Screening Results

			Hardness [a]	Cd		Cd-SWB		Cr			Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	**Date**	**Sample ID**	**mg/L as CaCO$_3$**	**ug/L**	**Q** [b]	**Ac**	**Ch**	**ug/L**	**Q**		**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**
Upper Lake/Marsh	8/5/2010	ULM-4	90.5	0.05	U	1.8	0.2	0.5	U	-	525.0	68.3	1		12.2	8.2	0.7		57.9	2.3	30		2888	1596	5	U	430.3	47.8	0.25	U	2.7	0.36	10		107.7	108.6
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	0.05	U	1.8	0.2	0.5	U	-	520.8	67.8	2		12.1	8.2	0.9		57.3	2.2	20		2879	1590	5	U	426.8	47.4	0.25	U	2.7	0.36	10		106.8	107.7
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	0.05	U	1.8	0.2	0.5	U	-	520.8	67.8	2		12.1	8.2	0.9		57.3	2.2	20		2879	1590	5	U	426.8	47.4	0.25	U	2.7	0.36	5	U	106.8	107.7
Upper Lake/Marsh	8/5/2010	ULM-6	83.0	0.05	U	1.7	0.2	0.5	U	-	489.1	63.6	1		11.3	7.6	1.4		52.7	2.1	150		2806	1550	5	U	400.0	44.4	0.25	U	2.3	0.36	20		100.1	100.9
Upper Lake/Marsh	8/5/2010	ULM-7	83.0	0.05	U	1.7	0.2	0.5	U	-	489.1	63.6	2		11.3	7.6	0.8		52.7	2.1	60		2806	1550	5	U	400.0	44.4	0.25	U	2.3	0.36	20		100.1	100.9
Upper Lake/Marsh	8/5/2010	ULM-8	89.6	0.05	U	1.8	0.2	0.5	U	-	520.8	67.8	1		12.1	8.2	0.8		57.3	2.2	60		2879	1590	5	U	426.8	47.4	0.25	U	2.7	0.36	20		106.8	107.7
Upper Lake/Marsh	8/5/2010	ULM-9	89.6	0.05	U	1.8	0.2	0.5	U	-	520.8	67.8	1		12.1	8.2	0.6		57.3	2.2	30		2879	1590	5	U	426.8	47.4	0.25	U	2.7	0.36	20		106.8	107.7
Wilson Ditch	6/4/2001	WD-1	61.8	0.5	U	1.3	0.2	nm		-	384.3	50.0	2	U	8.5	5.9	2.5	U	38.1	1.5	50		2544	1405	nm		311.7	34.6	nm		1.4	0.36	10	U	78.0	78.6
Wilson Ditch	6/4/2001	WD-2	61.4	0.5	U	1.3	0.2	nm		-	382.2	49.7	2	U	8.5	5.9	2.5	U	37.8	1.5	50		2538	1402	nm		310.0	34.4	nm		1.4	0.36	10	U	77.5	78.2
Wilson Ditch	6/20/2002	WD-1	50.2	2		1.0	0.2	nm		-	324.2	42.2	7		7.0	5.0	20		30.3	1.2	20		2374	1312	nm		261.6	29.1	nm		1.0	0.36	10	U	65.4	65.9
Wilson Ditch	6/20/2002	WD-2	50.2	0.5	U	1.0	0.2	nm		-	324.2	42.2	5		7.0	5.0	10		30.3	1.2	40		2374	1312	nm		261.6	29.1	nm		1.0	0.36	10	U	65.4	65.9
Wilson Ditch	8/10/2010	WD-2	89.6	0.05	U	1.8	0.2	0.5	U	-	520.8	67.8	2		12.1	8.2	1.1		57.3	2.2	50		2879	1590	5	U	426.8	47.4	0.25	U	2.7	0.36	20		106.8	107.7
Wilson Ditch	8/10/2010	WD-25	92.1	0.2		1.9	0.2	0.5	U	-	532.7	69.3	2		12.4	8.3	1.2		59.1	2.3	30		2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	20		109.3	110.2
Wilson Ditch	8/10/2010	WD-26	87.1	0.7		1.8	0.2	0.5	U	-	508.9	66.2	4		11.8	8.0	2		55.6	2.2	20		2852	1576	5	U	416.7	46.3	0.25	U	2.5	0.36	10		104.3	105.1
Wilson Ditch	8/10/2010	WD-3	92.1	0.1		1.9	0.2	0.5	U	-	532.7	69.3	2		12.4	8.3	1.4		59.1	2.3	40		2905	1605	5	U	436.8	48.5	0.25	U	2.8	0.36	20		109.3	110.2
Wilson Ditch	8/10/2010	WD-4	94.6	0.05	U	1.9	0.2	0.5	U	-	544.5	70.8	1		12.8	8.5	1.2		60.8	2.4	40		2931	1619	5	U	446.8	49.6	0.25	U	2.9	0.36	20		111.8	112.7

Notes:

(a) Acute and chronic citeria adjusted based on the sample specific hardness.

(b) If sample is nondected ("U"), concentration is assumed to be ½ the detection limit.

Metal is highlighted if concentrations exceeds the sample-specific acute or chronic benchmarks (Table D-1).

Table D-3. Total Metals Surface Water Screening Results

	Total Recoverable Surface Water Benchmark(b)		Maximum Total Surface Water Concentration (ug/L) for Each CSM Unit								
	Acute	Chronic	PPC		UL/ULM		WD		LL		COPC
Metal	**(ug/L)**	**(ug/L)**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	750	87	300	50-200	1620	100-200	-	-	60	50-200	**Y**
Antimony	900	190	U	1-60	U	3-60	-	-	437	-	**Y**
Arsenic	340	150	20	5-15	31.5	15	10	5	243	-	**Y**
Barium	2000	220	49.5	100	63.5	100	-	-	43.9	100	n
Beryllium	93	11	U	1-5	U	1-5	-	-	U	1-5	n
Cadmium [a]	2.1	0.27	0.36	0.2-1.4	30	-	3	1	40	3	**Y**
Chromium (III) [a]	1803	86	U	1-10	6	1-10	-	-	1	1-5	n
Chromium (IV)	16.0	11	U	1-10	6	1-10	-	-	1	1-5	n
Cobalt	220	24	U	0.5-50	2.7	0.5-50	-	-	U	0.5-50	n
Copper [a]	14	9	7	4-10	27.7	90	10	4	70	-	**Y**
Iron	na	1000	700	20-700	8370	-	300	-	710	200-400	**Y**
Lead [a]	82	3.2	20	5-10	800	10	60	-	178	-	**Y**
Manganese [a]	2986	1650	130	60-80	2180	-	60	-	500	-	**Y**
Mercury	1.4	0.77	U	0.01-6	0.01	0.01-1	U	0.01	0.05	1-6	n
Nickel [a]	469	52.2	1	10-40	U	10-40	-	-	4.3	10-40	n
Selenium	20	5	4	1-35	U	1-35	-	-	54	-	**Y**
Silver [a]	3.8	0.36	U	0.5-10	0.94	0.5-10	-	-	2.1	0.5-10	**Y**
Thallium	79	17	0.4	0.2-25	U	0.2-25	-	-	77	-	**Y**
Vanadium	150	44	U	10-50	5.6	10-100	-	-	U	10-50	n
Zinc [a]	120	120	94.7	20-60	300	60	100	-	200	20	**Y**

Notes:

PPC = Prickly Pear Creek

UL/ULM = Upper Lake and Upper Lake Marsh

WD = Wilson Ditch

LL = Lower Lake

U = Undetected

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed acute or chronic dissolved surface water benchmarks (highlighted).

(a) Criterion is shown at a hardness of 100 mg/L as $CaCO_3$*, however screening was conducted on a sample-specific basis (see Table D-4).*

(b) Benchmarks from Table C-1.

Table D-4. Hardness-Based Total Metals Surface Water Screening Results

			Total Metals																																								
	Sample		Hardness [a]	Cd			Cd-SWB		Cr			Cr-SWB		Cu			Cu-SWB		Pb			Pb-SWB		Mn			Mn-SWB		Ni			Ni-SWB		Ag			Ag-SWB		Zn			Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch
Lower Lake	2003	LL_1	180.0	8.2		Y	3.9	0.4	1		-	2917.9	139.5	26.8		Y	24.4	15.4	65.9		Y	172.5	6.7	204		-	3631	2006	20	U	-	769.9	85.5	2.1		Y	10.4	0.36	77.5		-	197.2	197.2
Lower Lake	2003	LL_2	203.0	8.3		Y	4.4	0.5	0.67		-	3219.9	153.9	30.1		Y	27.3	17.1	78.9		Y	201.1	7.8	221		-	3780	2088	3.9		-	852.3	94.7	1.2		Y	12.8	0.36	125		-	218.3	218.3
Lower Lake	2003	LL_3	207.0	8.9		Y	4.5	0.5	0.9		-	3271.8	156.4	31.8		Y	27.8	17.4	87.1		Y	206.1	8.0	224		-	3804	2102	4.3		-	866.5	96.2	5	U	Y	13.2	0.36	123		-	221.9	221.9
Lower Lake	5/10/2000	Lower Lake	608.0	40		Y	13.4	1.0	nm		-	7907.3	377.9	70		Y	76.7	43.6	90		Y	812.5	31.7	400		-	5447	3010	nm		-	2156.0	239.5	nm		-	84.4	0.36	200		-	553.0	553.0
Lower Lake	10/31/2000	Lower Lake	457.0	20		Y	10.0	0.8	nm		-	6259.0	299.2	40		Y	58.6	34.2	80		Y	565.0	22.0	400		-	4953	2737	nm		-	1693.5	188.1	nm		-	51.7	0.36	100		-	434.2	434.2
Lower Lake	5/3/2001	Lower Lake	254.8	20		Y	5.5	0.5	nm		-	3878.7	185.4	30		Y	33.8	20.7	80		Y	268.6	10.5	300		-	4077	2253	nm		-	1033.0	114.7	nm		-	18.9	0.36	100		-	264.7	264.7
Lower Lake	11/16/2001	Lower Lake	278.5	10		Y	6.0	0.6	nm		-	4171.2	199.4	20		-	36.7	22.4	30		Y	300.7	11.7	300		-	4199	2320	nm		-	1113.6	123.7	nm		-	22.0	0.36	60		-	285.3	285.3
Lower Lake	11/7/2002	Lower Lake	229.4	8		Y	5.0	0.5	nm		-	3558.6	170.1	50		Y	30.6	19.0	100		Y	234.9	9.2	400		-	3937	2175	nm		-	945.1	105.0	nm		-	15.8	0.36	30		-	242.1	242.1
Lower Lake	4/30/2003	Lower Lake	203.6	7		Y	4.4	0.5	nm		-	3227.8	154.3	30		Y	27.4	17.1	50		Y	201.8	7.9	500		-	3784	2090	nm		-	854.5	94.9	nm		-	12.9	0.36	60		-	218.9	218.9
Lower Lake	10/22/2003	Lower Lake	211.0	10		Y	4.6	0.5	nm		-	3324.0	158.9	31		Y	28.3	17.7	98		Y	211.3	8.2	250		-	3829	2116	nm		-	880.8	97.8	nm		-	13.7	0.36	94		-	225.6	225.6
Lower Lake	4/27/2004	Lower Lake	192.7	10		Y	4.2	0.4	nm		-	3086.0	147.5	52		Y	26.0	16.3	108		Y	188.2	7.3	280		-	3715	2053	nm		-	815.7	90.6	nm		-	11.7	0.36	80		-	208.9	208.9
Lower Lake	11/21/2005	Lower Lake	147.8	4		Y	3.2	0.4	nm		-	2482.8	118.7	20		Y	20.2	13.0	38		Y	134.2	5.2	130		-	3401	1879	nm		-	651.6	72.4	nm		-	7.4	0.36	20		-	166.8	166.8
Lower Lake	5/12/2006	Lower Lake	127.8	7		Y	2.7	0.3	nm		-	2204.4	105.4	36		Y	17.6	11.5	178		Y	111.6	4.3	250		-	3240	1790	nm		-	576.3	64.0	nm		-	5.8	0.36	120		-	147.5	147.5
Lower Lake	6/6/2007	Lower Lake	113.7	4		Y	2.4	0.3	0.5	U	-	2003.1	95.7	17		Y	15.8	10.4	70		Y	96.2	3.7	60		-	3116	1722	5	U	-	522.0	58.0	2.5	U	-	4.7	0.36	40		-	133.6	133.6
Lower Lake	10/31/2007	Lower Lake	132.8	2		Y	2.8	0.3	nm		-	2274.7	108.7	10		-	18.3	11.9	12		Y	117.2	4.6	140		-	3282	1813	nm		-	595.3	66.1	nm		-	6.2	0.36	10		-	152.4	152.4
Lower Lake	4/30/2008	Lower Lake	154.4	4		Y	3.3	0.4	0.5	U	-	2573.5	123.0	19		Y	21.1	13.5	55		Y	141.9	5.5	140		-	3451	1906	5	U	-	676.2	75.1	2.5	U	-	8.0	0.36	40		-	173.1	173.1
Lower Lake	10/24/2008	Lower Lake	125.3	3		Y	2.7	0.3	nm		-	2169.1	103.7	12		Y	17.3	11.3	41		Y	108.8	4.2	140		-	3219	1778	nm		-	566.7	62.9	nm		-	5.6	0.36	10	U	-	145.1	145.1
Lower Lake	5/1/2009	Lower Lake	139.4	3	UJ	Y	3.0	0.3	5	UJ	-	2367.1	113.1	15		Y	19.1	12.4	9.2		Y	124.6	4.9	70		-	3335	1843	5	U	-	620.2	68.9	0.25	U	-	6.7	0.36	10		-	158.8	158.8
Lower Lake	10/29/2009	Lower Lake	121.9	3	J	Y	2.6	0.3	0.5	U	-	2121.1	101.4	15	J	Y	16.9	11.1	48	J	Y	105.1	4.1	130		-	3190	1762	5	U	-	553.8	61.5	2.5	U	-	5.3	0.36	20		-	141.7	141.7
Prickly Pear Creek	2003	PPC_2	119.0	0.21		-	2.5	0.3	5	U	-	2079.1	99.4	5		-	16.5	10.8	4.1		Y	101.9	4.0	56.2		-	3164	1748	20	U	-	542.5	60.3	5	U	-	5.1	0.36	65.3		-	138.8	138.8
Prickly Pear Creek	2003	PPC_3	108.0	0.36		Y	2.3	0.3	5	U	-	1920.4	91.8	4.7		-	15.1	10.0	4.7		Y	90.0	3.5	89		-	3063	1692	20	U	-	499.7	55.5	5	U	Y	4.3	0.36	86.9		-	127.9	127.9
Prickly Pear Creek	2003	PPC_4	115.0	0.29		-	2.5	0.3	5	U	-	2021.7	96.6	4.4		-	16.0	10.5	4.9		Y	97.5	3.8	67.5		-	3128	1728	20	U	-	527.0	58.5	5	U	Y	4.8	0.36	68.2		-	134.9	134.9
Prickly Pear Creek	2003	PPC_5	139.0	0.11		-	3.0	0.3	5	U	-	2361.2	112.9	4.3		-	19.1	12.4	5	U	Y	124.2	4.8	15.9		-	3332	1841	20	U	-	618.7	68.7	5	U	-	6.7	0.36	94.7		-	158.4	158.4
Prickly Pear Creek	5/10/2000	PPC-101	86.3	0.5	U	Y	1.8	0.2	nm		-	1598.1	76.4	5		-	12.2	8.2	8		Y	67.7	2.6	90		-	2843	1571	nm		-	413.4	45.9	nm		-	2.9	0.36	40		-	105.8	105.8
Prickly Pear Creek	5/10/2000	PPC-102	86.3	0.5	U	Y	1.8	0.2	nm		-	1598.1	76.4	2	U	-	12.2	8.2	5		Y	67.7	2.6	80		-	2843	1571	nm		-	413.4	45.9	nm		-	2.9	0.36	50		-	105.8	105.8
Prickly Pear Creek	5/10/2000	PPC-103	86.7	0.5	U	Y	1.8	0.2	nm		-	1604.3	76.7	2	U	-	12.2	8.3	5		Y	68.1	2.7	80		-	2847	1573	nm		-	415.0	46.1	nm		-	3.0	0.36	50		-	106.2	106.2
Prickly Pear Creek	5/10/2000	PPC-3A	86.3	0.5	U	Y	1.8	0.2	nm		-	1598.1	76.4	2	U	-	12.2	8.2	2.5	U	-	67.7	2.6	60		-	2843	1571	nm		-	413.4	45.9	nm		-	2.9	0.36	50		-	105.8	105.8
Prickly Pear Creek	5/10/2000	PPC-5	86.7	0.5	U	Y	1.8	0.2	nm		-	1604.3	76.7	2	U	-	12.2	8.3	8		Y	68.1	2.7	90		-	2847	1573	nm		-	415.0	46.1	nm		-	3.0	0.36	50		-	106.2	106.2
Prickly Pear Creek	5/10/2000	PPC-7	86.3	0.5	U	Y	1.8	0.2	nm		-	1598.1	76.4	4		-	12.2	8.2	9		Y	67.7	2.6	90		-	2843	1571	nm		-	413.4	45.9	nm		-	2.9	0.36	60		-	105.8	105.8
Prickly Pear Creek	5/10/2000	PPC-8	88.8	1	U	Y	1.9	0.2	nm		-	1635.8	78.2	4		-	12.5	8.4	8		Y	70.2	2.7	90		-	2870	1586	nm		-	423.4	47.0	nm		-	3.1	0.36	60		-	108.3	108.3
Prickly Pear Creek	10/31/2000	PPC-101	100.0	0.5	U	Y	2.1	0.3	nm		-	1802.9	86.2	2	U	-	14.0	9.3	2.5	U	-	81.6	3.2	100		-	2986	1650	nm		-	468.2	52.0	nm		-	3.8	0.36	30		-	119.8	119.8
Prickly Pear Creek	10/31/2000	PPC-102	104.5	0.5	U	Y	2.2	0.3	nm		-	1869.9	89.4	2	U	-	14.6	9.7	5		Y	86.4	3.4	100		-	3030	1674	nm		-	486.2	54.0	nm		-	4.1	0.36	30		-	124.4	124.4
Prickly Pear Creek	10/31/2000	PPC-103	100.4	0.5	U	Y	2.1	0.3	nm		-	1809.0	86.5	2	U	-	14.1	9.4	5		Y	82.1	3.2	100		-	2990	1652	nm		-	469.8	52.2	nm		-	3.8	0.36	30		-	120.2	120.2
Prickly Pear Creek	10/31/2000	PPC-3A	97.1	0.5	U	Y	2.1	0.3	nm		-	1759.8	84.1	2	U	-	13.6	9.1	2.5	U	-	78.6	3.1	30		-	2956	1633	nm		-	456.6	50.7	nm		-	3.6	0.36	30		-	116.8	116.8
Prickly Pear Creek	10/31/2000	PPC-5	100.4	0.5	U	Y	2.1	0.3	nm		-	1809.0	86.5	4		-	14.1	9.4	10		Y	82.1	3.2	80		-	2990	1652	nm		-	469.8	52.2	nm		-	3.8	0.36	30		-	120.2	120.2
Prickly Pear Creek	10/31/2000	PPC-7	100.0	0.5	U	Y	2.1	0.3	nm		-	1802.9	86.2	2	U	-	14.0	9.3	20		Y	81.6	3.2	70		-	2986	1650	nm		-	468.2	52.0	nm		-	3.8	0.36	50		-	119.8	119.8
Prickly Pear Creek	10/31/2000	PPC-8	103.3	1	U	Y	2.2	0.3	nm		-	1851.8	88.5	4	U	-	14.4	9.6	7		Y	85.1	3.3	60		-	3018	1668	nm		-	481.3	53.5	nm		-	4.0	0.36	50		-	123.2	123.2
Prickly Pear Creek	5/3/2001	PPC-101	55.2	0.5	U	Y	1.2	0.2	nm		-	1108.9	53.0	2	U	-	8.0	5.6	6		Y	38.4	1.5	70	UJ	-	2450	1354	nm		-	283.4	31.5	nm		-	1.4	0.36	25	U	-	72.5	72.5
Prickly Pear Creek	5/3/2001	PPC-102	50.2	0.5	U	Y	1.1	0.2	nm		-	1026.1	49.0	2	U	-	7.3	5.2	6		Y	34.0	1.3	70	UJ	-	2374	1312	nm		-	261.6	29.1	nm		-	1.2	0.36	25	U	-	66.9	66.9
Prickly Pear Creek	5/3/2001	PPC-103	55.2	0.5	U	Y	1.2	0.2	nm		-	1108.9	53.0	4		-	8.0	5.6	6		Y	38.4	1.5	80	UJ	-	2450	1354	nm		-	283.4	31.5	nm		-	1.4	0.36	25	U	-	72.5	72.5
Prickly Pear Creek	5/3/2001	PPC-3A	55.2	0.5	U	Y	1.2	0.2	nm		-	1108.9	53.0	2	U	-	8.0	5.6	5		Y	38.4	1.5	60	UJ	-	2450	1354	nm		-	283.4	31.5	nm		-	1.4	0.36	25	U	-	72.5	72.5
Prickly Pear Creek	5/3/2001	PPC-5	55.2	0.5	U	Y	1.2	0.2	nm		-	1108.9	53.0	2	U	-	8.0	5.6	7		Y	38.4	1.5	70	UJ	-	2450	1354	nm		-	283.4	31.5	nm		-	1.4	0.36	25	U	-	72.5	72.5
Prickly Pear Creek	5/3/2001	PPC-7	55.2	0.5	U	Y	1.2	0.2	nm		-	1108.9	53.0	2	U	-	8.0	5.6	8		Y	38.4	1.5	70	UJ	-	2450	1354	nm		-	283.4	31.5	nm		-	1.4	0.36	30	U	-	72.5	72.5
Prickly Pear Creek	5/3/2001	PPC-8	55.2	1	U	Y	1.2	0.2	nm			1108.3	53.0	4		-	8.0	5.6	8		Y	38.3	1.5	80	UJ	-	2450	1353	nm			283.2	31.5	nm			1.4	0.36	60	U	-	72.4	72.4
Prickly Pear Creek	11/16/2001	PPC-101	105.0	0.5	U	Y	2.2	0.3	nm		-	1875.9	89.7	2	U	-	14.7	9.7	2.5	U	-	86.8	3.4	100		-	3034	1676	nm		-	487.8	54.2	nm		-	4.1	0.36	10	U	-	124.8	124.8
Prickly Pear Creek	11/16/2001	PPC-102	107.0	0.5	U	Y	2.3	0.3	nm		-	1906.4	91.1	2	U	-	14.9	9.9	2.5	U	-	89.0	3.5	90		-	3054	1687	nm		-	496.0	55.1	nm		-	4.3	0.36	10	U	-	126.9	126.9
Prickly Pear Creek	11/16/2001	PPC-103	107.9	0.5	U	Y	2.3	0.3	nm		-	1918.4	91.7	2	U	-	15.0	10.0	2.5	U	-	89.9	3.5	90		-	3062	1692	nm		-	499.2	55.4	nm		-	4.3	0.36	10	U	-	127.8	127.8
Prickly Pear Creek	11/16/2001	PPC-3A	104.5	0.5	U	Y	2.2	0.3	nm		-	1869.9	89.4	2	U	-	14.6	9.7	2.5	U	-	86.4	3.4	30		-	3030	1674	nm		-	486.2	54.0	nm		-	4.1	0.36	20		-	124.4	124.4
Prickly Pear Creek	11/16/2001	PPC-5	107.9	0.5	U	Y	2.3	0.3	nm		-	1918.4	91.7	2	U	-	15.0	10.0	2.5	U	-	89.9	3.5	100		-	3062	1692	nm		-	499.2	55.4	nm		-	4.3	0.36	20		-	127.8	127.8
Prickly Pear Creek	11/16/2001	PPC-7	107.9	0.5	U	Y	2.3	0.3	nm		-	1918.4	91.7	2	U	-	15.0	10.0	2.5	U	-	89.9	3.5	90		-	3062	1692	nm		-	499.2	55.4	nm		-	4.3	0.36	40		-	127.8	127.8
Prickly Pear Creek	11/16/2001	PPC-8	110.4	1	U	Y	2.4	0.3	nm		-	1954.7	93.4	4	U	-	15.4	10.1	5	U	Y	92.6	3.6	80		-	3085	1705	nm		-	509.0	56.5	nm		-	4.5	0.36	30		-	130.3	130.3

Table D-4. Hardness-Based Total Metals Surface Water Screening Results

			Total Metals																																								
	Sample		Hardness [a]	Cd			Cd-SWB		Cr			Cr-SWB		Cu			Cu-SWB		Pb			Pb-SWB		Mn			Mn-SWB		Ni			Ni-SWB		Ag			Ag-SWB		Zn			Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch
Prickly Pear Creek	5/15/2002	PPC-8	81.7	nm			1.7	0.2	nm		-	1528.6	73.1	nm		Y	11.6	7.9	nm			63.2	2.5	nm			2792	1542	nm		-	394.8	43.9	nm		-	2.7	0.36	nm			101.0	101.0
Prickly Pear Creek	11/6/2002	PPC-101	200.0	0.5	U	Y	4.3	0.5	nm		-	3180.3	152.0	5		-	26.9	16.9	2.5	U	-	197.2	7.7	20		-	3761	2078	nm		-	841.5	93.5	nm		-	12.5	0.36	10	U	-	215.5	215.5
Prickly Pear Creek	11/6/2002	PPC-102	106.2	0.5	U	Y	2.3	0.3	nm		-	1894.4	90.5	2	U	-	14.8	9.8	2.5	U	-	88.2	3.4	80		-	3046	1683	nm		-	492.8	54.7	nm		-	4.2	0.36	30		-	126.1	126.1
Prickly Pear Creek	11/6/2002	PPC-103	103.7	0.5	U	Y	2.2	0.3	nm		-	1857.8	88.8	2	U	-	14.5	9.6	2.5	U	-	85.5	3.3	70		-	3022	1670	nm		-	482.9	53.6	nm		-	4.0	0.36	30		-	123.6	123.6
Prickly Pear Creek	11/6/2002	PPC-5	110.0	0.5	U	Y	2.3	0.3	nm		-	1948.7	93.1	2	U	-	15.3	10.1	2.5	U	-	92.1	3.6	80		-	3082	1703	nm		-	507.4	56.4	nm		-	4.5	0.36	40		-	129.8	129.8
Prickly Pear Creek	11/6/2002	PPC-7	110.0	0.5	U	Y	2.3	0.3	nm		-	1948.7	93.1	2	U	-	15.3	10.1	2.5	U	-	92.1	3.6	60		-	3082	1703	nm		-	507.4	56.4	nm		-	4.5	0.36	40		-	129.8	129.8
Prickly Pear Creek	11/6/2002	PPC-8	110.4	1	U	Y	2.4	0.3	nm		-	1954.7	93.4	4	U	-	15.4	10.1	5	U	Y	92.6	3.6	60		-	3085	1705	nm		-	509.0	56.5	nm		-	4.5	0.36	40		-	130.3	130.3
Prickly Pear Creek	11/7/2002	PPC-3A	100.4	0.5	U	Y	2.1	0.3	nm		-	1809.0	86.5	2	U	-	14.1	9.4	2.5	U	-	82.1	3.2	50		-	2990	1652	nm		-	469.8	52.2	nm		-	3.8	0.36	30		-	120.2	120.2
Prickly Pear Creek	4/30/2003	PPC-103	62.7	0.5	U	Y	1.3	0.2	nm		-	1230.6	58.8	2	U	-	9.0	6.3	2.5	U	Y	45.1	1.8	60		-	2556	1412	nm		-	315.6	35.1	nm		-	1.7	0.36	50		-	80.7	80.7
Prickly Pear Creek	4/30/2003	PPC-3A	62.7	0.5	U	Y	1.3	0.2	nm		-	1230.6	58.8	4		-	9.0	6.3	2.5	U	Y	45.1	1.8	50		-	2556	1412	nm		-	315.6	35.1	nm		-	1.7	0.36	60		-	80.7	80.7
Prickly Pear Creek	4/30/2003	PPC-5	62.7	0.5	U	Y	1.3	0.2	nm		-	1230.6	58.8	4		-	9.0	6.3	2.5	U	Y	45.1	1.8	60		-	2556	1412	nm		-	315.6	35.1	nm		-	1.7	0.36	60		-	80.7	80.7
Prickly Pear Creek	4/30/2003	PPC-7	62.7	0.5	U	Y	1.3	0.2	nm		-	1230.6	58.8	4		-	9.0	6.3	2.5	U	Y	45.1	1.8	60		-	2556	1412	nm		-	315.6	35.1	nm		-	1.7	0.36	60		-	80.7	80.7
Prickly Pear Creek	4/30/2003	PPC-8	62.7	1	U	Y	1.3	0.2	nm		-	1230.6	58.8	5		-	9.0	6.3	5	U	Y	45.1	1.8	60		-	2556	1412	nm		-	315.6	35.1	nm		-	1.7	0.36	60		-	80.7	80.7
Prickly Pear Creek	10/22/2003	PPC-103	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	120		-	3175	1754	nm		-	547.6	60.8	nm		-	5.2	0.36	10	U	-	140.2	140.2
Prickly Pear Creek	10/22/2003	PPC-3A	117.8	0.5	U	Y	2.5	0.3	nm		-	2062.3	98.6	2	U	-	16.3	10.7	2.5	U	-	100.6	3.9	41		-	3153	1742	nm		-	537.9	59.7	nm		-	5.0	0.36	10	U	-	137.7	137.7
Prickly Pear Creek	10/22/2003	PPC-5	120.7	0.5	U	Y	2.6	0.3	nm		-	2103.9	100.6	5		-	16.7	11.0	5		Y	103.8	4.0	130		-	3179	1756	nm		-	549.2	61.0	nm		-	5.2	0.36	10	U	-	140.6	140.6
Prickly Pear Creek	10/22/2003	PPC-7	117.8	0.5	U	Y	2.5	0.3	nm		-	2062.3	98.6	7		-	16.3	10.7	7		Y	100.6	3.9	87		-	3153	1742	nm		-	537.9	59.7	nm		-	5.0	0.36	54		-	137.7	137.7
Prickly Pear Creek	10/22/2003	PPC-8	121.1	1	U	Y	2.6	0.3	nm			2109.1	100.8	5		-	16.8	11.0	5	U	Y	104.2	4.1	52		-	3182	1758	nm			550.6	61.2	nm			5.3	0.36	50		-	140.9	140.9
Prickly Pear Creek	4/29/2004	PPC-103	89.6	0.5	U	Y	1.9	0.2	nm		-	1648.2	78.8	2	U	-	12.6	8.5	2.5	U	-	71.0	2.8	70		-	2879	1590	nm		-	426.8	47.4	nm		-	3.1	0.36	20	UJ	-	109.2	109.2
Prickly Pear Creek	4/29/2004	PPC-3A	87.1	0.5	U	Y	1.9	0.2	nm		-	1610.5	77.0	2	U	-	12.3	8.3	2.5	U	-	68.5	2.7	60		-	2852	1576	nm		-	416.7	46.3	nm		-	3.0	0.36	30	UJ	-	106.6	106.6
Prickly Pear Creek	4/29/2004	PPC-5	87.1	0.5	U	Y	1.9	0.2	nm		-	1610.5	77.0	2	U	-	12.3	8.3	6		Y	68.5	2.7	90		-	2852	1576	nm		-	416.7	46.3	nm		-	3.0	0.36	30	UJ	-	106.6	106.6
Prickly Pear Creek	4/29/2004	PPC-7	87.1	0.5	U	Y	1.9	0.2	nm		-	1610.5	77.0	2	U	-	12.3	8.3	6		Y	68.5	2.7	80		-	2852	1576	nm		-	416.7	46.3	nm		-	3.0	0.36	30	UJ	-	106.6	106.6
Prickly Pear Creek	4/29/2004	PPC-8	87.1	1	U	Y	1.9	0.2	nm			1610.2	77.0	4	U	-	12.3	8.3	7		Y	68.5	2.7	90		-	2851	1575	nm			416.6	46.3	nm			3.0	0.36	30	UJ	-	106.6	106.6
Prickly Pear Creek	11/21/2005	PPC-103	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	110		-	3175	1754	nm		-	547.6	60.8	nm		-	5.2	0.36	70		-	140.2	140.2
Prickly Pear Creek	11/21/2005	PPC-3A	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	60		-	3175	1754	nm		-	547.6	60.8	nm		-	5.2	0.36	80		-	140.2	140.2
Prickly Pear Creek	11/21/2005	PPC-5	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	110		-	3175	1754	nm		-	547.6	60.8	nm		-	5.2	0.36	80		-	140.2	140.2
Prickly Pear Creek	11/21/2005	PPC-7	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	80		-	3175	1754	nm		-	547.6	60.8	nm		-	5.2	0.36	60		-	140.2	140.2
Prickly Pear Creek	11/21/2005	PPC-8	122.8	0.5	U	Y	2.6	0.3	nm		-	2133.6	102.0	2	U	-	17.0	11.1	2.5	U	-	106.1	4.1	70		-	3197	1766	nm		-	557.2	61.9	nm		-	5.4	0.36	60		-	142.6	142.6
Prickly Pear Creek	5/12/2006	PPC-103	80.5	0.5	U	Y	1.7	0.2	nm		-	1509.7	72.2	2	U	-	11.4	7.8	2.5	U	Y	62.0	2.4	60		-	2778	1535	nm		-	389.8	43.3	nm		-	2.6	0.36	50		-	99.7	99.7
Prickly Pear Creek	5/12/2006	PPC-3A	78.0	0.5	U	Y	1.7	0.2	nm		-	1471.2	70.3	2	U	-	11.1	7.5	2.5	U	Y	59.5	2.3	40		-	2749	1519	nm		-	379.5	42.2	nm		-	2.5	0.36	60		-	97.1	97.1
Prickly Pear Creek	5/12/2006	PPC-5	84.6	0.5	U	Y	1.8	0.2	nm		-	1572.6	75.2	2	U	-	12.0	8.1	2.5	U	-	66.0	2.6	60		-	2824	1560	nm		-	407.4	45.3	nm		-	2.8	0.36	50		-	104.0	104.0
Prickly Pear Creek	5/12/2006	PPC-7	80.5	0.5	U	Y	1.7	0.2	nm		-	1509.7	72.2	2	U	-	11.4	7.8	2.5	U	Y	62.0	2.4	60		-	2778	1535	nm		-	390.5	43.4	nm		-	2.6	0.36	60		-	99.7	99.7
Prickly Pear Creek	5/12/2006	PPC-8	80.5	0.5	U	Y	1.7	0.2	nm		-	1509.7	72.2	2	U	-	11.4	7.8	2.5	U	Y	62.0	2.4	60		-	2778	1535	nm		-	390.5	43.4	nm		-	2.6	0.36	60		-	99.7	99.7
Prickly Pear Creek	12/8/2006	PPC-103	121.2	0.5	U	Y	2.6	0.3	nm		-	2110.6	100.9	4		-	16.8	11.0	2.5	U	-	104.3	4.1	90		-	3183	1759	nm		-	552.1	61.4	nm		-	5.3	0.36	80		-	141.0	141.0
Prickly Pear Creek	12/8/2006	PPC-3A	118.7	0.5	U	Y	2.5	0.3	nm		-	2074.9	99.2	2	U	-	16.5	10.8	2.5	U	-	101.6	4.0	50		-	3161	1747	nm		-	542.4	60.3	nm		-	5.1	0.36	80		-	138.6	138.6
Prickly Pear Creek	12/8/2006	PPC-5	121.2	0.5	U	Y	2.6	0.3	nm		-	2110.6	100.9	2	U	-	16.8	11.0	2.5	U	-	104.3	4.1	100		-	3183	1759	nm		-	552.1	61.4	nm		-	5.3	0.36	70		-	141.0	141.0
Prickly Pear Creek	12/8/2006	PPC-7	127.8	0.5	U	Y	2.7	0.3	nm		-	2204.4	105.4	2	U	-	17.6	11.5	6		Y	111.6	4.3	100		-	3240	1790	nm		-	577.4	64.2	nm		-	5.8	0.36	90		-	147.5	147.5
Prickly Pear Creek	12/8/2006	PPC-8	121.2	0.5	U	Y	2.6	0.3	nm		-	2110.6	100.9	2	U	-	16.8	11.0	6		Y	104.3	4.1	110		-	3183	1759	nm		-	552.1	61.4	nm		-	5.3	0.36	90		-	141.0	141.0
Prickly Pear Creek	6/6/2007	PPC-103	52.3	0.5	U	Y	1.1	0.2	0.5	U	-	1060.4	50.7	4		-	7.6	5.4	6		Y	35.8	1.4	70		-	2406	1329	5	U	-	271.1	30.1	2.5	U	Y	1.2	0.36	60		-	69.2	69.2
Prickly Pear Creek	6/6/2007	PPC-3A	49.8	0.5	U	Y	1.1	0.2	0.5	U	-	1018.7	48.7	4		-	7.3	5.1	7		Y	33.6	1.3	60		-	2367	1308	5	U	-	260.1	28.9	2.5	U	Y	1.1	0.36	70		Y	66.4	66.4
Prickly Pear Creek	6/6/2007	PPC-5	52.3	0.3		Y	1.1	0.2	1	U	-	1060.4	50.7	5	U	-	7.6	5.4	8.1		Y	35.8	1.4	67		-	2406	1329	1		-	271.1	30.1	0.25	U	-	1.2	0.36	57		-	69.2	69.2
Prickly Pear Creek	6/6/2007	PPC-7	52.3	0.5	U	Y	1.1	0.2	0.5	U	-	1060.4	50.7	4		-	7.6	5.4	8		Y	35.8	1.4	70		-	2406	1329	5	U	-	271.1	30.1	2.5	U	Y	1.2	0.36	60		-	69.2	69.2
Prickly Pear Creek	6/6/2007	PPC-8	52.3	0.5	U	Y	1.1	0.2	0.5	U	-	1060.4	50.7	4		-	7.6	5.4	7		Y	35.8	1.4	70		-	2406	1329	5	U	-	271.1	30.1	2.5	U	Y	1.2	0.36	70		Y	69.2	69.2
Prickly Pear Creek	10/31/2007	PPC-103	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	100		-	3175	1754	nm		-	548.7	61.0	nm		-	5.2	0.36	40		-	140.2	140.2
Prickly Pear Creek	10/31/2007	PPC-3A	115.3	0.5	U	Y	2.5	0.3	nm		-	2026.4	96.9	2	U	-	16.0	10.5	2.5	U	-	97.9	3.8	20		-	3131	1730	nm		-	529.3	58.9	nm		-	4.8	0.36	40		-	135.2	135.2
Prickly Pear Creek	10/31/2007	PPC-5	120.3	0.5	U	Y	2.6	0.3	nm		-	2098.0	100.3	2	U	-	16.7	10.9	2.5	U	-	103.3	4.0	90		-	3175	1754	nm		-	548.7	61.0	nm		-	5.2	0.36	30		-	140.2	140.2
Prickly Pear Creek	10/31/2007	PPC-7	120.3	0.5	U	Y	2.6	0.3	0.5	U	-	2098.0	100.3	2	U	-	16.7	10.9	6		Y	103.3	4.0	70		-	3175	1754	5	U	-	548.7	61.0	2.5	U	-	5.2	0.36	40		-	140.2	140.2
Prickly Pear Creek	10/31/2007	PPC-8	120.3	1	U	Y	2.6	0.3	nm			2098.0	100.3	4	U	-	16.7	10.9	5	U	Y	103.3	4.0	80		-	3175	1754	nm			548.7	61.0	nm			5.2	0.36	30		-	140.2	140.2
Prickly Pear Creek	4/30/2008	PPC-103	108.7	0.5	U	Y	2.3	0.3	0.5	U	-	1930.8	92.3	2	U	-	15.1	10.0	2.5	U	-	90.8	3.5	70		-	3070	1696	5	U	-	503.5	56.0	2.5	U	-	4.4	0.36	40		-	128.6	128.6
Prickly Pear Creek	4/30/2008	PPC-3A	97.1	0.5	U	Y	2.1	0.3	0.5	U	-	1760.2	84.1	2	U	-	13.6	9.1	2.5	U	-	78.7	3.1	60		-	2957	1634	5	U	-	457.7	50.9	2.5	U	-	3.6	0.36	50		-	116.9	116.9
Prickly Pear Creek	4/30/2008	PPC-5	108.7	0.5	U	Y	2.3	0.3	0.5	U	-	1930.8	92.3	5		-	15.1	10.0	5		Y	90.8	3.5	70		-	3070	1696	5	U	-	503.5	56.0	2.5	U	-	4.4	0.36	40		-	128.6	128.6

Table D-4. Hardness-Based Total Metals Surface Water Screening Results

			Total Metals																																								
	Sample		Hardness [a]	Cd			Cd-SWB		Cr			Cr-SWB		Cu			Cu-SWB		Pb			Pb-SWB		Mn			Mn-SWB		Ni			Ni-SWB		Ag			Ag-SWB		Zn			Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch	ug/L	Q		Ac	Ch
Prickly Pear Creek	4/30/2008	PPC-7	108.7	0.5	U	Y	2.3	0.3	nm		-	1930.8	92.3	2	U	-	15.1	10.0	2.5	U	-	90.8	3.5	80		-	3070	1696	nm		-	503.5	56.0	nm		-	4.4	0.36	70		-	128.6	128.6
Prickly Pear Creek	4/30/2008	PPC-8	108.7	1	U	Y	2.3	0.3	1	U	-	1930.8	92.3	6		-	15.1	10.0	9		Y	90.8	3.5	90		-	3070	1696	10	U	-	503.5	56.0	5	U	-	4.4	0.36	50		-	128.6	128.6
Prickly Pear Creek	10/24/2008	PPC-103	94.6	1	U	Y	2.0	0.3	nm		-	1723.1	82.4	4	U		13.3	8.9	5	U	Y	76.1	3.0	80		-	2931	1619	nm		-	447.7	49.8	nm		-	3.4	0.36	70		-	114.3	114.3
Prickly Pear Creek	10/24/2008	PPC-3A	92.1	0.5	U	Y	2.0	0.3	nm		-	1685.8	80.6	2	U	-	13.0	8.7	2.5	U	-	73.5	2.9	40		-	2905	1605	nm		-	437.7	48.7	nm		-	3.3	0.36	60		-	111.8	111.8
Prickly Pear Creek	10/24/2008	PPC-5	94.6	0.5	U	Y	2.0	0.3	nm		-	1723.1	82.4	2	U	-	13.3	8.9	2.5	U	-	76.1	3.0	90		-	2931	1619	nm		-	447.7	49.8	nm		-	3.4	0.36	70		-	114.3	114.3
Prickly Pear Creek	5/1/2009	PPC-103	78.0	1.1	UJ	Y	1.7	0.2	5	UJ	-	1471.2	70.3	3		-	11.1	7.5	3.5		Y	59.5	2.3	50		-	2749	1519	5	U	-	380.3	42.3	0.25	U	-	2.5	0.36	50		-	97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-103A	78.0	1.4	UJ	Y	1.7	0.2	5	UJ	-	1471.2	70.3	3		-	11.1	7.5	3.1		Y	59.5	2.3	50		-	2749	1519	5	U	-	380.3	42.3	0.25	U	-	2.5	0.36	60		-	97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-5	78.0	0.2	UJ	-	1.7	0.2	5	UJ	-	1471.2	70.3	3		-	11.1	7.5	2.8		Y	59.5	2.3	50		-	2749	1519	5	U	-	380.3	42.3	0.25	U	-	2.5	0.36	50		-	97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-7	78.0	0.3	UJ	Y	1.7	0.2	5	UJ	-	1471.2	70.3	3		-	11.1	7.5	3.1		Y	59.5	2.3	50		-	2749	1519	5	U	-	380.3	42.3	0.25	U	-	2.5	0.36	50		-	97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-8	73.0	1.1	UJ	Y	1.5	0.2	2.5	U	-	1393.6	66.6	3		-	10.4	7.1	3.8		Y	54.7	2.1	50		-	2689	1486	5	U	-	359.6	40.0	0.25	U	-	2.2	0.36	60		-	91.8	91.8
Prickly Pear Creek	10/29/2009	PPC-103	103.7	1	UJ	Y	2.2	0.3	0.5	U	-	1857.8	88.8	2	J	-	14.5	9.6	2.5	U	-	85.5	3.3	80		-	3022	1670	5	U	-	483.9	53.8	5	UJ	Y	4.0	0.36	80		-	123.6	123.6
Prickly Pear Creek	10/29/2009	PPC-3A	101.2	1	UJ	Y	2.2	0.3	0.5	U	-	1821.1	87.0	2	J	-	14.2	9.4	5	J	Y	82.9	3.2	50		-	2998	1656	5	U	-	474.0	52.7	5	UJ	Y	3.9	0.36	90		-	121.1	121.1
Prickly Pear Creek	10/29/2009	PPC-5	101.2	1	UJ	Y	2.2	0.3	0.5	U	-	1821.1	87.0	2	J	-	14.2	9.4	5	J	Y	82.9	3.2	80		-	2998	1656	5	U	-	474.0	52.7	5	UJ	Y	3.9	0.36	80		-	121.1	121.1
Prickly Pear Creek	10/29/2009	PPC-7	101.2	1	UJ	Y	2.2	0.3	1	U	-	1821.1	87.0	2	J	-	14.2	9.4	5	UJ	Y	82.9	3.2	80		-	2998	1656	10	U	-	474.0	52.7	5	UJ	Y	3.9	0.36	90		-	121.1	121.1
Prickly Pear Creek	10/29/2009	PPC-8	101.2	1	UJ	Y	2.2	0.3	0.5	U	-	1821.1	87.0	4	J	-	14.2	9.4	5	J	Y	82.9	3.2	80		-	2998	1656	5	U	-	474.0	52.7	2.5	U	-	3.9	0.36	90		-	121.1	121.1
Prickly Pear Creek	7/8/2010	PPC-7	66.4	nm			1.4	0.2	nm		-	1289.4	61.6	nm			9.5	6.6	nm			48.5	1.9	nm			2605	1439	nm		-	331.8	36.9	nm		-	1.9	0.36	nm			84.7	84.7
Prickly Pear Creek	7/8/2010	PPC-8	58.9	nm			1.2	0.2	nm			1169.0	55.9	nm			8.5	5.9	nm			41.6	1.6	nm			2503	1383	nm			299.9	33.3	nm			1.5	0.36	nm			76.5	76.5
Upper Lake/Marsh	2003	ULM_1	133.0	0.21		-	2.9	0.3	5	U	-	2277.4	108.9	4		-	18.3	11.9	6.9		Y	117.4	4.6	47.6		-	3283	1814	20	U	-	597.2	66.4	5	U	-	6.2	0.36	27.4		-	152.6	152.6
Upper Lake/Marsh	2003	ULM_10	111.0	0.85		Y	2.4	0.3	5	U	-	1963.9	93.9	5.4		-	15.4	10.2	31.6		Y	93.2	3.6	90.1		-	3091	1708	20	U	-	512.5	57.0	5	U	Y	4.5	0.36	30	U	-	130.9	130.9
Upper Lake/Marsh	2003	ULM_3	107.0	0.44		Y	2.3	0.3	0.67		-	1905.8	91.1	4.1		-	14.9	9.9	16.5		Y	89.0	3.5	70.8		-	3054	1687	20	U	-	496.8	55.2	0.86		-	4.3	0.36	30	U	-	126.9	126.9
Upper Lake/Marsh	2003	ULM_4	114.0	0.11		-	2.4	0.3	5	U	-	2007.3	95.9	4		-	15.8	10.4	5	U	Y	96.5	3.8	85.2		-	3119	1723	20	U	-	524.2	58.3	5	U	Y	4.7	0.36	30	U	-	133.9	133.9
Upper Lake/Marsh	2003	ULM_7	107.0	0.18		-	2.3	0.3	0.96		-	1905.8	91.1	3.8		-	14.9	9.9	5	U	Y	89.0	3.5	49.5		-	3054	1687	20	U	-	496.8	55.2	5	U	Y	4.3	0.36	30	U	-	126.9	126.9
Upper Lake/Marsh	2003	ULM_11	112.0	1.1		Y	2.4	0.3	0.69		-	1978.4	94.6	8.3		-	15.6	10.3	28.2		Y	94.3	3.7	79.2		-	3101	1713	20	U	-	516.4	57.4	-	R	Y	4.6	0.36	31.9		-	131.9	131.9
Upper Lake/Marsh	2003	ULM_12	110.0	5.6		Y	2.4	0.3	0.89		-	1949.4	93.2	22.1		Y	15.3	10.1	156		Y	92.2	3.6	97.9		-	3082	1703	20	U	-	508.6	56.5	0.94		-	4.5	0.36	97.9		-	129.9	129.9
Upper Lake/Marsh	2003	ULM_2	127.0	2.1		Y	2.7	0.3	2.9		-	2192.9	104.8	23.4		Y	17.5	11.4	57.6		Y	110.7	4.3	2180		Y	3233	1786	20	U	-	574.3	63.9	5	U	-	5.7	0.36	253		Y	146.7	146.7
Upper Lake/Marsh	2003	ULM_5	122.0	2.9		Y	2.6	0.3	1.9		-	2122.0	101.4	27.7		Y	16.9	11.1	115		Y	105.2	4.1	241		-	3190	1763	20	U	-	555.1	61.7	-	R	Y	5.3	0.36	140		-	141.8	141.8
Upper Lake/Marsh	2003	ULM_6	115.0	0.25		-	2.5	0.3	4.1		-	2021.7	96.6	7.9		-	16.0	10.5	19.9		Y	97.5	3.8	40.7		-	3128	1728	20	U	-	528.1	58.7	0.81		-	4.8	0.36	30	U	-	134.9	134.9
Upper Lake/Marsh	2003	ULM_8	157.0	3.1		Y	3.4	0.4	2.4		-	2608.9	124.7	21.5		Y	21.4	13.7	68.4		Y	145.0	5.6	1740		-	3470	1917	20	U	-	687.2	76.4	0.8		-	8.2	0.36	127		-	175.6	175.6
Upper Lake/Marsh	2003	ULM_9	111.0	1.4		Y	2.4	0.3	1.1		-	1963.9	93.9	13.4		Y	15.4	10.2	20.6		Y	93.2	3.6	382		-	3091	1708	20	U	-	512.5	57.0	5	U	Y	4.5	0.36	59.3		-	130.9	130.9
Upper Lake/Marsh	11/7/2002	Upper Lake	127.0	30		Y	2.7	0.3	nm		Y	2192.4	104.8	90	U	Y	17.5	11.4	800		Y	110.6	4.3	200		-	3233	1786	nm		-	574.2	63.8	nm		Y	5.7	0.36	300		Y	146.7	146.7
Upper Lake/Marsh	5/6/2009	Upper Lake	75.5	3		Y	1.6	0.2	6		-	1432.6	68.5	11	U	Y	10.7	7.3	44		Y	57.1	2.2	40		-	2719	1502	10	U	-	370.0	41.1	0.5	U	-	2.3	0.36	60		-	94.4	94.4
Upper Lake/Marsh	10/29/2009	Upper Lake	103.7	2	J	Y	2.2	0.3	1	U	-	1857.8	88.8	6	J	-	14.5	9.6	27	J	Y	85.5	3.3	40		-	3022	1670	10	U	-	483.9	53.8	5	U	-	4.0	0.36	60		-	123.6	123.6
Wilson Ditch	6/4/2001	WD-1	61.8	1	U	Y	1.3	0.2	nm		-	1216.0	58.1	4	U	-	8.9	6.2	10		Y	44.3	1.7	60		-	2544	1405	nm		-	312.3	34.7	nm		-	1.7	0.36	30		-	79.7	79.7
Wilson Ditch	6/20/2002	WD-1	50.2	3		Y	1.1	0.2	nm		-	1026.1	49.0	10		Y	7.3	5.2	60		Y	34.0	1.3	40		-	2374	1312	nm		-	262.1	29.1	nm		-	1.2	0.36	40		-	66.9	66.9
Wilson Ditch	6/4/2001	WD-2	61.4	1	U	Y	1.3	0.2	nm			1209.3	57.8	4	U	-	8.8	6.1	7		Y	43.9	1.7	60		-	2538	1402	nm			310.5	34.5	nm			1.6	0.36	30		-	79.3	79.3
Wilson Ditch	6/20/2002	WD-2	50.2	2		Y	1.1	0.2	nm			1025.4	49.0	7			7.3	5.2	30		Y	34.0	1.3	60		-	2373	1311	nm			261.9	29.1	nm			1.2	0.36	100			66.8	66.8

Notes:

(a) Acute and chronic citeria adjusted based on the sample specific hardness.

(b) If sample is nondected ("U"), concentration is assumed to be ½ the detection limit.

Metal is highlighted if concentrations exceeds the sample-specific acute or chronic benchmarks (Table D3).

Table D-5. Total Recoverable Metals Surface Water Screening Results

	Total Recoverable Surface Water Benchmark(b)		Maximum Total Recoverable Concentration (ug/L) for Each CSM Unit								
	Acute (ug/L)	Chronic (ug/L)	PPC		UL/ULM		WD		LL		COPC (Y/N)
Metal			**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	
Aluminum	750	87	210	50	1960	50	70	50	50	50	**Y**
Antimony	900	190	26	3	3	3	U	3	146	-	n
Arsenic	340	150	30	5	29.3	-	12	5	200	-	**Y**
Barium	2000	220	U	100	U	100	U	100	U	100	n
Beryllium	93	11	U	1	U	1	U	1	U	1	n
Cadmium [a]	2.1	0.27	1.4	0.1-1	3.1	-	1.3	1	9	3	**Y**
Chromium (III) [a]	1803	86	3	1	2	1	U	1	2	1	n
Chromium (IV)	16.0	11	3	1	2	1	U	0.5	2	1	n
Cobalt	220	24	U	0.5	2.4	0.5	U	0.5	U	0.5	n
Copper [a]	14	9	10	4	54	-	9	4	60	-	**Y**
Iron	na	1000	860	20	4180	-	300	-	320	20	**Y**
Lead [a]	82	3.2	23	5	286	-	10	-	63	-	**Y**
Manganese [a]	2986	1650	110	-	1030	-	60	-	710	-	n
Mercury	1.4	0.77	U	0.0001	-	-	-	-	U	0.0001	n
Nickel [a]	469	52.2	U	10	U	10	U	10	U	10	n
Selenium	20	5	4	1	1	1	U	1	28	-	**Y**
Silver [a]	3.8	0.36	U	0.5	1.5	0.5	U	0.5	U	0.5	**Y**
Thallium	79	17	U	0.2	U	0.2	U	0.2	35	-	**Y**
Vanadium	150	44	U	10-100	U	10-100	U	100	U	10-100	n
Zinc [a]	120	120	100	-	290	-	30	-	50	10	**Y**

Notes:

PPC = Prickly Pear Creek

UL/ULM = Upper Lake and Upper Lake Marsh

WD = Wilson Ditch

LL = Lower Lake

U = Undetected

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed acute or chronic dissolved surface water benchmarks (highlighted).

(a) Criterion is shown at a hardness of 100 mg/L as $CaCO_3$*, however screening was conducted on a sample-specific basis (see Table D-6).*

(b) Benchmarks from Table C-1.

Table D-6. Hardness-Based Total Recoverable Metals Surface Water Screening Results

			Hardness [a]	Cd		Cd-SWB		Cr		Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	Date	Sample ID	mg/L as $CaCO_3$	ug/L	Q [b]	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch	ug/L	Q	Ac	Ch
Lower Lake	5/15/2002	Lower Lake	280.9268	8		6.1	0.6	nm		4201.5	200.8	30		37.0	22.6	40		304.1	11.8	400		4212	2327	nm		1124.2	125.0	nm		22.4	0.36	50		287.5	287.5
Lower Lake	11/4/2004	Lower Lake	161.153	3	UJ	3.5	0.4	nm		2665.2	127.4	14		21.9	14.0	22		149.9	5.8	270		3500	1934	nm		702.5	78.1	nm		8.6	0.36	20		179.5	179.5
Lower Lake	6/9/2005	Lower Lake	157.8	9		3.4	0.4	nm		2619.4	125.2	23		21.5	13.8	63		145.9	5.7	160		3475	1920	nm		690.1	76.7	nm		8.3	0.36	50		176.3	176.3
Lower Lake	5/1/2009	Lower Lake	139.4	2.9	J	3.0	0.3	2		2367.1	113.1	14		19.1	12.4	9.1		124.6	4.9	80		3335	1843	5	U	621.5	69.1	0.25	U	6.7	0.36	20		158.8	158.8
Lower Lake	7/8/2010	Lower Lake	103.7	2		2.2	0.3	0.5	U	1857.8	88.8	9		14.5	9.6	4.9		85.5	3.3	150		3022	1670	5	U	483.9	53.8	0.25	U	4.0	0.36	5	U	123.6	123.6
Lower Lake	8/3/2010	LL-21	105.3	1.4		2.2	0.3	0.5	U	1881.5	89.9	10		14.7	9.8	13.5		87.2	3.4	350		3038	1678	5	U	489.3	54.3	0.25	U	4.1	0.36	5	U	125.2	125.2
Lower Lake	8/3/2010	LL-22	107.8	1.5		2.3	0.3	0.5	U	1918.0	91.7	10		15.0	10.0	11.8		89.9	3.5	340		3062	1692	5	U	499.1	55.4	0.25	U	4.3	0.36	5	U	127.7	127.7
Lower Lake	8/3/2010	LL-23	102.8	6.3		2.2	0.3	0.5	U	1844.9	88.2	60		14.4	9.6	55.8		84.6	3.3	710		3014	1665	5	U	479.5	53.3	0.25	U	4.0	0.36	30		122.7	122.7
Lower Lake	8/3/2010	LL-24	102.8	1.1		2.2	0.3	0.5	U	1844.9	88.2	8		14.4	9.6	7.6		84.6	3.3	330		3014	1665	5	U	479.5	53.3	0.25	U	4.0	0.36	5	U	122.7	122.7
Lower Lake	8/3/2010	LL-25	105.3	1.2		2.2	0.3	0.5	U	1881.5	89.9	8		14.7	9.8	8		87.2	3.4	350		3038	1678	5	U	489.3	54.3	0.25	U	4.1	0.36	5	U	125.2	125.2
Prickly Pear Creek	5/15/2002	PPC-101	233.2	0.5	U	5.0	0.5	nm		3606.7	172.4	10		31.1	19.2	2.5	U	239.9	9.3	50		3958	2187	nm		960.2	106.8	nm		16.2	0.36	100		245.5	245.5
Prickly Pear Creek	5/15/2002	PPC-102	82.2	0.5	U	1.7	0.2	nm		1534.9	73.4	4		11.6	7.9	5		63.6	2.5	90		2796	1545	nm		397.3	44.2	nm		2.7	0.36	50		101.4	101.4
Prickly Pear Creek	5/15/2002	PPC-103	81.7	0.5	U	1.7	0.2	nm		1528.6	73.1	4		11.6	7.9	6		63.2	2.5	80		2792	1542	nm		395.6	44.0	nm		2.7	0.36	50		101.0	101.0
Prickly Pear Creek	5/15/2002	PPC-3A	81.3	0.5	U	1.7	0.2	nm		1522.3	72.8	2	U	11.5	7.8	2.5	U	62.8	2.4	60		2787	1540	nm		393.9	43.8	nm		2.7	0.36	50		100.6	100.6
Prickly Pear Creek	5/15/2002	PPC-5	78.8	0.5	U	1.7	0.2	nm		1483.9	70.9	4		11.2	7.6	6		60.3	2.4	80		2758	1524	nm		383.7	42.7	nm		2.5	0.36	50		97.9	97.9
Prickly Pear Creek	5/15/2002	PPC-6A	82.1544	0.5	U	1.7	0.2	nm		1534.9	73.4	5		11.6	7.9	7		63.6	2.5	90		2796	1545	nm		397.3	44.2	nm		2.7	0.36	60		101.4	101.4
Prickly Pear Creek	5/15/2002	PPC-7	81.7	0.5	U	1.7	0.2	nm		1528.6	73.1	5		11.6	7.9	7		63.2	2.5	90		2792	1542	nm		395.6	44.0	nm		2.7	0.36	60		101.0	101.0
Prickly Pear Creek	5/15/2002	PPC-8	81.7	0.5	U	1.7	0.2	nm		1528.6	73.1	7		11.6	7.9	8		63.2	2.5	100		2792	1542	nm		395.6	44.0	nm		2.7	0.36	70		101.0	101.0
Prickly Pear Creek	11/4/2004	PPC-103	103.7	0.5	U	2.2	0.3	nm		1857.8	88.8	2	U	14.5	9.6	2.5	U	85.5	3.3	80	J	3022	1670	nm		483.9	53.8	nm		4.0	0.36	30		123.6	123.6
Prickly Pear Creek	11/4/2004	PPC-3A	106.2	0.5	U	2.3	0.3	nm		1894.4	90.5	2	U	14.8	9.8	2.5	U	88.2	3.4	50	J	3046	1683	nm		493.7	54.9	nm		4.2	0.36	40		126.1	126.1
Prickly Pear Creek	11/4/2004	PPC-5	103.7	0.5	U	2.2	0.3	nm		1857.8	88.8	2	U	14.5	9.6	2.5	U	85.5	3.3	60	J	3022	1670	nm		483.9	53.8	nm		4.0	0.36	20		123.6	123.6
Prickly Pear Creek	11/4/2004	PPC-7	101.2	0.5	U	2.2	0.3	nm		1821.1	87.0	2	U	14.2	9.4	2.5	U	82.9	3.2	70	J	2998	1656	nm		474.0	52.7	nm		3.9	0.36	50		121.1	121.1
Prickly Pear Creek	11/4/2004	PPC-8	101.2	0.5	U	2.2	0.3	nm		1821.1	87.0	2	U	14.2	9.4	2.5	U	82.9	3.2	70	J	2998	1656	nm		474.0	52.7	nm		3.9	0.36	60		121.1	121.1
Prickly Pear Creek	6/9/2005	PPC-103	49.8	0.5	U	1.1	0.2	nm		1018.7	48.7	5		7.3	5.1	9		33.6	1.3	60		2367	1308	nm		260.1	28.9	nm		1.1	0.36	70		66.4	66.4
Prickly Pear Creek	6/9/2005	PPC-3A	52.3	0.5	U	1.1	0.2	nm		1060.4	50.7	5		7.6	5.4	9		35.8	1.4	60		2406	1329	nm		271.1	30.1	nm		1.2	0.36	70		69.2	69.2
Prickly Pear Creek	6/9/2005	PPC-5	49.8	0.5	U	1.1	0.2	nm		1018.7	48.7	5		7.3	5.1	8		33.6	1.3	50		2367	1308	nm		260.1	28.9	nm		1.1	0.36	60		66.4	66.4
Prickly Pear Creek	6/9/2005	PPC-7	52.3	0.5	U	1.1	0.2	nm		1060.4	50.7	6		7.6	5.4	9		35.8	1.4	50		2406	1329	nm		271.1	30.1	nm		1.2	0.36	70		69.2	69.2
Prickly Pear Creek	6/9/2005	PPC-8	49.8	0.5	U	1.1	0.2	nm		1018.7	48.7	5		7.3	5.1	9		33.6	1.3	60		2367	1308	nm		260.1	28.9	nm		1.1	0.36	70		66.4	66.4
Prickly Pear Creek	5/1/2009	PPC-103	78.0	1.2	J	1.7	0.2	3		1471.2	70.3	4		11.1	7.5	2.6		59.5	2.3	50		2749	1519	5	U	380.3	42.3	0.25	U	2.5	0.36	70		97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-103A	78.0	1.4	J	1.7	0.2	2		1471.2	70.3	3		11.1	7.5	3.1		59.5	2.3	50		2749	1519	5	U	380.3	42.3	0.25	U	2.5	0.36	80		97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-5	78.011	0.1	UJ	1.7	0.2	2		1471.2	70.3	4		11.1	7.5	2.6		59.5	2.3	50		2749	1519	5	U	380.3	42.3	0.25	U	2.5	0.36	60		97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-7	78.0	0.2	J	1.7	0.2	2		1471.2	70.3	4		11.1	7.5	2.9		59.5	2.3	50		2749	1519	5	U	380.3	42.3	0.25	U	2.5	0.36	60		97.1	97.1
Prickly Pear Creek	5/1/2009	PPC-8	73.0	1.2	J	1.5	0.2	2		1393.6	66.6	4		10.4	7.1	3.5		54.7	2.1	50		2689	1486	5	U	359.6	40.0	0.25	U	2.2	0.36	70		91.8	91.8
Prickly Pear Creek	7/8/2010	PPC-103	58.9	0.6		1.2	0.2	0.5	U	1169.0	55.9	8		8.5	5.9	22.6		41.6	1.6	110		2503	1383	5	U	299.9	33.3	0.25	U	1.5	0.36	80		76.5	76.5
Prickly Pear Creek	7/8/2010	PPC-3A	58.9	0.3		1.2	0.2	0.5	U	1169.0	55.9	5		8.5	5.9	8.9		41.6	1.6	80		2503	1383	5	U	299.9	33.3	0.25	U	1.5	0.36	60		76.5	76.5
Prickly Pear Creek	7/8/2010	PPC-5	58.913	0.3		1.2	0.2	0.5	U	1169.0	55.9	5		8.5	5.9	9.1		41.6	1.6	70		2503	1383	5	U	299.9	33.3	0.25	U	1.5	0.36	50		76.5	76.5
Prickly Pear Creek	7/8/2010	PPC-7	66.4	0.3		1.4	0.2	0.5	U	1289.4	61.6	5		9.5	6.6	9.6		48.5	1.9	80		2605	1439	5	U	331.8	36.9	0.25	U	1.9	0.36	60		84.7	84.7
Prickly Pear Creek	7/8/2010	PPC-8	58.9	0.3		1.2	0.2	0.5	U	1169.0	55.9	5		8.5	5.9	9.8		41.6	1.6	70		2503	1383	5	U	299.9	33.3	0.25	U	1.5	0.36	60		76.5	76.5
Prickly Pear Creek	8/4/2010	PPC-22 (SG-03A)	92.1	0.2		2.0	0.3	0.5	U	1685.8	80.6	3		13.0	8.7	3		73.5	2.9	50		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	40		111.8	111.8
Prickly Pear Creek	8/4/2010	PPC-102 (SG-06)	89.6	0.2		1.9	0.2	0.5	U	1648.2	78.8	3		12.6	8.5	4.9		71.0	2.8	90		2879	1590	5	U	427.6	47.5	0.25	U	3.1	0.36	40		109.2	109.2
Prickly Pear Creek	8/4/2010	PPC-5 (SG-07)	92.1	0.2		2.0	0.3	0.5	U	1685.8	80.6	3		13.0	8.7	5.3		73.5	2.9	90		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	40		111.8	111.8
Prickly Pear Creek	8/4/2010	PPC-23 (SG-08)	87.1	0.3		1.9	0.2	0.5	U	1610.5	77.0	3		12.3	8.3	6		68.5	2.7	90		2852	1576	5	U	417.5	46.4	0.25	U	3.0	0.36	50		106.6	106.6
Prickly Pear Creek	8/4/2010	PPC-7 (SG-09)	83.0	0.3		1.8	0.2	0.5	U	1547.9	74.0	3		11.7	8.0	6.2		64.4	2.5	90		2806	1550	5	U	400.8	44.6	0.25	U	2.7	0.36	50		102.3	102.3
Prickly Pear Creek	8/4/2010	PPC-8 (SG-10)	80.5	0.3		1.7	0.2	0.5	U	1509.7	72.2	3		11.4	7.8	6.3		62.0	2.4	90		2778	1535	5	U	390.5	43.4	0.25	U	2.6	0.36	50		99.7	99.7
Prickly Pear Creek	8/4/2010	SG-11	85.5	0.3		1.8	0.2	0.5	U	1586.0	75.8	3		12.1	8.2	6.5		66.9	2.6	80		2834	1566	5	U	410.9	45.7	0.25	U	2.9	0.36	50		104.9	104.9
Prickly Pear Creek	8/5/2010	PPC-102 (piezometer)	86.3	0.05	U	1.8	0.2	0.5	U	1598.1	76.4	1		12.2	8.2	6.1		67.7	2.6	1370		2843	1571	5	U	414.2	46.0	0.25	U	2.9	0.36	1820		105.8	105.8
Prickly Pear Creek	8/5/2010	PPC-103 (piezometer)	86.7	0.7		1.8	0.2	0.5	U	1604.2	76.7	2		12.2	8.3	5.7		68.1	2.7	710		2847	1573	5	U	415.8	46.2	0.25	U	3.0	0.36	1880		106.2	106.2
Upper Lake/Marsh	5/6/2009	Upper Lake	75.5	3.1		1.6	0.2	0.5	U	1432.6	68.5	10		10.7	7.3	44.5		57.1	2.2	50		2719	1502	5	U	370.0	41.1	0.25	U	2.3	0.36	60		94.4	94.4
Upper Lake/Marsh	8/3/2010	UL-21	87.1	1.6		1.9	0.2	0.5	U	1610.5	77.0	11		12.3	8.3	44.5		68.5	2.7	80		2852	1576	5	U	417.5	46.4	0.25	U	3.0	0.36	40		106.6	106.6
Upper Lake/Marsh	8/5/2010	UL-22	92.1	0.1		2.0	0.3	0.5	U	1685.8	80.6	3		13.0	8.7	3.5		73.5	2.9	110		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	30		111.8	111.8

Table D-6. Hardness-Based Total Recoverable Metals Surface Water Screening Results

			Hardness [a]	Cd		Cd-SWB		Cr		Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	**Date**	**Sample ID**	**mg/L as $CaCO_3$**	**ug/L**	**Q [b]**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**
Upper Lake/Marsh	8/5/2010	UL-23	92.1	0.2		2.0	0.3	0.5	U	1685.8	80.6	3		13.0	8.7	7.3		73.5	2.9	150		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	30		111.8	111.8
Upper Lake/Marsh	8/5/2010	UL-24	92.1	1.3		2.0	0.3	0.5	U	1685.8	80.6	6		13.0	8.7	35.3		73.5	2.9	70		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	30		111.8	111.8
Upper Lake/Marsh	8/5/2010	UL-25	107.1	0.2		2.3	0.3	0.5	U	1907.2	91.2	3		14.9	9.9	5.4		89.1	3.5	140		3055	1688	5	U	497.2	55.3	0.25	U	4.3	0.36	30		127.0	127.0
Upper Lake/Marsh	8/5/2010	ULM-1	94.6	3.2		2.0	0.3	2		1723.1	82.4	54		13.3	8.9	286		76.1	3.0	1030		2931	1619	5	U	447.7	49.8	1.5		3.4	0.36	290		114.3	114.3
Upper Lake/Marsh	8/5/2010	ULM-2	85.5	0.1		1.8	0.2	0.5	U	1586.0	75.8	3		12.1	8.2	3.2		66.9	2.6	50		2834	1566	5	U	410.9	45.7	0.25	U	2.9	0.36	40		104.9	104.9
Upper Lake/Marsh	8/5/2010	ULM-3	97.1	0.1		2.1	0.3	0.5	U	1760.2	84.1	3		13.6	9.1	3.5		78.7	3.1	80		2957	1634	5	U	457.7	50.9	0.25	U	3.6	0.36	40		116.9	116.9
Upper Lake/Marsh	8/5/2010	ULM-4	90.5	0.1		1.9	0.3	0.5	U	1661.4	79.4	3		12.7	8.6	2.9		71.9	2.8	40		2888	1596	5	U	431.2	47.9	0.25	U	3.2	0.36	30		110.1	110.1
Upper Lake/Marsh	8/5/2010	ULM-5	89.6	0.2		1.9	0.2	0.5	U	1648.2	78.8	4		12.6	8.5	5.8		71.0	2.8	40		2879	1590	5	U	427.6	47.5	0.25	U	3.1	0.36	30		109.2	109.2
Upper Lake/Marsh	8/5/2010	ULM-6	83.0	0.3		1.8	0.2	0.5	U	1547.9	74.0	3		11.7	8.0	5.3		64.4	2.5	200		2806	1550	5	U	400.8	44.6	0.25	U	2.7	0.36	30		102.3	102.3
Upper Lake/Marsh	8/5/2010	ULM-7	83.0	0.3		1.8	0.2	0.5	U	1547.9	74.0	5		11.7	8.0	7.1		64.4	2.5	210		2806	1550	5	U	400.8	44.6	0.25	U	2.7	0.36	50		102.3	102.3
Upper Lake/Marsh	8/5/2010	ULM-8	89.6	0.2		1.9	0.2	0.5	U	1648.2	78.8	4		12.6	8.5	7.2		71.0	2.8	90		2879	1590	5	U	427.6	47.5	0.25	U	3.1	0.36	50		109.2	109.2
Upper Lake/Marsh	8/5/2010	ULM-9	89.6	0.1		1.9	0.2	0.5	U	1648.2	78.8	3		12.6	8.5	2.3		71.0	2.8	40		2879	1590	5	U	427.6	47.5	0.25	U	3.1	0.36	40		109.2	109.2
Wilson Ditch	6/4/2001	WD-1	61.8	0.5	U	1.3	0.2	nm		1216.0	58.1	2	U	8.9	6.2	10		44.3	1.7	60		2544	1405	nm		312.3	34.7	nm		1.7	0.36	20		79.7	79.7
Wilson Ditch	6/4/2001	WD-2	61.4	0.5	U	1.3	0.2	nm		1209.4	57.8	2	U	8.8	6.2	7		43.9	1.7	60		2538	1402	nm		310.6	34.5	nm		1.6	0.36	20		79.3	79.3
Wilson Ditch	8/10/2010	WD-2	89.6	0.2		1.9	0.2	0.5	U	1648.2	78.8	3		12.6	8.5	6		71.0	2.8	60		2879	1590	5	U	427.6	47.5	0.25	U	3.1	0.36	30		109.2	109.2
Wilson Ditch	8/10/2010	WD-25	92.1	0.4		2.0	0.3	0.5	U	1685.8	80.6	3		13.0	8.7	6.7		73.5	2.9	50		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	30		111.8	111.8
Wilson Ditch	8/10/2010	WD-26	87.1	1.3		1.9	0.2	0.5	U	1610.5	77.0	7		12.3	8.3	8.1		68.5	2.7	60		2852	1576	5	U	417.5	46.4	0.25	U	3.0	0.36	20		106.6	106.6
Wilson Ditch	8/10/2010	WD-3	92.1	0.2		2.0	0.3	0.5	U	1685.8	80.6	2		13.0	8.7	4		73.5	2.9	50		2905	1605	5	U	437.7	48.7	0.25	U	3.3	0.36	30		111.8	111.8
Wilson Ditch	8/10/2010	WD-4	94.6	0.2		2.0	0.3	0.5	U	1723.1	82.4	9		13.3	8.9	4.5		76.1	3.0	50		2931	1619	5	U	447.7	49.8	0.25	U	3.4	0.36	30		114.3	114.3

Notes:

(a) Acute and chronic citeria adjusted based on the sample specific hardness.

(b) If sample is nondected ("U"), concentration is assumed to be ½ the detection limit.

Metal is highlighted if concentrations exceeds the sample-specific acute or chronic benchmarks (Table D-5).

Table D-7. Dissolved Sediment Porewater Screening Results

	Dissolved Surface Water Benchmark(b)		Maximum Dissolved Concentration (ug/L) for Each CSM Unit						
	Acute	Chronic	PPC		UL/ULM		LL		COPC
Metal	**(ug/L)**	**(ug/L)**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	750	87	U	50-200	U	200	145	-	**Y**
Antimony	900	190	12.1	3-60	U	60	483	-	**Y**
Arsenic	340	150	10.3	15	U	15	2530	-	**Y**
Barium	2000	220	108	100-200	183	-	42.9	-	n
Beryllium	93	11	U	1-5	U	5	U	5	n
Cadmium [a]	2.0	0.25	2.2	0.1	0.35	5	3.2	-	**Y**
Chromium (III) [a]	570	74	1.2	1-10	3.1	-	4.6	-	n
Chromium (IV)	16	11	1.2	1-10	3.1	-	4.6	-	n
Cobalt	220	24	3.8	0.5-50	1.2	50	U	50	n
Copper [a]	14	9	6.4	1	3.8	25	7.6	-	n
Iron	na	1000	89.4	20	19900	-	323	-	**Y**
Lead [a]	65	2.5	U	0.5-10	10.5	10	17.7	-	**Y**
Manganese [a]	2986	1650	1260	15	3010	-	773	-	**Y**
Mercury	1.4	0.77	U	0.005-0.2	U	0.2	-	-	n
Nickel [a]	468	52.0	U	10-40	3.1	40	6.1	-	n
Selenium	20	4.61	14.1	1-35	U	35	7.2	-	**Y**
Silver [a]	3.2	0.36	1.2	0.5	1.4	10	1.5	-	**Y**
Thallium	79	17	U	0.2-25	U	25	U	25	n
Vanadium	150	44	5.4	100	U	50	4.6	-	n
Zinc [a]	117	118	194	-	30	60	40.9	-	**Y**

Notes:

PPC = Prickly Pear Creek

UL/ULM = Upper Lake and Upper Lake Marsh

WD = Wilson Ditch

LL = Lower Lake

U = Undetected

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed acute or chronic dissolved surface water benchmarks (highlighted).

(a) Criterion is shown at a hardness of 100 mg/L as $CaCO_3$, however screening was conducted on a sample-specific basis (see Table D-8).

(b) Benchmarks from Table C-1.

Table D-8. Hardness-Based Dissolved Sediment Porewater Screening Results

		Hardness ^{a}	Cd		Cd-SWB		Cr		Cr-SWB		Cu		Cu-SWB		Pb		Pb-SWB		Mn		Mn-SWB		Ni		Ni-SWB		Ag		Ag-SWB		Zn		Zn-SWB	
CSM Unit	**Sample ID**	**mg/L as $CaCO_3$**	**ug/L**	**Q ^{b}**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**	**ug/L**	**Q**	**Ac**	**Ch**
Lower Lake	LL_1	193	3.2		3.8	0.4	4.6		976	127	7.6		25.0	15.7	17.7		274.9	10.0	773		3717	2054	6.1		817	91	1.5		10.0	0.36	40.9		204.6	206.2
Upper Lake/Marsh	ULM_3	182	2.5	U	3.6	0.4	1.6		930	121	3.5		23.6	14.9	5	U	255.1	9.2	916		3645	2014	3.1		777	86	0.94		9.0	0.36	30	U	194.6	237.5
Upper Lake/Marsh	ULM_4	154	2.5	U	3.1	0.3	2		811	106	12.5	U	20.2	13.0	5	U	206.1	7.3	1990		3448	1905	20	U	675	75	5	U	6.8	0.36	30	U	168.9	204.9
Upper Lake/Marsh	ULM_7	229	2.5	U	4.5	0.4	2.3		1123	146	3.8		29.3	18.2	4.7		341.9	12.6	1840		3935	2174	20	U	944	105	1.1		13.4	0.36	30	U	236.5	291.0
Upper Lake/Marsh	ULM_10	290	0.35		5.7	0.5	2.7		1363	177	12.5	U	36.6	22.2	5	U	462.1	17.2	2700		4257	2352	20	U	1153	128	1.2		20.1	0.36	30	U	288.8	358.6
Upper Lake/Marsh	ULM_6	196	2.5	U	3.9	0.4	3.1		989	129	3.3		25.3	15.9	7.5		280.4	10.2	3010		3736	2064	20	U	827	92	1.4		10.2	0.36	30		207.2	253.6
Upper Lake/Marsh	ULM_12	222	2.5	U	4.4	0.4	2.7		1095	142	3.1		28.5	17.7	10.5		328.7	12.1	2460		3894	2152	20	U	919	102	0.78		12.7	0.36	30	U	230.3	283.1
Prickly Pear Creak	PPC_2	118	1		2.4	0.3	0.75		652	85	4.3		15.7	10.3	5	U	146.7	5.0	547		3155	1743	20	U	539	60	1.2		4.3	0.36	194		134.8	161.9
Prickly Pear Creak	PPC_3	116	0.27		2.3	0.3	5	U	643	84	6.4		15.5	10.2	5	U	143.5	4.9	7.5	U	3137	1733	20	U	531	59	0.7		4.2	0.36	187		132.9	159.5
Prickly Pear Creak	PPC_4	118	0.31		2.4	0.3	5	U	652	85	6		15.7	10.3	5	U	146.7	5.0	7.5	U	3155	1743	20	U	539	60	0.99		4.3	0.36	140		134.8	161.9
Prickly Pear Creak	PPC_5	212	2.2		4.2	0.4	1.2		1054	137	3.9		27.3	17.0	5	U	309.9	11.3	1260		3835	2119	20	U	884	98	1		11.7	0.36	170		221.5	271.8

Notes:

(a) Acute and chronic citeria adjusted based on the sample specific hardness.

(b) If sample is nondected ("U"), concentration is assumed to be ½ the detection limit.

Metal is highlighted if concentrations exceeds the sample-specific acute or chronic benchmarks (Table D-7).

Table D-9. Sediment Screening Results

	Sediment Benchmarks (mg/kg) for Benthic Invertebrates(a)		Maximum Sediment Concentration (mg/kg-dw) for Each CSM Unit								
			PPC		UL/ULM		WD		LL		COPC
Metal	**TEC**	**PEC**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	25,519	59,572	10,100	-	20,000	-	7,070	-	13,000	-	n
Antimony	2	25	4.5	0.5 - 15.5	112	-	5.9	-	990	-	**Y**
Arsenic	9.79	33	250	-	581	-	79	-	3,030	-	**Y**
Barium	none	none	352	100	282	100	-	100	245	100	**Y (no bm)**
Beryllium	none	none	1.4	10	2.1	10	-	10	1.8	10	**Y (no bm)**
Cadmium	0.99	4.98	36.8	-	338	-	27.7	-	2,680	-	**Y**
Chromium	43.4	111	21.2	5	27.3	-	8	5	22.1	-	n
Cobalt	50	none	21.2	-	24.1	-	6	-	35.1	-	n
Copper	31.6	149	480	-	2,290	-	154	-	2,600	-	**Y**
Iron	188,400	247,600	38,100	-	34,400	-	12,200	-	35,200	-	n
Lead	35.8	128	1,090	-	10,800	-	1,610	-	14,400	-	**Y**
Manganese	460	1100	9,030	-	2,520	-	1,120	-	1,370	-	**Y**
Mercury	0.18	1.06	3.1	0.05-0.5	230	0.5	120	-	53.3	-	**Y**
Nickel	22.7	48.6	16.1	5	24.8	5	6	5	36.4	5	**Y**
Selenium	none	none	5.3	0.5	21.8	0.5	1.6	0.5	432	-	**Y (no bm)**
Silver	1	2.2	2.5	2.4-2.6	127	2.6	11.1	-	141	-	**Y**
Thallium	none	none	-	1-6	5	1-10.5	2	1	1,980	-	**Y (no bm)**
Vanadium	none	none	55.2	10	59.4	-	27	-	57.7	-	**Y (no bm)**
Zinc	121	459	3,930	-	6,550	-	720	-	6,930	-	**Y**

Notes:

PPC = Prickly Pear Creek

ULM = Upper Lake Marsh

UL = Upper Lake

WD = Wilson Ditch

LL = Lower Lake

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed sediment benchmarks (highlighted).

no bm = No Benchmark

(a) Benchmarks from Table C-2

Table D-10. Dietary Benchmark Screening for Fish

	Dietary Benchmark[c]		Aquatic Invertebrates (mg/kg-dw)								Aquatic Plants (mg/kg-dw) [a]								Forage Fish (mg/kg-dw)								Sediment (mg/kg-dw) [b]								
	Threshold	NOAEL	PPC		ULM		WD		LL		PPC		ULM		WD		LL		PPC		ULM		WD		LL		PPC		ULM		WD		LL		COPC
Metal	(mg/kg-dw)	(mg/kg-dw)	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	(Y/N)
Arsenic	40	63	11.4	-	11	10	5.01	-	390	-	nm	-	85	-	nm	-	nm	-	0.83	-	1.60	10	0.93	-	18.5	-	25	-	58.1	-	7.9	-	303	-	**Y**
Cadmium	na	55	2.48	-	48	-	1.87	-	48.5	-	nm	-	21	2	nm	-	nm	-	0.10	-	7	-	0.47	-	16.3	-	3.68	-	33.8	-	2.77	-	268	-	**Y**
Copper	na	340	90.5	-	398	-	14.9	-	239	-	nm	-	94	-	nm	-	nm	-	0.92	-	45.5	-	2.69	-	28.3	-	48	-	229	-	15.4	-	260	-	**Y**
Lead	na	170	25.6	-	526	-	45.1	-	648	-	nm	-	209	-	nm	-	nm	-	1.27	-	125	-	20	-	164.0	-	109	-	1080	-	161	-	1440	-	**Y**
Selenium	3	2	0.42	-	0.91	25	0.34	-	6.18	-	nm	-	-	25	nm	-	nm	-	0.55	-	0.6	25	0.3	-	8.4	-	0.53		2.18		0.16	-	43.2	-	**Y**
Zinc	na	1500	208	-	231	-	111	-	596	-	nm	-	470	-	nm	-	nm	-	40.4	-	330	-	59.9	-	124.0	-	393	-	655	-	72	-	693	-	n

Notes:

PPC = Prickly Pear Creek

UL/ULM = Upper Lake and Upper Lake Marsh

WD = Wilson Ditch

LL = Lower Lake

U = Undetected

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed dietary benchmarks (highlighted).

(a) Moisture percent not report, therefore 80% assumed.

(b) Sediment ingestion assumed to be 10%, therefore 10% of the maximum value shown (see Table D-9 for maximum sediment concentrations).

(c) Benchmarks from Table C-4.

Table D-11. Soil Screening Results for Terrestrial Plants

	Soil Benchmark for Plants(a) (mg/kg-dw)	**Maximum Soil Concentration (mg/kg-dw) for Each CSM Unit**														
										SP						
		PPC		**UL**		**LL**		**Tito Park**		**West**		**East**		**FS**		**COPC**
Metal		**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	soil pH<5.5	7890	-	13100	-	12400	-	13400	-	12000	-	6820	-	12400	-	n
Antimony	5	56	-	61	-	115	-	67	-	92	-	28	-	173	-	**Y**
Arsenic	18	232	-	393	-	1190	-	8091	-	829	0.1	3121	0.1	21625	-	**Y**
Barium	500	912	100	143	100	351	100	178	-	838	100	107	100	797	100	**Y**
Beryllium	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	n
Cadmium	32	57.7	-	380	-	350	-	14725	-	363	5	92	5	3069	5	**Y**
Chromium (total)	1	21	-	17	5	17	-	18	-	26	-	15	-	26	-	**Y**
Cobalt	13	16	-	13	-	21	-	9	-	46	0.1	8	-	43	-	**Y**
Copper	70	1030	-	882	-	2410	-	23599	-	9750	-	16375	0.1	35750	0.1	**Y**
Iron	soil pH <5 or >8	43800	-	20300	-	27500	-	20100	-	57500	-	22700	-	52900	-	**Y (pH)**
Lead	120	3590	-	8690	-	8130	-	71196	-	11600	-	3811	-	62282	-	**Y**
Manganese	220	1350	-	498	-	1040	-	493	-	3290	-	830	-	3910	-	**Y**
Mercury	0.3	11	0.5	58	-	28	-	10	-	8.2	-	11	-	17	-	**Y**
Nickel	38	12	-	15	5	36	-	24	-	82	5	8	-	84	-	**Y**
Selenium	0.52	33	-	54	-	23	0.5	13	0.5	27	-	4.1	-	20	-	**Y**
Silver	560	54	-	61	2	90	2	42	2	233	-	18	-	133	-	n
Thallium	1.0	2.6	1	7	-	29	-	8	0.1-50	6	-	3.7	-	6	-	**Y**
Vanadium	2	46	-	48	-	48	-	45	-	53	-	50	-	54	-	**Y**
Zinc	160	3010	-	2620	-	5270	-	44050	-	14100	-	3560	-	84650	-	**Y**
pH range		6.76-7.52		7.7-8.6		7.6-8.1		7.9-8.4		8.06-8.33		7.91-8.14		7.6-8.3		

Notes:

PPC = Prickly Pear Creek Riparian Zone

UL = Upper Lake Banks

LL = Lower Lake Banks

SP = Site Perimeter Uplands (UOP samples)

FS = Soils from Unpaved Areas within the Facility (LOS, RCS, UPS samples)

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed soil benchmarks (highlighted).

(a) Benchmarks from Table C-9.

Table D-12. Soil Screening Results for Terrestrial Soil Invertebrates

	Soil Benchmark for Invertebrates[(a)] (mg/kg-dw)	Maximum Soil Concentration (mg/kg-dw) for Each CSM Unit														
										SP						
		PPC		UL		LL		Tito Park		West		East		FS		COPC
Metal		DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	(Y/N)
Aluminum	soil pH<5.5	7890	-	13100	-	12400	-	13400	-	12000	-	6820	-	12400	-	n
Antimony	78	56	-	61	-	115	-	67	-	92	-	28	-	173	-	**Y**
Arsenic	60	232	-	393	-	1190	-	8091	-	829	0.1	3121	0.1	21625	-	**Y**
Barium	330	912	100	143	100	351	100	178	-	838	100	107	100	797	100	**Y**
Beryllium	40	U	10	U	10	U	10	U	10	U	10	U	10	U	10	n
Cadmium	140	57.7	-	380	-	350	-	14725	-	363	5	92	5	3069	5	**Y**
Chromium (total)	0.4	21	-	17	5	17	-	18	-	26	-	15	-	26	-	**Y**
Cobalt	1000	16	-	13	-	21	-	9	-	46	0.1	8	-	43	-	n
Copper	80	1030	-	882	-	2410	-	23599	-	9750	-	16375	0.1	35750	0.1	**Y**
Iron	soil pH <5 or >8	43800	-	20300	-	27500	-	20100	-	57500	-	22700	-	52900	-	**Y (pH)**
Lead	1700	3590	-	8690	-	8130	-	71196	-	11600	-	3811	-	62282	-	**Y**
Manganese	450	1350	-	498	-	1040	-	493	-	3290	-	830	-	3910	-	**Y**
Mercury	0.1	11	0.5	58	-	28	-	10	-	8.2	-	11	-	17	-	**Y**
Nickel	280	12	-	15	5	36	-	24	-	82	5	8	-	84	-	n
Selenium	4.1	33	-	54	-	23	0.5	13	0.5	27	-	4.1	-	20	-	**Y**
Silver	50	54	-	61	2	90	2	42	2	233	-	18	-	133	-	**Y**
Thallium	1	2.6	1	7	-	29	-	8	0.1-50	6	-	3.7	-	6	-	**Y**
Vanadium	20	46	-	48	-	48	-	45	-	53	-	50	-	54	-	**Y**
Zinc	120	3010	-	2620	-	5270	-	44050	-	14100	-	3560	-	84650	-	**Y**
pH range		6.76-7.52		7.7-8.6		7.6-8.1		7.9-8.4		8.06-8.33		7.91-8.14		7.6-8.3		

Notes:

PPC = Prickly Pear Creek Riparian Zone

UL = Upper Lake Banks

LL = Lower Lake Banks

SP = Site Perimeter Uplands (UOP samples)

FS = Soils from Unpaved Areas within the Facility (LOS, RCS, UPS samples)

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed soil benchmarks (highlighted).

(a) Benchmarks from Table C-9.

Table D-13. Soil Screening Results for Wildlife

		Maximum Soil Concentration (mg/kg-dw) for Each CSM Unit														
										SP						
	Soil Benchmark for Wildlife[a] (mg/kg-dw)	PPC		UL		LL		Tito Park		West		East		FS		COPC
Metal		DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	DT	ND	(Y/N)
Aluminum	soil pH<5.5	7890	-	13100	-	12400	-	13400	-	12000	-	6820	-	12400	-	n
Antimony	0.27	56	-	61	-	115	-	67	-	92	-	28	-	173	-	**Y**
Arsenic	43	232	-	393	-	1190	-	8091	-	829	0.1	3121	0.1	21625	-	**Y**
Barium	2000	912	100	143	100	351	100	178	-	838	100	107	100	797	100	n
Beryllium	21	U	10	U	10	U	10	U	10	U	10	U	10	U	10	n
Cadmium	0.36	57.7	-	380	-	350	-	14725	-	363	5	92	5	3069	5	**Y**
Chromium (III)	26	21	-	17	5	17	-	18	-	26	-	15	-	26	-	n
Chromium (IV)	130	21	-	17	5	17	-	18	-	46	-	15	-	26	-	n
Cobalt	120	16	-	13	-	21	-	9	-	46	0.1	8	-	43	-	n
Copper	28	1030	-	882	-	2410	-	23599	-	9750	-	16375	0.1	35750	0.1	**Y**
Iron	soil pH <5 or >8	43800	-	20300	-	27500	-	20100	-	57500	-	22700	-	52900	-	**Y (pH)**
Lead	11	3590	-	8690	-	8130	-	71196	-	11600	-	3811	-	62282	-	**Y**
Manganese	4000	1350	-	498	-	1040	-	493	-	3290	-	830	-	3910	-	n
Mercury	0.1	11	0.5	58	-	28	-	10	-	8.2	-	11	-	17	-	**Y**
Nickel	130	12	-	15	5	36	-	24	-	82	5	8	-	84	-	n
Selenium	0.63	33	-	54	-	23	0.5	13	0.5	27	-	4.1	-	20	-	**Y**
Silver	4.2	54	-	61	2	90	2	42	2	233	-	18	-	133	-	**Y**
Thallium	0.057	2.6	1	7	-	29	-	8	0.1-50	6	-	3.7	-	6	-	**Y**
Vanadium	7.8	46	-	48	-	48	-	45	-	53	-	50	-	54	-	**Y**
Zinc	46	3010	-	2620	-	5270	-	44050	-	14100	-	3560	-	84650	-	**Y**
pH range		6.76-7.52		7.7-8.6		7.6-8.1		7.9-8.4		8.06-8.33		7.91-8.14		7.6-8.3		

Notes:

PPC = Prickly Pear Creek Riparian Zone

UL = Upper Lake Banks

LL = Lower Lake Banks

SP = Site Perimeter Uplands (UOP samples)

FS = Soils from Unpaved Areas within the Facility (LOS, RCS, UPS samples)

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metal is considered a COPC if concentrations exceed soil benchmarks (highlighted).

(a) Benchmarks from Table C-9.

Table D-14 Sediment Screening Results for Wildlife

	Sediment Benchmark for Wildlife(a)	Maximum Sediment Concentration (mg/kg-dw) for Each CSM Unit								
		PPC		UL/ULM		WD		LL		COPC
Metal	**(mg/kg-dw)**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	3,976	10,100	-	20,000	-	7,070	-	13,000	-	**Y**
Antimony	none	4.5	0.5 - 15.5	112	-	5.9	-	990	-	**Y (no bm)**
Arsenic	321	250	-	581	-	79	-	3,030	-	**Y**
Barium	673	352	100	282	100	-	100	245	100	n
Beryllium	none	1.4	10	2.1	10	-	10	1.8	10	**Y (no bm)**
Cadmium	46	36.8	-	338	-	27.7	-	2,680	-	**Y**
Chromium	28	21.2	5	27.3	-	8	5	22.1	-	n
Cobalt	131	21.2	-	24.1	-	6	-	35.1	-	n
Copper	182	480	-	2,290	-	154	-	2,600	-	**Y**
Iron	none	38,100	-	34,400	-	12,200	-	35,200	-	**Y (no bm)**
Lead	123	1,090	-	10,800	-	1,610	-	14,400	-	**Y**
Manganese	834	9,030	-	2,520	-	1,120	-	1,370	-	**Y**
Mercury	24	3.1	0.05-0.5	230	0.5	120	-	53.3	-	**Y**
Methylmercury	1.0	3.1	0.05-0.5	230	0.5	120	-	53.3	-	**Y**
Nickel	994	16.1	5	24.8	5	6	5	36.4	5	n
Selenium	6.4	5.3	0.5	21.8	0.5	1.6	0.5	432	-	**Y**
Silver	218	2.5	2.4-2.6	127	2.6	11.1	-	141	-	n
Thallium	7.6	-	1-6	5	1-10.5	2	1	1,980	-	**Y**
Vanadium	353	55.2	10	59.4	-	27	-	57.7	-	n
Zinc	4,168	3,930	-	6,550	-	720	-	6,930	-	**Y**

Notes:

PPC = Prickly Pear Creek

ULM = Upper Lake Marsh

UL = Upper Lake

WD = Wilson Ditch

LL = Lower Lake

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metals is considered a COPC if concentrations exceed the sediment benchmark.

no bm = No Benchmark

(a) Benchmarks from Table C-11

Table D-15. Benthic Invertebrate Tissue Screening Results for Wildlife

	Tissue Benchmark for Wildlife(a)	Maximum Tissue Concentration (mg/kg ww) for Each CSM Unit								
		PPC		UL/ULM		WD		LL		COPC
Metal	**(mg/kg ww)**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**DT**	**ND**	**(Y/N)**
Aluminum	195	78.1	-	42.3	-	23.7	-	758	-	**Y**
Antimony	none	0.08	-	0.33	-	0.13	-	9.67	-	**Y (no bm)**
Arsenic	16	2.05	-	2.51	2	0.76	-	130	-	**Y**
Barium	33	2.95	-	5.14	-	4.15	-	20.8	-	n
Beryllium	none	0.01	0.01	0.008	0.005-0.021	U	0.01	0.12		**Y (no bm)**
Cadmium	2.3	0.7	-	9.6	-	0.32	-	19.5	-	**Y**
Chromium	1.4	0.25	-	0.25	-	0.07	-	1.57	-	**Y**
Cobalt	6.5	0.21	-	0.09	-	0.04	-	1.5	-	n
Copper	9.0	25.4	-	79.5	-	2.56	-	96.3	-	**Y**
Iron	none	198	-	106	-	51.4	-	1745	-	**Y (no bm)**
Lead	6.1	7.19	-	105	-	6.86	-	261	-	**Y**
Manganese	41	50.5	-	21	-	27	-	440	-	**Y**
Mercury	1.2	0.012	-	0.016	-	0.022	-	0.742	-	n
Methylmercury	0.1	0.012	-	0.016	-	0.022	-	0.742	-	**Y**
Nickel	49	0.22	-	0.13	-	0.04	-	1.65	-	n
Selenium	0.3	0.12	-	0.16	5	0.05	-	2.03	-	**Y**
Silver	11	0.15	-	0.13	-	0.03	-	2.52	-	n
Thallium	0.4	0.01	0.01	0.015	0.005-0.021	0.005	0.09	6.09	-	**Y**
Vanadium	17	0.72	-	0.28	0.05	0.1	-	4.96	-	n
Zinc	205	41.9	-	67	-	16.9	-	240	-	**Y**

Notes:
PPC = Prickly Pear Creek
ULM = Upper Lake Marsh
UL = Upper Lake
WD = Wilson Ditch
LL = Lower Lake
DT = Maximum detected value
ND = Range of detection limits
U = Undetected
COPC (Y/N) = Metals is considered a COPC if concentrations exceed the benchmark (highlighted).
no bm = No Benchmark
(a) Benchmarks from Table C-11

Table D-16. Fish Tissue Screening Results for Wildlife

Metal	Belted Kingfisher(a) mg/kg-ww	Mink(a) mg/kg-ww	Maximum Tissue[a] Concentration (mg/kg ww) for Each CSM Unit								
			PPC		UL/ULM		WD		LL		COPC (Y/N)
			DT	ND	DT	ND	DT	ND	DT	ND	
Aluminum	218.0	10.7	4.3	-	15.09	-	10.54	-	393	-	**Y**
Antimony	none	0.4	0.01	0.04-0.05	0.03	.04-0.21	0.03	-	4.7	-	**Y**
Arsenic	17.6	4.2	0.16	-	0.34	2	0.14	-	18.5	-	**Y**
Barium	36.9	33.9	0.36	-	1.88	-	0.48	-	7.3	-	n
Beryllium	none	3.7	U	0.01	U	0.01-0.05	U	0.01	U	0.05-0.2	n
Cadmium	2.5	5.6	0.09	-	1.4	-	0.07	-	16.3	-	**Y**
Chromium	1.5	3.3	0.05	0.04-0.05	0.78	0.07	0.02	-	0.5	-	n
Cobalt	7.2	2.8	0.02	-	0.02	-	0.01	-	1.44	-	n
Copper	10.0	65.1	1.02	-	9.1	-	0.4	-	28.3	-	**Y**
Iron	none	none	15.73	-	34.58	-	24.42	-	813	-	**Y (no bm)**
Lead	6.8	61.2	0.27	-	25	-	2.96	-	164	-	**Y**
Manganese	45.7	489.6	3.42	-	9.43	-	10.33	-	105	-	**Y**
Mercury	1.3	5.6	0.08	-	0.07	-	0.01	-	0.42	-	n
Methylmercury	0.1	0.2	0.08	-	0.07	-	0.01	-	0.42	-	**Y**
Nickel	54.5	222.5	U	0.06-0.08	0.04	0.07-0.26	0.01	-	0.6	-	n
Selenium	0.4	1.1	0.21	-	0.16	5	0.04	-	8.38	-	**Y**
Silver	12.0	104.6	0.01	-	0.03	-	0.01	-	0.84	-	n
Thallium	0.4	0.4	0.002	0.01	0.01	0.01-0.05	0.003	-	3.29	-	**Y**
Vanadium	19.3	1.16	0.08	-	0.09	-	0.06	-	1.2	-	**Y**
Zinc	228.5	890.1	20.61	-	66	-	8.87	-	124	-	n

Notes:

(a) = Fish tissues screening includes whole body concentrations from forage fish and piscivorous fish.

PPC = Prickly Pear Creek

ULM = Upper Lake Marsh

UL = Upper Lake

WD = Wilson Ditch

LL = Lower Lake

DT = Maximum detected value

ND = Range of detection limits

COPC (Y/N) = Metals is considered a COPC if concentrations exceed the tissue benchmark.

no bm = No Benchmark

(a) Benchmarks from Table C-11

Appendix E

Baseline Risk Assessment Tables

Table E-1a. Evaluation of sediment chemistry data (mean PEC Quotients)

		Mean	Total Metals (mg/kg dry-weight)																									
	Location	PECQ	As		As_PECQ	Cd		Cd_PECQ	Cr		Cr_PECQ	Cu		Cu_PECQ	Pb		Pb_PECQ	Hg		Hg_PECQ	Ni		Ni_PECQ	Zn		Zn_PECQ
CSM Unit	Sample ID	All Metals	mg/kg	Q	33	mg/kg	Q	4.98	mg/kg	Q	111	mg/kg	Q	149	mg/kg	Q	128	mg/kg	Q	1.06	mg/kg	Q	48.6	mg/kg	Q	459
Canyon Ferry (Ref)	CFR_1	0.21	12.4		0.38	0.97		0.19	21.2		0.19	28.1		0.19	17.2		0.13	0.11	U	0.10	16.8		0.35	81.4		0.18
Canyon Ferry (Ref)	CFR_2	0.26	15.6		0.47	1.2		0.24	23.6		0.21	33.6		0.23	23.5		0.18	0.145	U	0.14	18.8		0.39	102		0.22
Lower Lake	LL_1	55.60	1660		50.30	1230		246.99	10.4		0.09	1920		12.89	9470		73.98	53.3		50.28	24.7		0.51	4490		9.78
Lower Lake	LL_2	56.25	2730		82.73	1150		230.92	22.1		0.20	1900		12.75	9420		73.59	38		35.85	36.4		0.75	6080		13.25
Lower Lake	LL_3	102.70	3030		91.82	2680		538.15	21.9		0.20	2600		17.45	14400		112.50	48.4		45.66	34		0.70	6930		15.10
Lower Lake	LL-21	17.69	901	J	27.30	228		45.78	9		0.08	932	J	6.26	3900	J	30.47	28		26.42	13		0.27	2280		4.97
Lower Lake	LL-22	6.17	223	J	6.76	92		18.47	6		0.05	220	J	1.48	846	J	6.61	14		13.21	7		0.14	1220		2.66
Lower Lake	LL-23	2.68	133	J	4.03	30		6.02	8		0.07	239	J	1.60	506	J	3.95	3.5		3.30	6		0.12	1070		2.33
Lower Lake	LL-24	2.52	94	J	2.85	19		3.82	17		0.15	168	J	1.13	600	J	4.69	4.1		3.87	8		0.16	1620		3.53
Lower Lake	LL-25	3.95	138	J	4.18	40		8.03	6		0.05	223	J	1.50	1070	J	8.36	8		7.55	2.5	U	0.05	864		1.88
Prickly Pear Creek	PPC_2	1.13	52.1		1.58	6		1.20	10.3		0.09	93.9		0.63	370		2.89	0.43		0.41	9.9		0.20	925		2.02
Prickly Pear Creek	PPC_3	2.93	122		3.70	22.8		4.58	15.9		0.14	221		1.48	878		6.86	2.5		2.36	12.7		0.26	1860		4.05
Prickly Pear Creek	PPC_4	4.84	250		7.58	36.8		7.39	21.2		0.19	480		3.22	1090		8.52	3.1		2.92	16.1		0.33	3930		8.56
Prickly Pear Creek	PPC_5	0.64	32.1		0.97	4.1		0.82	8.2		0.07	44.1		0.30	203		1.59	0.27		0.25	6.2		0.13	444		0.97
Prickly Pear Creek	PPC-102	0.58	44		1.33	4.7		0.94	6		0.05	41		0.28	118		0.92	0.19		0.18	2.5	U	0.05	420		0.92
Prickly Pear Creek	PPC-103	0.25	36		1.09	0.7		0.14	2.5	U	0.02	11		0.07	43		0.34	0.025	U	0.02	2.5	U	0.05	125		0.27
Prickly Pear Creek	PPC-22	0.26	12		0.36	1.1		0.22	7		0.06	20		0.13	61		0.48	0.25	U	0.24	2.5	U	0.05	259		0.56
Prickly Pear Creek	PPC-23	0.51	24		0.73	2.1		0.42	10		0.09	42		0.28	165		1.29	0.33		0.31	5		0.10	386		0.84
Prickly Pear Creek	PPC-24	0.37	19		0.58	1.2		0.24	8		0.07	25		0.17	116		0.91	0.28		0.26	2.5	U	0.05	328		0.71
Prickly Pear Creek	PPC-5	0.24	23		0.70	0.7		0.14	7		0.06	13		0.09	57		0.45	0.058		0.05	2.5	U	0.05	172		0.37
Prickly Pear Creek	PPC-7	0.53	26		0.79	1.8		0.36	9		0.08	40		0.27	173		1.35	0.28		0.26	6		0.12	448		0.98
Prickly Pear Creek	PPC-8	0.26	16		0.48	0.8		0.16	2.5	U	0.02	17		0.11	92		0.72	0.025	U	0.02	2.5	U	0.05	241		0.53
Prickly Pear Creek (Ref)	PPC_1	0.52	11.5		0.35	3.5		0.70	18		0.16	59.7		0.40	104		0.81		R		10.4		0.21	454		0.99
Prickly Pear Creek (Ref)	Ref-PPC-1	0.32	20		0.61	1.1		0.22	2.5	U	0.02	24		0.16	95		0.74	0.051		0.05	2.5	U	0.05	308		0.67
Prickly Pear Creek (Ref)	Ref-PPC-2	0.18	12		0.36	0.7		0.14	2.5	U	0.02	14		0.09	45		0.35	0.025	U	0.02	2.5	U	0.05	197		0.43
Prickly Pear Creek (Ref)	Ref-PPC-3	0.31	19		0.58	1.1		0.22	11		0.10	27		0.18	96		0.75	0.025	U	0.02	2.5	U	0.05	276		0.60
Prickly Pear Creek (Ref)	Ref-PPC-4	0.38	20		0.61	1.3		0.26	7		0.06	29		0.19	111		0.87	0.055		0.05	6		0.12	395		0.86
Prickly Pear Creek (Ref)	Ref-PPC-5	0.31	18		0.55	0.9		0.18	2.5	U	0.02	23		0.15	110		0.86	0.025	U	0.02	2.5	U	0.05	308		0.67
Prickly Pear Creek (Ref)	Ref-PPC-6	0.33	18		0.55	1.2		0.24	10		0.09	22		0.15	106		0.83	0.025	U	0.02	5		0.10	310		0.68
Prickly Pear Creek (Ref)	Ref-PPC-7	0.47	21		0.64	2.4		0.48	6		0.05	38		0.26	174		1.36	0.12		0.11	2.5	U	0.05	366		0.80
Prickly Pear Creek (Ref)	Ref-PPC-8	0.37	20		0.61	1.2		0.24	9		0.08	25		0.17	113		0.88	0.053		0.05	6		0.12	363		0.79
Upper Lake/Marsh	UL-21	32.48	251	J	7.61	56		11.24	9		0.08	308	J	2.07	2550	J	19.92	230		216.98	9		0.19	817		1.78
Upper Lake/Marsh	UL-22	5.69	115		3.48	31.3		6.29	10		0.09	316		2.12	1270		9.92	22	J	20.75	9		0.19	1220		2.66
Upper Lake/Marsh	UL-23	26.02	531		16.09	105		21.08	10		0.09	720		4.83	10800		84.38	79	J	74.53	11		0.23	3190		6.95
Upper Lake/Marsh	UL-24	9.62	353		10.70	74.7		15.00	8		0.07	511		3.43	3890		30.39	15	J	14.15	9		0.19	1410		3.07
Upper Lake/Marsh	UL-25	17.12	57		1.73	25.5		5.12	10		0.09	105		0.70	557		4.35	130	J	122.64	6		0.12	1010		2.20
Upper Lake/Marsh	ULM-1	5.01	75		2.27	9.6		1.93	7		0.06	189		1.27	863		6.74	28	J	26.42	2.5	U	0.05	601		1.31
Upper Lake/Marsh	ULM-2	2.36	37		1.12	4.4		0.88	10		0.09	74		0.50	188		1.47	14	J	13.21	7		0.14	670		1.46
Upper Lake/Marsh	ULM-3	19.39	98		2.97	14.1		2.83	12		0.11	155		1.04	573		4.48	150	J	141.51	10		0.21	909		1.98
Upper Lake/Marsh	ULM-4	20.37	108		3.27	11.4		2.29	14		0.13	125		0.84	492		3.84	160	J	150.94	10		0.21	656		1.43
Upper Lake/Marsh	ULM-5	5.81	119		3.61	26		5.22	13		0.12	217		1.46	991		7.74	27	J	25.47	10		0.21	1230		2.68
Upper Lake/Marsh	ULM-6	4.57	78		2.36	39.8		7.99	13		0.12	280		1.88	1420		11.09	11	J	10.38	11		0.23	1140		2.48
Upper Lake/Marsh	ULM-7	0.82	38		1.15	2.9		0.58	8		0.07	71		0.48	253		1.98	0.74	J	0.70	6		0.12	682		1.49
Upper Lake/Marsh	ULM-8	0.89	51		1.55	4.2		0.84	8		0.07	91		0.61	267		2.09	0.25	U	0.24	6		0.12	754		1.64
Upper Lake/Marsh	ULM-9	0.49	21		0.64	1.6		0.32	10		0.09	41		0.28	151		1.18	0.25	U	0.24	6		0.12	470		1.02
Upper Lake/Marsh	ULM_1	10.66	229		6.94	112		22.49	19.5		0.18	686		4.60	4270		33.36	14.2		13.40	17.9		0.37	1810		3.94
Upper Lake/Marsh	ULM_10	17.94	337		10.21	238		47.79	20.1		0.18	1310		8.79	5140		40.16	28.3		26.70	19.6		0.40	4260		9.28
Upper Lake/Marsh	ULM_3	5.68	162		4.91	66.9		13.43	22.3		0.20	430		2.89	1470		11.48	4.7		4.43	20.1		0.41	3540		7.71
Upper Lake/Marsh	ULM_4	4.30	116		3.52	42.5		8.53	15.6		0.14	404		2.71	1170		9.14	5.9		5.57	12.1		0.25	2100		4.58
Upper Lake/Marsh	ULM_7	1.74	54.6		1.65	15		3.01	12.4		0.11	158		1.06	486		3.80	1.2		1.13	9.3		0.19	1360		2.96

Table E-1a. Evaluation of sediment chemistry data (mean PEC Quotients)

		Mean	Total Metals (mg/kg dry-weight)																							
	Location	PECQ	As		As_PECQ	Cd		Cd_PECQ	Cr		Cr_PECQ	Cu		Cu_PECQ	Pb		Pb_PECQ	Hg		Hg_PECQ	Ni		Ni_PECQ	Zn		Zn_PECQ
CSM Unit	**Sample ID**	**All Metals**	**mg/kg**	**Q**	**33**	**mg/kg**	**Q**	**4.98**	**mg/kg**	**Q**	**111**	**mg/kg**	**Q**	**149**	**mg/kg**	**Q**	**128**	**mg/kg**	**Q**	**1.06**	**mg/kg**	**Q**	**48.6**	**mg/kg**	**Q**	**459**
Upper Lake/Marsh	ULM_11	30.61	581		17.61	338		67.87	27.3		0.25	2290		15.37	10400		81.25	50.6		47.74	24.8		0.51	6550		14.27
Upper Lake/Marsh	ULM_12	28.88	452		13.70	316		63.45	24.7		0.22	1970		13.22	8990		70.23	59.1		55.75	23		0.47	6420		13.99
Upper Lake/Marsh	ULM_2	2.10	121		3.67	12.2		2.45	20.5		0.18	191		1.28	594		4.64	0.59		0.56	16.2		0.33	1680		3.66
Upper Lake/Marsh	ULM_5	5.70	124		3.76	46.6		9.36	13.1		0.12	332		2.23	1610		12.58	14.5		13.68	10.1		0.21	1680		3.66
Upper Lake/Marsh	ULM_6	16.98	326		9.88	199		39.96	26.7		0.24	1270		8.52	5360		41.88	27.3		25.75	22.5		0.46	4200		9.15
Upper Lake/Marsh	ULM_8	6.04	297		9.00	38.3		7.69	15.8		0.14	391		2.62	1850		14.45	10.1		9.53	13.4		0.28	2120		4.62
Upper Lake/Marsh	ULM_9	2.44	146		4.42	17.7		3.55	20.9		0.19	180		1.21	529		4.13	2.1		1.98	17.9		0.37	1670		3.64
Walker Creek (Marsh)	WPM-1	0.07	2		0.06	0.25	U	0.05	7		0.06	40		0.27	3		0.02	0.025	U	0.02	2.5	U	0.05	21		0.05
Walker Creek (Marsh)	WPM-2	0.08	3		0.09	0.25	U	0.05	9		0.08	36		0.24	4		0.03	0.025	U	0.02	2.5	U	0.05	28		0.06
Walker Creek (Marsh)	WPM-3	0.09	4		0.12	0.25	U	0.05	8		0.07	42		0.28	5		0.04	0.025	U	0.02	2.5	U	0.05	28		0.06
Walker Creek (Marsh)	WPM-4	0.07	2		0.06	0.25	U	0.05	10		0.09	32		0.21	5		0.04	0.025	U	0.02	2.5	U	0.05	24		0.05
Walker Creek (Marsh)	WPM-5	0.08	2		0.06	0.25	U	0.05	12		0.11	36		0.24	5		0.04	0.025	U	0.02	2.5	U	0.05	29		0.06
Walker Creek (Pond)	WP-1	0.07	2		0.06	0.25	U	0.05	7		0.06	32		0.21	6		0.05	0.025	U	0.02	2.5	U	0.05	28		0.06
Walker Creek (Pond)	WP-2	0.08	3		0.09	0.25	U	0.05	7		0.06	43		0.29	5		0.04	0.025	U	0.02	2.5	U	0.05	29		0.06
Walker Creek (Pond)	WP-3	0.07	3		0.09	0.25	U	0.05	6		0.05	25		0.17	6		0.05	0.025	U	0.02	2.5	U	0.05	31		0.07
Walker Creek (Pond)	WP-4	0.08	3		0.09	0.25	U	0.05	9		0.08	33		0.22	6		0.05	0.025	U	0.02	2.5	U	0.05	33		0.07
Walker Creek (Pond)	WP-5	0.08	2		0.06	0.25	U	0.05	9		0.08	35		0.23	5		0.04	0.025	U	0.02	2.5	U	0.05	29		0.06
Wilson Ditch	WD-2	5.08	79		2.39	20.8		4.18	2.5	U	0.02	154		1.03	1610		12.58	20		18.87	2.5	U	0.05	678		1.48
Wilson Ditch	WD-3	2.03	34		1.03	19.6		3.94	8		0.07	78		0.52	625		4.88	4.7		4.43	6		0.12	586		1.28
Wilson Ditch	WD-4	2.08	28		0.85	17.1		3.43	6		0.05	93		0.62	680		5.31	5		4.72	2.5	U	0.05	720		1.57
Wilson Ditch	WD-25	0.98	23		0.70	10.1		2.03	2.5	U	0.02	41		0.28	320		2.50	1.4		1.32	2.5	U	0.05	421		0.92
Wilson Ditch	WD-26	15.77	44		1.33	27.7		5.56	7		0.06	68		0.46	536		4.19	120		113.21	5		0.10	583		1.27

Notes:

nr = not reported

nm = not measured

U = not detected, value is equal to ½ the detection limit

J = estimated value

R = rejected

PECs from MacDonald et al. (2000)

Table E-1b. Evaluation of sediment chemistry data (hazard quotients)

		Total Metals (mg/kg dry-weight)														
	Location	**Al**		**Al_HQ**	**Sb**		**Sb_HQ**	**Fe**		**Fe_HQ**	**Mn**		**Mn_HQ**	**Ag**		**Ag_HQ**
CSM Unit	**Sample ID**	**mg/kg**	**Q**	**59572**	**mg/kg**	**Q**	**25**	**mg/kg**	**Q**	**247600**	**mg/kg**	**Q**	**1100**	**mg/kg**	**Q**	**2.2**
Canyon Ferry (Ref)	CFR_1	13200		0.22	11.6	U	0.46	16100		0.07	198		0.18	1.95	U	0.89
Canyon Ferry (Ref)	CFR_2	17600		0.30	12.1	U	0.48	19500		0.08	258		0.23	2	U	0.91
Lower Lake	LL_1	4440		0.07	990		39.60	17500		0.07	851		0.77	101		45.91
Lower Lake	LL_2	13000		0.22	353		14.12	35200		0.14	1230		1.12	93.7		42.59
Lower Lake	LL_3	11500		0.19	530		21.20	30300		0.12	1370		1.25	141		64.09
Lower Lake	LL-21	5010		0.08	111		4.44	22800		0.09	726	J	0.66	38.6		17.55
Lower Lake	LL-22	4620		0.08	121		4.84	9000		0.04	192	J	0.17	10		4.55
Lower Lake	LL-23	6180		0.10	11		0.44	12100		0.05	562	J	0.51	3.7		1.68
Lower Lake	LL-24	4480		0.08	55		2.20	17300		0.07	465	J	0.42	5.1		2.32
Lower Lake	LL-25	4410		0.07	14		0.56	11100		0.04	471	J	0.43	4.9		2.23
Prickly Pear Creek	PPC_2	7750		0.13	7.75	U	0.31	18600		0.08	672		0.61	1.3	U	0.59
Prickly Pear Creek	PPC_3	9500		0.16	4.1		0.16	24800		0.10	3920		3.56	0.85		0.39
Prickly Pear Creek	PPC_4	10100		0.17	4.5		0.18	38100		0.15	9030		8.21	2.5		1.14
Prickly Pear Creek	PPC_5	4880		0.08	1.9		0.08	11800		0.05	558		0.51	1.2	U	0.55
Prickly Pear Creek	PPC-102	3630		0.06	1.1		0.04	9390		0.04	322		0.29	1.1		0.50
Prickly Pear Creek	PPC-103	1640		0.03	0.5		0.02	4990		0.02	168		0.15	0.3		0.14
Prickly Pear Creek	PPC-22	2690		0.05	0.5		0.02	9090		0.04	329		0.30	0.3		0.14
Prickly Pear Creek	PPC-23	4500		0.08	1.5	J	0.06	13900		0.06	389	J	0.35	1.1		0.50
Prickly Pear Creek	PPC-24	2890		0.05	0.8	J	0.03	10100		0.04	419	J	0.38	0.7		0.32
Prickly Pear Creek	PPC-5	1770		0.03	0.25	U	0.01	8740		0.04	253	J	0.23	0.5		0.23
Prickly Pear Creek	PPC-7	3810		0.06	1	J	0.04	13400		0.05	452	J	0.41	1.1		0.50
Prickly Pear Creek	PPC-8	2090		0.04	0.25	U	0.01	7210		0.03	369	J	0.34	0.4		0.18
Prickly Pear Creek (Ref)	PPC_1	8590		0.14		R		20700		0.08	720		0.65		R	
Prickly Pear Creek (Ref)	Ref-PPC-1	3270		0.05	0.6	J	0.02	10500		0.04	522	J	0.47	0.7		0.32
Prickly Pear Creek (Ref)	Ref-PPC-2	2110		0.04	0.25	U	0.01	7320		0.03	459	J	0.42	0.3		0.14
Prickly Pear Creek (Ref)	Ref-PPC-3	3890		0.07	0.8	J	0.03	14100		0.06	611	J	0.56	0.8		0.36
Prickly Pear Creek (Ref)	Ref-PPC-4	3900		0.07	0.6	J	0.02	12100		0.05	490	J	0.45	0.9		0.41
Prickly Pear Creek (Ref)	Ref-PPC-5	3700		0.06	0.6	J	0.02	10300		0.04	524	J	0.48	0.7		0.32
Prickly Pear Creek (Ref)	Ref-PPC-6	3780		0.06	0.8	J	0.03	13100		0.05	506	J	0.46	0.7		0.32
Prickly Pear Creek (Ref)	Ref-PPC-7	4030		0.07	1	J	0.04	10200		0.04	414	J	0.38	1.3		0.59
Prickly Pear Creek (Ref)	Ref-PPC-8	4250		0.07	0.6	J	0.02	12100		0.05	513	J	0.47	0.8		0.36
Upper Lake/Marsh	UL-21	9340		0.16	14		0.56	13300		0.05	310	J	0.28	6.7		3.05
Upper Lake/Marsh	UL-22	5830		0.10	17.8		0.71	10700		0.04	299		0.27	13.7		6.23
Upper Lake/Marsh	UL-23	6380		0.11	40.7		1.63	13900		0.06	409		0.37	61.4		27.91
Upper Lake/Marsh	UL-24	4560		0.08	57.2		2.29	12900		0.05	295		0.27	30.7		13.95
Upper Lake/Marsh	UL-25	5240		0.09	4.1	J	0.16	10300		0.04	221		0.20	3.6		1.64
Upper Lake/Marsh	ULM-1	4430		0.07	7.8		0.31	12200		0.05	510		0.46	12.7		5.77
Upper Lake/Marsh	ULM-2	6330		0.11	1.1	J	0.04	11100		0.04	420		0.38	1.9		0.86
Upper Lake/Marsh	ULM-3	8730		0.15	4.3	J	0.17	15800		0.06	680		0.62	5.6		2.55
Upper Lake/Marsh	ULM-4	9950		0.17	2.5	J	0.10	19600		0.08	660		0.60	3.5		1.59
Upper Lake/Marsh	ULM-5	8830		0.15	5.4	J	0.22	12900		0.05	532		0.48	6.9		3.14
Upper Lake/Marsh	ULM-6	8680		0.15	8.5	J	0.34	11900		0.05	381		0.35	10.6		4.82
Upper Lake/Marsh	ULM-7	6010		0.10	1.5	J	0.06	11800		0.05	619		0.56	1.5		0.68
Upper Lake/Marsh	ULM-8	6140		0.10	1.9	J	0.08	11000		0.04	519		0.47	1.9		0.86
Upper Lake/Marsh	ULM-9	5560		0.09	0.9	J	0.04	12400		0.05	519		0.47	0.8		0.36
Upper Lake/Marsh	ULM_1	15700		0.26	19.5		0.78	23500		0.09	720		0.65	29.1		13.23
Upper Lake/Marsh	ULM_10	14200		0.24	60		2.40	25600		0.10	911		0.83	64.1		29.14
Upper Lake/Marsh	ULM_3	15700		0.26	5.6		0.22	29200		0.12	955		0.87	10.2		4.64
Upper Lake/Marsh	ULM_4	11900		0.20	16.8		0.67	18400		0.07	576		0.52	14		6.36
Upper Lake/Marsh	ULM_7	9650		0.16	1.2		0.05	16300		0.07	472		0.43	2.7		1.23

Table E-1b. Evaluation of sediment chemistry data (hazard quotients)

		Total Metals (mg/kg dry-weight)														
	Location	Al		Al_HQ	Sb		Sb_HQ	Fe		Fe_HQ	Mn		Mn_HQ	Ag		Ag_HQ
CSM Unit	Sample ID	mg/kg	Q	59572	mg/kg	Q	25	mg/kg	Q	247600	mg/kg	Q	1100	mg/kg	Q	2.2
Upper Lake/Marsh	ULM_11	17500		0.29	112		4.48	30200		0.12	1300		1.18	127		57.73
Upper Lake/Marsh	ULM_12	15900		0.27	64.9		2.60	29300		0.12	1190		1.08	107		48.64
Upper Lake/Marsh	ULM_2	14500		0.24	1.7		0.07	32600		0.13	2520		2.29	0.65		0.30
Upper Lake/Marsh	ULM_5	9490		0.16	10.9		0.44	16000		0.06	484		0.44	11.9		5.41
Upper Lake/Marsh	ULM_6	20000		0.34	68.6		2.74	34400		0.14	747		0.68	59.3		26.95
Upper Lake/Marsh	ULM_8	12200		0.20	6.5		0.26	19300		0.08	890		0.81	14.2		6.45
Upper Lake/Marsh	ULM_9	15600		0.26	0.43		0.02	26200		0.11	755		0.69	1.3	U	0.59
Walker Creek (Marsh)	WPM-1	7120		0.12	0.25	U	0.01	16700		0.07	230	J	0.21	0.05	U	0.02
Walker Creek (Marsh)	WPM-2	7840		0.13	0.25	U	0.01	15000		0.06	203		0.18	0.05	U	0.02
Walker Creek (Marsh)	WPM-3	10800		0.18	0.25	U	0.01	14600		0.06	238		0.22	0.05	U	0.02
Walker Creek (Marsh)	WPM-4	6410		0.11	0.25	U	0.01	16300		0.07	154		0.14	0.05	U	0.02
Walker Creek (Marsh)	WPM-5	8400		0.14	0.25	U	0.01	20100		0.08	180		0.16	0.05	U	0.02
Walker Creek (Pond)	WP-1	6740		0.11	0.25	U	0.01	11800		0.05	183	J	0.17	0.05	U	0.02
Walker Creek (Pond)	WP-2	8360		0.14	0.25	U	0.01	15800		0.06	343	J	0.31	0.05	U	0.02
Walker Creek (Pond)	WP-3	6800		0.11	0.6		0.02	10600		0.04	129	J	0.12	0.05	U	0.02
Walker Creek (Pond)	WP-4	8420		0.14	0.25	U	0.01	19800		0.08	301	J	0.27	0.05	U	0.02
Walker Creek (Pond)	WP-5	8270		0.14	0.25	U	0.01	17000		0.07	303	J	0.28	0.05	U	0.02
Wilson Ditch	WD-2	4430		0.07	5.9	J	0.24	8950		0.04	1010		0.92	11.1		5.05
Wilson Ditch	WD-3	6650		0.11	1.9	J	0.08	12200		0.05	919		0.84	4.7		2.14
Wilson Ditch	WD-4	5820		0.10	2.9	J	0.12	10300		0.04	1120		1.02	6.8		3.09
Wilson Ditch	WD-25	5980		0.10	1.2	J	0.05	9270		0.04	790		0.72	2.2		1.00
Wilson Ditch	WD-26	7070		0.12	2.4	J	0.10	11700		0.05	839		0.76	3.6		1.64

Notes:
nr = not reported
nm = not measured
U = not detected, value is equal to ½ the detection limit
J = estimated value
R = rejected
PECs developed from alternative sources, see Appendix C.

Table E-2. Simultaneously Extracted Metals (SEM) in Sediments

		Conventionals			SEM Metals (umol/g dry-weight)										Equilibrium Screening [a]	
	Location	TOC	Acid Volatile Sulfide		Cd		Cu		Pb		Ni		Zn		ΣSEM-AVS	ΣSEM-AVS/f_{oc}
CSM Unit	Sample ID	%	umol/g dry-weight	Q [b]	umol/g	Q	umol/g	Q	umol/g	Q	umol/g	Q	umol/g	Q	umol/g	umol/g_{oc}
Prickly Pear Creek (Ref)	Ref-PPC-4	0.78	0.4	U	0.009		0.2		0.44		0.09	U	4.2		4.539	582
Prickly Pear Creek (Ref)	Ref-PPC-6	0.6	0.4	U	0.009		0.2		0.4		0.09	U	3.68		3.979	663
Prickly Pear Creek (Ref)	Ref-PPC-8	0.63	0.921	J	0.017		0.37		0.79		0.09	U	6.85		7.196	1142
Prickly Pear Creek (Ref)	Ref-PPC-2	0.22	0.4	U	0.009	U	0.1		0.23		0.09	U	2.48	J	2.509	1140
Prickly Pear Creek (Ref)	Ref-PPC-1	0.31	0.4	U	0.016		0.39		0.64		0.09	U	5.48	J	6.216	2005
Prickly Pear Creek	PPC-24	0.42	0.4	U	0.009		0.33		0.64		0.09	U	9.45	J	10.119	2409
Prickly Pear Creek	PPC-7	0.73	0.4	U	0.025		0.38		0.76		0.09	U	5.65	J	6.505	891
Prickly Pear Creek	PPC-5	0.27	0.4	U	0.013		0.24		0.41		0.09	U	3.09	J	3.443	1275
Prickly Pear Creek	PPC-103	0.31	1.8	J	0.013		0.16		0.29		0.09	U	2.98	J	1.733	559
Prickly Pear Creek	PPC-102	1.56	9.57	J	0.021		0.15		0.48		0.09	U	4.36	J	-4.469	-286
Prickly Pear Creek	PPC-22	0.51	3.98	J	0.017		0.31		0.73		0.09	U	6.07		3.237	635
Lower Lake	LL-25	2.71	25.8		0.525		0.08	U	7.44		0.09	U	16.1		-1.565	-58
Lower Lake	LL-22	2.67	19.3		0.874		0.08	U	3.06		0.09	U	11.8		-3.396	-127
Lower Lake	LL-21	1.12	14.2		0.576		0.08	U	5.79		0.12		12.5		4.866	434
Lower Lake	LL-24	1.56	17.5		0.081		0.08	U	1.08		0.09	U	5.09		-11.079	-710
Lower Lake	LL-23	1.96	29.6		0.486		0.08	U	1.2		0.09	U	12.3		-15.444	-788
Upper Lake	UL-21	3.2	5.3		0.316		1.02		11		0.09		16.9		24.026	751
Upper Lake	UL-24	2.34	2.42	J	1.42		4.98	J	31.4		0.13		36.9		72.41	3094
Upper Lake	UL-23	3.02	1.13	J	1.92		7.15	J	121		0.13		59.8		188.87	6254
Upper Lake	UL-22	3.31	92.4		0.645		0.08	U	4.51		0.15		35.7		-51.315	-1550
Upper Lake	UL-25	2.52	116		0.294		0.08	U	3.47		0.12		33		-79.036	-3136
Upper Lake Marsh	ULM-2	3.11	6.9		0.046		0.5		1.08		0.09	U	13.7		8.516	274
Upper Lake Marsh	ULM-3	4.04	56.5		0.249		0.08	U	2.61		0.1		31.5		-21.961	-544
Upper Lake Marsh	ULM-4	3.39	83.5		0.564		0.08	U	5.03		0.14		33.9		-43.786	-1292
Upper Lake Marsh	ULM-5	5.02	94.4		0.668		0.08	U	7.56		0.2		61.9		-23.992	-478
Upper Lake Marsh	ULM-1	2.58	0.667	J	0.134		2.61		5.49		0.09	U	11.6		19.257	746
Wilson Ditch	WD-2	3.03	0.4	U	0.408		4.72		23.6		0.1		19.2		47.628	1572
Walker Creek (Pond)	WP-3	1.24	0.598		0.009	U	0.1		0.02	U	0.09	U	0.13		-0.249	-20
Walker Creek (Pond)	WP-4	0.61	1.44		0.009	U	0.08	U	0.02	U	0.09	U	0.12		-1.121	-184
Walker Creek (Pond)	WP-5	0.44	0.856		0.009	U	0.13		0.02	U	0.09	U	0.11		-0.497	-113
Walker Creek (Pond)	WP-1	1.08	1.95		0.009	U	0.14		0.03		0.09	U	0.16		-1.521	-141
Walker Creek (Pond)	WP-2	0.86	2.65		0.009	U	0.27		0.02	U	0.09	U	0.08		-2.181	-254
Walker Creek (Marsh)	WPM-1	0.59	2.48		0.009	U	0.25		0.02	U	0.09	U	0.11		-2.001	-339
Walker Creek (Marsh)	WPM-2	1.0	0.507		0.009	U	0.22		0.02	U	0.09	U	0.08		-0.088	-9
Walker Creek (Marsh)	WPM-3	2.26	0.812		0.009	U	0.41		0.03		0.09	U	0.18		-0.093	-4
Walker Creek (Marsh)	WPM-4	0.9	0.4	U	0.009	U	0.19		0.02	U	0.09	U	0.13		0.039	4
Walker Creek (Marsh)	WPM-5	0.73	0.4	U	0.009	U	0.29		0.02	U	0.09	U	0.09		0.099	14

Notes:

(a) The screening process followed procedures developed by US EPA. (2005b). Procedures for the Derivation of Equilibrium Partitioning Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc).

Interpretation of SEM/AVS data follows:

1) Any sediment with AVS > 0.0 will not cause adverse biological effects due to Cr or Ag.

2) Any sediment (shaded green) in which (SEM -AVS)/fOC < 130 µmols/gOC should pose low risk of adverse biological effects due to Cd, Cu, Pb, Ni and Zn.

3) Any sediment (shaded yellow) in which 130 µmols/gOC < (SEM - AVS)/fOC < 3,000 µmols/gOC may have adverse biological effects due to Cd, Cu, Pb, Ni, or Zn.

4) In any sediment (shaded orange) in which (SEM - AVS)/fOC > 3,000 µmols/gOC adverse biological effects due to Cd, Cu, Pb, Ni, or Zn may be expected.

(b) Q = data qualifiers

U - not detected

Table E-3. Statistical comparison of on-site sediment metals concentrations to reference areas.

	Prickly Pear Creek					Prickly Pear Creek (upstream)						Lower Lake					Upper Lake/Marsh					Wilson Ditch					Walker Creek (Pond/Marsh)					
	mean (mg/kg-dw)	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg-dw)**	**stdev**	**FOD**	***n***	**Test**	***p* value**	**mean (mg/kg-dw)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg-dw)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg-dw)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg-dw)**	**stdev**	**FOD**	***n***	**Test**	***p* value**
Al	2877.50	1033.84	NS	100	8	3616.25	670.90	100	8	P	0.11	4940.00	730.99	S	100	5	6857.86	1854.54	NS	100	14	5990.00	1008.04	NS	100	5	7916.00	1276.46	100	10	P	0.006
Sb	0.74	0.44	NS	75	8	0.66	0.22	87.5	8	NP	0.96	62.40	52.05	S	100	5	11.98	16.74	S*	100	14	2.86	1.81	NS	100	5	0.29	0.11	10	10	NP	<0.001
As	25.00	10.52	NS	100	8	18.50	2.83	100	8	NP	0.20	297.80	340.47	S	100	5	138.00	144.76	S	100	14	41.60	22.32	NS	100	5	2.60	0.70	100	10	NP	<0.001
Ba	50.00	0.00	NS	0	8	50.00	0.00	0	8	NP	1.00	101.80	79.10	NS	40	5	96.36	52.94	NS	57.1	14	50.00	0.00	NS	0	5	82.10	34.49	50	10	NP	0.25
Be	5.00	0.00	NS	0	8	5.00	0.00	0	8	NP	1.00	5.00	0.00	NS	0	5	5.00	0.00	NS	0	14	5.00	0.00	NS	0	5	5.00	0.00	0	10	NP	1
Cd	1.64	1.34	NS	100	8	1.24	0.51	100	8	NP	1.00	81.80	86.39	S	100	5	29.04	30.76	S	100	14	19.06	6.37	S	100	5	0.25	0.00	0	10	NP	<0.001
Cr	6.50	2.76	NS	75	8	6.31	3.52	62.5	8	P	0.91	9.20	4.55	NS	100	5	10.14	2.14	NS	100	14	5.20	2.56	NS	60	5	8.40	1.78	100	10	NP	0.008
Co	3.63	1.06	S	100	8	4.25	0.71	100	8	NP	0.008	3.63	1.06	NS	100	5	6.14	1.70	NS	100	14	5.00	0.71	NS	100	5	6.40	1.96	100	10	P	0.017
Cu	26.13	13.03	NS	100	8	25.25	6.80	100	8	P	0.87	356.40	322.88	S	100	5	228.79	190.91	S	100	14	86.80	42.08	NS	100	5	35.40	5.38	100	10	NP	<0.001
Fe	9602.50	2956.54	NS	100	8	11215.00	2104.17	100	8	P	0.23	14460.00	5574.32	NS	100	5	12842.86	2414.93	NS	100	14	10484.00	1439.11	S	100	5	15770.00	3020.32	100	10	P	0.022
Pb	103.13	48.90	NS	100	8	106.25	35.16	100	8	P	0.89	1384.40	1423.36	S*	100	5	1733.21	2809.99	S*	100	14	754.20	497.68	S*	100	5	5.00	0.94	100	10	NP	<0.001
Mn	337.63	92.26	S	100	8	504.88	56.79	100	8	P	<0.001	483.20	193.93	S	100	5	455.29	144.44	S	100	14	935.60	132.61	S	100	5	226.40	70.31	100	10	P	<0.001
Hg	0.18	0.13	NS	62.5	8	0.10	0.10	50	8	P	0.19	11.52	10.12	S*	100	5	61.91	74.94	S	85.7	14	30.22	50.70	S*	100	5	0.03	0.00	0	10	NP	<0.001
Ni	3.25	1.41	NS	25	8	3.69	1.67	37.5	8	NP	0.65	7.30	3.80	S	80	5	8.04	2.48	S	92.9	14	3.70	1.68	NS	40	5	2.50	0.00	0	10	NP	<0.001
Se	0.25	0.00	NS	0	8	0.25	0.00	0	8	NP	1.00	11.30	9.13	S	100	5	2.70	5.57	S	71.4	14	0.83	0.51	NS	80	5	0.25	0.00	0	10	NP	<0.001
Ag	0.69	0.36	NS	100	8	0.78	0.28	100	8	P	0.60	12.46	14.81	S*	100	5	11.54	16.34	S*	100	14	5.68	3.47	S*	100	5	0.05	0.00	0	10	NP	<0.001
Tl	0.50	0.00	NS	0	8	0.50	0.00	0	8	NP	1.00	36.00	35.19	S	100	5	1.11	1.29	NS	21.4	14	0.90	0.65	NS	40	5	0.50	0.00	0	10	NP	<0.001
V	21.75	8.41	NS	87.5	8	27.50	7.48	100	8	P	0.17	28.20	15.74	S*	100	5	29.00	6.21	NS	100	14	20.80	4.82	S	100	5	38.50	8.07	100	10	NP	0.002
Zn	297.38	117.47	NS	100	8	315.38	61.96	100	8	NP	0.88	1410.80	559.20	S	100	5	1054.21	674.53	S	100	14	597.60	115.09	NS	100	5	28.00	3.37	100	10	NP	<0.001

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

S-significant, NS-not significant, S-significant using NP, but not significant using P*

P - Parametric testing, NP - Non-parametric testing

Table E-4. Exposure point concentrations for surface water and porewater

		Surface Water (ug/L, Total)				Surface Water (ug/L, Total Recoverable)				Surface Water (ug/L, Dissolved)				Porewater (ug/L, Dissolved)				Piezometer/Porewater (ug/L, Dissolved)			
CSM Unit	Metal	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max
PPC	Al	138.70	160.50	b3	300.00	84.50	128.20	b7	210.00	40.70	100.00	b8	100.00	100.00	100.00	b8	100.00	25.00	25.00	b8	25.00
	Sb	6.58	30.00	b8	30.00	1.50	1.50	b8	1.50	5.57	30.00	b8	30.00	25.50	30.00	b12	30.00	12.80	24.00	b12	24.00
	As	6.58	7.34	b5	40.00	1.62	8.56	b7	30.00	5.54	6.38	b5	50.00	9.33	10.30	b12	10.30	1287.00	2430.00	b12	2430.00
	Ba	30.06	39.34	b3	49.50	50.00	50.00	b8	50.00	29.10	39.07	b3	49.60	66.40	108.00	b12	108.00	50.00	50.00	b12	50.00
	Be	45.85	50.00	b12	50.00	0.50	0.50	b8	0.50	0.76	2.50	b8	2.50	2.50	2.50	b8	2.50	0.50	0.50	b8	0.50
	Cd	0.22	0.29	b3	0.36	0.33	0.40	b3	1.40	0.20	0.39	b5	2.10	0.95	2.20	b12	2.20	0.05	0.05	b8	0.05
	Cr	1.69	5.00	b8	5.00	2.04	2.12	b3	3.00	0.95	5.00	b12	5.00	2.99	5.00	b12	5.00	0.50	0.50	b8	0.50
	Co	7.18	25.00	b8	25.00	0.25	0.25	b8	0.25	1.25	1.56	b3	2.90	19.70	25.00	b12	25.00	0.25	0.25	b8	0.25
	Cu	3.08	3.34	b3	7.00	4.07	5.08	b7	10.00	2.10	2.33	b3	5.00	5.15	6.40	b12	6.40	0.50	0.50	b8	0.50
	Fe	321.30	342.60	b5	700.00	363.70	467.50	b7	860.00	79.34	86.65	b5	200.00	77.35	89.40	b12	89.40	220.00	430.00	b12	430.00
	Hg	1.48	3.00	b8	3.00	0.0001	0.0001	b8	0.0001	1.10	3.00	b8, c	3.00	0.10	0.10	b8, c	0.10	0.005	0.005	b8, c	0.005
	Mn	70.92	74.36	b5	130.00	66.05	78.95	b7	110.00	53.73	57.33	b5	110.00	456.00	1260.00	b12	1260.00	925.00	1210.00	b12	1210.00
	Ni	7.33	20.00	b12	20.00	5.00	5.00	b8	5.00	13.87	20.00	b8	20.00	20.00	20.00	b8	20.00	5.00	5.00	b8	5.00
	Pb	4.93	5.40	b3	20.00	5.63	6.62	b5	22.60	0.91	1.07	b3	1.60	5.00	5.00	b8	5.00	0.25	0.25	b8	0.25
	Se	1.39	1.87	b3	4.00	2.07	2.25	b3	4.00	1.85	2.46	b3	9.30	12.60	17.50	b12	17.50	0.50	0.50	b8	0.50
	Ag	2.35	5.00	b8	5.00	0.25	0.25	b8	0.25	0.57	0.66	b3	1.30	0.97	1.20	b12	1.20	0.25	0.25	b8	0.25
	Tl	2.59	12.50	b8	12.50	0.10	0.10	b8	0.10	2.03	12.50	b8	12.50	12.50	12.50	b8	12.50	1.75	3.40	b12	3.40
	V	8.33	25.00	b8	25.00	32.00	50.00	b8	50.00	3.33	3.75	b3	3.90	3.75	5.40	b12	5.40	50.00	50.00	b8	50.00
	Zn	49.72	53.69	b5	94.70	57.44	61.03	b3	100.00	40.91	44.33	b5	137.00	173.00	194.00	b12	194.00	1165.00	1360.00	b12	1360.00
UL&M	Al	315.10	524.20	b3	1620.00	222.00	453.90	b3	1960.00	56.90	100.00	b8	100.00	100.00	100.00	b8	100.00	na			
	Sb	25.93	30.00	b8	30.00	1.60	3.00	b12	3.00	12.61	30.00	b8	30.00	30.00	30.00	b8	30.00	na			
	As	12.69	16.29	b2	31.50	8.24	11.03	b10	29.30	5.42	5.95	b2	8.80	7.50	7.50	b8	7.50	na			
	Ba	37.60	44.65	b3	63.50	50.00	50.00	b8	50.00	32.08	35.83	b3	43.50	142.67	168.99	b10	183.00	na			
	Be	2.21	2.50	b8	2.50	0.50	0.50	b8	0.50	1.33	2.50	b8	2.50	2.50	2.50	b8	2.50	na			
	Cd	3.55	7.36	b1	30.00	0.74	1.95	b6	3.20	0.22	0.29	b3	1.10	2.14	2.50	b12	2.50	na			
	Cr	2.04	2.92	b2	6.00	0.60	2.00	b12	2.00	0.85	0.98	b3	2.10	2.40	2.85	b10	3.10	na			
	Co	1.63	2.70	b4	2.70	0.39	2.40	b12	2.40	9.86	25.00	b8	25.00	21.00	25.00	b12	25.00	na			
	Cu	11.61	21.51	b7	27.70	7.87	22.52	b6	54.00	2.93	3.68	b5	11.70	3.43	3.73	b3	3.80	na			
	Fe	1361.00	3914.00	b6	8370.00	576.70	1704.00	b6	4180.00	93.58	108.16	b5	230.00	5109.17	19791.42	b1	19900.00	na			
	Hg	0.039	0.500	b10	0.500	nm				0.010	0.011	b3, c	0.014	0.10	0.10	b8, c	0.10	na			
	Mn	358.90	1104.00	b6	2180.00	158.70	259.60	b10	1030.00	153.37	578.86	b7	1940.00	2152.67	2766.36	b10	3010.00	na			
	Ni	17.86	20.00	b8	20.00	5.00	5.00	b8	5.00	11.20	20.00	b8	20.00	17.20	20.00	b12	20.00	na			
	Pb	93.73	320.00	b7	800.00	30.92	112.20	b6	286.00	2.89	3.73	b5	8.00	6.83	9.46	b3	10.50	na			
	Se	15.07	17.50	b8	17.50	0.53	1.00	b12	1.00	7.54	17.50	b8	17.50	17.50	17.50	b8	17.50	na			
	Ag	0.84	0.89	b3	0.94	0.33	1.50	b12	1.50	1.01	1.46	b3	5.00	1.08	1.30	b3	1.40	na			
	Tl	10.76	12.50	b8	12.50	0.10	0.10	b8	0.10	5.25	12.50	b8	12.50	12.50	12.50	b8	12.50	na			
	V	3.85	4.97	b3	5.60	47.00	50.00	b8	50.00	35.76	50.00	b8	50.00	25.00	25.00	b8	25.00	na			
	Zn	90.28	127.90	b4	300.00	54.67	128.70	b6	290.00	38.74	66.40	b7	139.00	30.00	30.00	b12	30.00	na			

Table E-4. Exposure point concentrations for surface water and porewater

		Surface Water (ug/L, Total)				Surface Water (ug/L, Total Recoverable)				Surface Water (ug/L, Dissolved)				Porewater (ug/L, Dissolved)				Piezometer/Porewater (ug/L, Dissolved)			
CSM Unit	Metal	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max
WD	Al	nm				54.00	64.79	b3	70.00	25.00	25.00	b8	25.00	na				na			
	Sb	nm				1.50	1.50	b8	1.50	1.50	1.50	b8	1.50	na				na			
	As	5.50	10.00	b12	10.00	6.11	8.17	b5	12.00	6.10	7.65	b10	10.50	na				na			
	Ba	nm				50.00	50.00	b8	50.00	50.00	50.00	b8	50.00	na				na			
	Be	nm				0.50	0.50	b8	0.50	0.50	0.50	b8	0.50	na				na			
	Cd	1.50	3.00	b12	3.00	0.40	1.10	b7	1.30	0.44	0.88	b3	2.00	na				na			
	Cr	nm				0.50	0.50	b8	0.50	0.50	0.50	b8	0.50	na				na			
	Co	nm				0.25	0.25	b8	0.25	0.25	0.25	b8	0.25	na				na			
	Cu	5.25	10.00	b12	10.00	4.19	6.26	b3	9.00	2.94	4.21	b3	7.00	na				na			
	Fe	275.00	300.00	b12	300.00	245.70	280.60	b10	300.00	81.11	90.00	b4	90.00	na				na			
	Hg	0.005	0.005	b8	0.005	nm				0.005	0.005	b8, c	0.005	na				na			
	Mn	55.00	60.00	b12	60.00	55.71	59.64	b10	60.00	37.78	45.23	b10	50.00	na				na			
	Ni	nm				5.00	5.00	b8	5.00	5.00	5.00	b8	5.00	na				na			
	Pb	26.75	60.00	b2	60.00	6.61	8.13	b10	10.00	4.41	18.22	b7	20.00	na				na			
	Se	nm				0.50	0.50	b8	0.50	3.20	5.00	b8	5.00	na				na			
	Ag	nm				0.25	0.25	b8	0.25	0.25	0.25	b8	0.25	na				na			
	Tl	nm				0.10	0.10	b8	0.10	0.10	0.10	b8	0.10	na				na			
	V	nm				50.00	50.00	b8	50.00	50.00	50.00	b8	50.00	na				na			
	Zn	50.00	100.00	b12	100.00	25.71	29.64	b10	30.00	14.44	17.89	b3	20.00	na				na			
LL	Al	66.88	100.00	b12	100.00	29.17	50.00	b12	50.00	46.45	100.00	b8	100.00	145.00	145.00	b12	145.00	na			
	Sb	274.90	376.30	b10	437.00	67.14	95.56	b1	146.00	178.17	373.20	b7	428.00	483.00	483.00	b12	483.00	na			
	As	159.10	225.10	b7	243.00	145.70	172.50	b10	200.00	147.04	196.04	b7	217.00	2530.00	2530.00	b12	2530.00	na			
	Ba	41.87	43.90	b4	43.90	50.00	50.00	b12	50.00	41.43	42.80	b4	42.80	42.90	42.90	b12	42.90	na			
	Be	46.51	50.00	b8	50.00	0.50	0.50	b8	0.50	1.00	2.50	b8	2.50	2.50	2.50	b8	2.50	na			
	Cd	9.95	13.19	b1	40.00	2.90	7.76	b7	9.00	5.13	12.40	b7	40.00	3.20	3.20	b12	3.20	na			
	Cr	0.82	1.00	b3	1.00	0.71	2.00	b12	2.00	1.28	5.00	b12	5.00	4.60	4.60	b12	4.60	na			
	Co	12.89	25.00	b8	25.00	0.25	0.25	b8	0.25	7.85	25.00	b12	25.00	25.00	25.00	b8	25.00	na			
	Cu	29.25	35.39	b10	70.00	18.60	31.65	b11	60.00	13.24	16.66	b5	50.00	7.60	7.60	b12	7.60	na			
	Fe	383.80	435.00	b3	710.00	191.00	260.80	b3	430.00	69.28	96.15	b2	350.00	323.00	323.00	b12	323.00	na			
	Hg	0.038	0.050	b4	0.050	0.00005	0.00005	b12	0.00005	0.040	0.047	b3, c	0.050	na				na			
	Mn	238.90	287.70	b10	500.00	314.00	415.30	b10	710.00	206.15	244.54	b3	400.00	773.00	773.00	b12	773.00	na			
	Ni	4.10	4.30	b4	4.30	5.00	5.00	b8	5.00	3.63	4.40	b4	4.40	6.10	6.10	b12	6.10	na			
	Pb	69.43	84.95	b10	178.00	23.57	41.78	b1	63.00	10.78	16.57	b5	76.00	17.70	17.70	b12	17.70	na			
	Se	38.83	46.68	b10	54.10	14.86	19.25	b10	28.00	29.08	49.02	b7	52.30	7.20	7.20	b12	7.20	na			
	Ag	1.50	2.10	b4	2.10	0.25	0.25	b8	0.25	1.04	1.84	b3	5.00	1.50	1.50	b12	1.50	na			
	Tl	53.39	69.97	b10	77.00	13.19	30.06	b6	35.40	35.03	73.00	b4	73.00	12.50	12.50	b8	12.50	na			
	V	13.57	25.00	b8	25.00	37.14	50.00	b8	50.00	28.75	50.00	b8	50.00	4.60	4.60	b12	4.60	na			
	Zn	69.45	89.84	b3	200.00	27.00	34.70	b3	50.00	44.84	60.00	b3	200.00	40.90	40.90	b12	40.90	na			

Table E-4. Exposure point concentrations for surface water and porewater

		Surface Water (ug/L, Total)			Surface Water (ug/L, Total Recoverable)			Surface Water (ug/L, Dissolved)			Porewater (ug/L, Dissolved)			Piezometer/Porewater (ug/L, Dissolved)		
CSM Unit	Metal	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max

Notes:

na = No data available

(a) 95% Upper confidence levels (UCLs) estimated using US EPA's ProUCL Software (V4.00.05). ProUCL Output presented at the end of this appendix.

(b)

(1) ProUCL recommended a 95% UCL estimated assuming a gamma distribution.
(2) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (percentile bootstrap) method.
(3) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (t) method.
(4) ProUCL recommended a 95% UCL greater than the maximum detected value, therefore the maximum detected value was substituted as the 95% UCL.
(5) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (BCA) method.
(6) ProUCL recommended a 95% UCL estimated using the non-parametric Chebyshev method.
(7) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (Chebyshev) method.
(8) All samples were non-detected, therefore ½ of the maximum detection limit was used as the exposure point concentration.
(9) ProUCL recommended a 95% UCL estimated using the lognormal (H-UCL) method.
(10) ProUCL recommended a 95% UCL estimated using the normal (Student's-t) method.
(11) ProUCL recommended a 95% UCL estimated using the non-paranetric (Hall's bootstrap) method.
(12) Sample size was less than 5, therefore a 95% UCL could not be calculated, exposure concentrations estimated using ½ the detection limit for non-detects, and the maximum value was selected as the 95% UCL.

(c) Methyl mercury concentrations assumed to be the same as total mercury concentrations.

Table E-5a. Hazard quotients for surface water and porewater (non-hardness based metals)

		Total Recoverable Surface Water Benchmarks		Dissolved Surface Water Benchmarks		Surface Water (ug/L, Total)			Surface Water (ug/L, Total Recoverable)			Surface Water (ug/L, Dissolved)			Porewater (ug/L, Dissolved)			Piezometer/Porewater (ug/L, Dissolved)		
CSM Unit	Metal	Acute	Chronic	Acute	Chronic	95% UCL	Acute HQ	Chronic HQ	95% UCL	Acute HQ	Chronic HQ	95%	Acute HQ	Chronic HQ	95%	Acute HQ	Chronic HQ	95%	Acute HQ	Chronic HQ
PPC	Al	750	87	750	87	160.50	<1	2	128.20	<1	1	100.00	<1	1	100.00	<1	1	25.00	<1	<1
	Sb	900	190	900	190	30.00	<1	<1	1.50	<1	<1	30.00	<1	<1	30.00	<1	<1	24.00	<1	<1
	As	340	150	340	150	7.34	<1	<1	8.56	<1	<1	6.38	<1	<1	10.30	<1	<1	2430.00	7	16
	Fe	-	1000	-	1000	342.60	-	<1	467.50	-	<1	86.65	-	<1	89.40	-	<1	430.00	-	<1
	Hg	1.4	0.8	1.4	0.8	3.00	2	4	0.0001	<1	<1	3.00	2	4	0.10	<1	<1	0.01	<1	<1
	Se	20	5	20	5	1.87	<1	<1	2.25	<1	<1	2.46	<1	<1	17.50	<1	4	0.50	<1	<1
	Tl	79	17	79	17	12.50	<1	<1	0.10	<1	<1	12.50	<1	<1	12.50	<1	<1	3.40	<1	<1
UL&M	Al	750	87	750	87	524.20	<1	6	453.90	<1	5	100.00	<1	1	100.00	<1	1	nm	-	-
	Sb	900	190	900	190	30.00	<1	<1	3.00	<1	<1	30.00	<1	<1	30.00	<1	<1	nm	-	-
	As	340	150	340	150	16.29	<1	<1	11.03	<1	<1	5.95	<1	<1	7.50	<1	<1	nm	-	-
	Fe	-	1000	-	1000	3914.00	-	4	1704.00	-	2	108.16	-	<1	19791.42	-	20	nm	-	-
	Hg	1.4	0.8	1.4	0.8	0.50	<1	<1	-	-	-	0.01	<1	<1	0.10	<1	<1	nm	-	-
	Se	20	5	20	5	17.50	<1	4	1.00	<1	<1	17.50	<1	4	17.50	<1	4	nm	-	-
	Tl	79	17	79	17	12.50	<1	<1	0.10	<1	<1	12.50	<1	<1	12.50	<1	<1	nm	-	-
WD	Al	750	87	750	87	-	-	-	64.79	<1	<1	25.00	<1	<1	nm	-	-	nm	-	-
	Sb	900	190	900	190	-	-	-	1.50	<1	<1	1.50	<1	<1	nm	-	-	nm	-	-
	As	340	150	340	150	10.00	<1	<1	8.17	<1	<1	7.65	<1	<1	nm	-	-	nm	-	-
	Fe	-	1000	-	1000	300.00	-	<1	280.60	-	<1	90.00	-	<1	nm	-	-	nm	-	-
	Hg	1.4	0.8	1.4	0.8	0.01	<1	<1	-	-	-	0.01	<1	<1	nm	-	-	nm	-	-
	Se	20	5	20	5	-	-	-	0.50	<1	<1	5.00	<1	1	nm	-	-	nm	-	-
	Tl	79	17	79	17	-	-	-	0.10	<1	<1	0.10	<1	<1	nm	-	-	nm	-	-
LL	Al	750	87	750	87	100.00	<1	1	50.00	<1	<1	100.00	<1	1	145.00	<1	2	nm	-	-
	Sb	900	190	900	190	376.30	<1	2	95.56	<1	<1	373.20	<1	2	483.00	<1	3	nm	-	-
	As	340	150	340	150	225.10	<1	2	172.50	<1	1	196.04	<1	1	2530.00	7	17	nm	-	-
	Fe	-	1000	-	1000	435.00	-	<1	260.80	-	<1	96.15	-	<1	323.00	-	<1	nm	-	-
	Hg	1.4	0.8	1.4	0.8	0.05	<1	<1	0.0001	<1	<1	0.05	<1	<1	-	-	-	nm	-	-
	Se	20	5	20	5	46.68	2	9	19.25	<1	4	49.02	2	11	7.20	<1	2	nm	-	-
	Tl	79	17	79	17	69.97	<1	4	30.06	<1	2	73.00	<1	4	12.50	<1	<1	nm	-	-

Notes

nm - not measured

Table E-5b. Hazard quotients for surface water and porewater (hardness based metals)

		Total Recoverable Surface Water Benchmarks						Surface Water (ug/L, Total)							Surface Water (ug/L, Total Recoverable)							Dissolved Surface Water Benchmarks						Surface Water (ug/L, Dissolved)						
		Acute			Chronic			95%	Acute HQ			Chronic HQ			95%	Acute HQ			Chronic HQ			Acute			Chronic			95%	Acute HQ			Chronic HQ		
CSM Unit	Metal	Min	Mean	Max	Min	Mean	Max	UCL	Min	Mean	Max	Min	Mean	Max	UCL	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	UCL	Min	Mean	Max	Min	Mean	Max
PPC	Hardness	49.8	82.2	233.2	49.8	82.2	233.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49.8	93.8	200.0	49.8	93.8	200.0	-	-	-	-	-	-	-
	Cd	1.1	1.7	5.0	0.2	0.2	0.5	0.29	<1	<1	<1	2	1	<1	0.40	<1	<1	<1	2	2	<1	1.0	1.9	3.9	0.2	0.2	0.4	0.39	<1	<1	<1	3	2	<1
	Cr	1018.7	1535.6	3607.3	48.7	73.4	172.4	5.00	<1	<1	<1	<1	<1	<1	2.12	<1	<1	<1	<1	<1	<1	322	541	1005	42	70	131	5.00	<1	<1	<1	<1	<1	<1
	Cu	7.3	11.6	31.1	5.1	7.9	19.2	3.34	<1	<1	<1	<1	<1	<1	5.08	<1	<1	<1	<1	<1	<1	7.0	12.7	25.8	4.9	8.5	16.2	2.33	<1	<1	<1	<1	<1	<1
	Mn	2367.0	2797.0	3958.5	1307.7	1545.3	2187.1	74.36	<1	<1	<1	<1	<1	<1	78.95	<1	<1	<1	<1	<1	<1	2360	2914	3750	1308	1615	2078	57.33	<1	<1	<1	<1	<1	<1
	Ni	260.1	397.5	960.4	28.9	44.2	106.8	20.00	<1	<1	<1	<1	<1	<1	5.00	<1	<1	<1	<1	<1	<1	260	444	842	29	49	93	20.00	<1	<1	<1	<1	<1	<1
	Pb	33.6	63.6	239.9	1.3	2.5	9.3	5.40	<1	<1	<1	4	2	<1	6.62	<1	<1	<1	5	3	<1	30	60	136	1.2	2.3	5.3	1.07	<1	<1	<1	<1	<1	<1
	Ag	1.1	2.7	16.2	0.36			5.00	4	2	<1	14			0.25	<1	<1	<1	<1			0.97	2.88	10.60	0.36			0.66	<1	<1	<1	2		
	Zn	66.4	101.5	245.5	66.4	101.5	245.5	53.69	<1	<1	<1	<1	<1	<1	61.03	<1	<1	<1	<1	<1	<1	65	111	211	65	112	213	44.33	<1	<1	<1	<1	<1	<1
UL/ULM	Hardness	75.5	75.5	75.5	75.5	75.5	75.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	76	105	163	76	105	163	-	-	-	-	-	-	-
	Cd	1.6	1.6	1.6	0.2	0.2	0.2	7.36	5	5	5	33	33	33	1.95	1	1	1	9	9	9	1.5	2.1	3.2	0.2	0.3	0.3	0.29	<1	<1	<1	1	1	<1
	Cr	1432.3	1432.3	1432.3	68.5	68.5	68.5	2.92	<1	<1	<1	<1	<1	<1	2.00	<1	<1	<1	<1	<1	<1	453	594	850	59	77	111	0.98	<1	<1	<1	<1	<1	<1
	Cu	10.7	10.7	10.7	7.3	7.3	7.3	21.51	2	2	2	3	3	3	22.52	2	2	2	3	3	3	10.3	14.1	21.3	7.0	9.4	13.6	3.68	<1	<1	<1	<1	<1	<1
	Mn	2718.9	2718.9	2718.9	1502.2	1502.2	1502.2	1104.00	<1	<1	<1	<1	<1	<1	259.60	<1	<1	<1	<1	<1	<1	2711	3028	3503	1502	1678	1941	578.86	<1	<1	<1	<1	<1	<1
	Ni	369.9	369.9	369.9	41.1	41.1	41.1	20.00	<1	<1	<1	<1	<1	<1	5.00	<1	<1	<1	<1	<1	<1	369	489	708	41	54	79	20.00	<1	<1	<1	<1	<1	<1
	Pb	57.1	57.1	57.1	2.2	2.2	2.2	320.00	6	6	6	144	144	144	30.92	<1	<1	<1	14	14	14	47	68	109	1.9	2.7	4.3	3.73	<1	<1	<1	2	1	<1
	Ag	2.3	2.3	2.3	0.36			0.89	<1	<1	<1	2			1.50	<1	<1	<1	4			1.98	3.52	7.45	0.36			1.46	<1	<1	<1	4		
	Zn	94.4	94.4	94.4	94.4	94.4	94.4	127.90	1	1	1	1	1	1	128.70	1	1	1	1	1	1	92	122	177	93	123	179	66.40	<1	<1	<1	<1	<1	<1
WD	Hardness	61.4	61.6	61.8	61.4	61.6	61.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	76	92.1	50	76	92.1	-	-	-	-	-	-	-
	Cd	1.3	1.3	1.3	0.2	0.2	0.2	3.00	2	2	2	16	16	16	1.10	<1	<1	<1	6	6	6	1.0	1.5	1.9	0.2	0.2	0.2	0.88	<1	<1	<1	6	4	4
	Cr	1209.3	1212.5	1215.7	57.8	58.0	58.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	324	453	533	42	59	69	0.50	<1	<1	<1	<1	<1	<1
	Cu	8.8	8.9	8.9	6.1	6.2	6.2	10.00	1	1	1	2	2	2	6.26	<1	<1	<1	1	1	1	7.0	10.3	12.4	5.0	7.0	8.3	4.21	<1	<1	<1	<1	<1	<1
	Mn	2537.9	2540.7	2543.4	1402.2	1403.7	1405.3	60.00	<1	<1	<1	<1	<1	<1	59.64	<1	<1	<1	<1	<1	<1	2366	2711	2896	1311	1502	1605	45.23	<1	<1	<1	<1	<1	<1
	Ni	310.5	311.4	312.3	34.5	34.6	34.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	261	369	437	29	41	49	5.00	<1	<1	<1	<1	<1	<1
	Pb	43.9	44.1	44.2	1.7	1.7	1.7	60.00	1	1	1	35	35	35	8.13	<1	<1	<1	5	5	5	30	47	59	1.2	1.9	2.3	18.22	<1	<1	<1	15	10	8
	Ag	1.6	1.6	1.7	0.36			-	-	-	-	-			-	-	-	-	-			0.98	1.98	2.79	0.36			0.25	<1	<1	<1	<1		
	Zn	79.3	79.5	79.7	79.3	79.5	79.7	100.00	1	1	1	1	1	1	29.64	<1	<1	<1	<1	<1	<1	65	92	109	66	93	110	17.89	<1	<1	<1	<1	<1	<1
LL	Hardness	103.7	168.6	280.9	103.7	168.8	280.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	190	608	103	190	608	-	-	-	-	-	-	-
	Cd	2.2	3.6	6.1	0.3	0.4	0.6	13.19	6	4	2	47	33	23	7.76	4	2	1	28	19	13	2.1	3.8	11.6	0.3	0.4	0.9	12.40	6	3	1	49	32	14
	Cr	1857.5	2765.7	4201.5	88.8	132.3	200.8	1.00	<1	<1	<1	<1	<1	<1	2.00	<1	<1	<1	<1	<1	<1	583	964	2499	76	125	325	5.00	<1	<1	<1	<1	<1	<1
	Cu	14.5	22.9	37.0	9.6	14.6	22.6	35.39	2	2	<1	4	2	2	31.65	2	1	<1	3	2	1	13.8	24.6	73.6	9.2	15.5	41.9	16.66	1	<1	<1	2	1	<1
	Mn	3022.0	3553.1	4211.8	1669.7	1963.9	2327.0	287.70	<1	<1	<1	<1	<1	<1	415.30	<1	<1	<1	<1	<1	<1	3004	3686	5431	1665	2043	3010	244.54	<1	<1	<1	<1	<1	<1
	Ni	483.8	729.9	1124.2	53.8	81.2	125.0	4.30	<1	<1	<1	<1	<1	<1	5.00	<1	<1	<1	<1	<1	<1	479	806	2156	53	89	239	4.40	<1	<1	<1	<1	<1	<1
	Pb	85.5	158.8	304.1	3.3	6.2	11.8	84.95	<1	<1	<1	25	14	7	41.78	<1	<1	<1	13	7	4	67	129	429	2.6	5.0	16.7	16.57	<1	<1	<1	6	3	<1
	Ag	4.0	9.3	22.4	0.36			2.10	<1	<1	<1	6			0.25	<1	<1	<1	<1			3.37	9.70	71.74	0.36			1.84	<1	<1	<1	5		
	Zn	123.6	186.5	287.5	123.6	186.7	287.5	89.84	<1	<1	<1	<1	<1	<1	34.70	<1	<1	<1	<1	<1	<1	120	202	541	121	203	545	60.00	<1	<1	<1	<1	<1	<1

Notes

nm - not measured

Table E-5b. Hazard quotients for surface water and porewater (hardness based metals)

		Porewater Benchmarks						Porewater (ug/L, Dissolved)							Piezometer Benchmarks						Piezometer/Porewater (ug/L, Dissolved)						
		Acute			Chronic			95%	Acute HQ			Chronic HQ			Acute			Chronic			95%	Acute HQ			Chronic HQ		
CSM Unit	Metal	Min	Mean	Max	Min	Mean	Max	UCL	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	UCL	Min	Mean	Max	Min	Mean	Max
PPC	Hardness	116.0	141.0	212.0	116.0	141.0	212.0	-	-	-	-	-	-	-	86.3	86.5	86.7	86.3	86.5	86.7	-	-	-	-	-	-	-
	Cd	2.3	2.8	4.2	0.3	0.3	0.4	2.20	<1	<1	<1	8	7	5	1.8	1.8	1.8	1.8	1.8	1.8	0.05	<1	<1	<1	<1	<1	<1
	Cr	643	754.9	1054	84	98	137	5.00	<1	<1	<1	<1	<1	<1	1598	1601	1604	1598	1601	1604	0.50	<1	<1	<1	<1	<1	<1
	Cu	15.5	18.6	27.3	10.2	12.0	17.0	6.40	<1	<1	<1	<1	<1	<1	12.2	12.2	12.2	12.2	12.2	12.2	0.50	<1	<1	<1	<1	<1	<1
	Mn	3128	3338	3823	1733	1850	2119	1260.00	<1	<1	<1	<1	<1	<1	2843	2845	2847	2843	2845	2847	1210.00	<1	<1	<1	<1	<1	<1
	Ni	531	626.2	884.2	59	70	98	20.00	<1	<1	<1	<1	<1	<1	414	415	416	414.2	415	416	5.00	<1	<1	<1	<1	<1	<1
	Pb	76	94	145	3.0	3.7	5.6	5.00	<1	<1	<1	2	1	<1	68	68	68	68	68	68	0.25	<1	<1	<1	<1	<1	<1
	Ag	4.15	5.81	11.71	0.36			1.20	<1	<1	<1	3			2.94	2.95	2.96	0.36			0.25	<1	<1	<1	<1		
	Zn	133	157	221	134	158	223	194.00	1	1	<1	1	1	<1	106	106	106	106	106	106	1360.00	13	13	13	13	13	13
UL/ULM	Hardness	154	212.2	290	154	212.2	290	-	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Cd	3.1	4.2	5.7	0.3	0.4	0.5	2.50	<1	<1	<1	8	6	5	nm						nm	-	-	-	-	-	-
	Cr	811	1055	1363	106	137	177	2.85	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Cu	20.2	27.3	36.6	13.0	17.0	22.2	3.73	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Mn	3437	3825	4244	1905	2119	2352	2766.36	<1	<1	<1	1	1	1	nm						nm	-	-	-	-	-	-
	Ni	675	884.9	1153	75	98	128	20.00	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Pb	103	145	201	4.0	5.6	7.8	9.46	<1	<1	<1	2	2	1	nm						nm	-	-	-	-	-	-
	Ag	6.76	11.73	20.08	0.36			1.30	<1	<1	<1	4			nm						nm	-	-	-	-	-	-
	Zn	169	222	289	170	223	291	30.00	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
WD	Hardness	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Cd	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Cr	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Cu	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Mn	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Ni	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Pb	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Ag	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Zn	nm						nm	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
LL	Hardness	193	193	193	193	193	193	-	-	-	-	-	-	-	nm						nm	-	-	-	-	-	-
	Cd	3.8	3.8	3.8	0.4	0.4	0.4	3.20	<1	<1	<1	8	8	8	nm						nm	-	-	-	-	-	-
	Cr	976	976.3	976.3	127	127	127	4.60	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Cu	25.0	25.0	25.0	15.7	15.7	15.7	7.60	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Mn	3706	3706	3706	2054	2054	2054	773.00	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Ni	817	816.7	816.7	91	91	91	6.10	<1	<1	<1	<1	<1	<1	nm						nm	-	-	-	-	-	-
	Pb	131	131	131	5.1	5.1	5.1	17.70	<1	<1	<1	3	3	3	not measured						nm	-	-	-	-	-	-
	Ag	9.97	9.97	9.97	0.36			1.50	<1	<1	<1	4			not measured						nm	-	-	-	-	-	-
	Zn	205	205	205	206	206	206	40.90	<1	<1	<1	<1	<1	<1	not measured						nm	-	-	-	-	-	-

Notes

nm - not measured

Table E-6. Statistical comparison of on-site surface water metals (dissolved) concentrations to reference areas.

	Prickly Pear Creek					**Prickly Pear Creek (upstream)**						**Lower Lake**					**Upper Lake/Marsh**					**Wilson Ditch**					**Walker Creek (Pond/Marsh)**					
	mean (ug/L)	**stdev**	**S/NS**	**FOD**	***n***	**mean (ug/L)**	**stdev**	**FOD**	***n***	**Test**	***p* value**	**mean (ug/L)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (ug/L)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (ug/L)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (ug/L)**	**stdev**	**FOD**	***n***	**Test**	***p* value**
Al	25.00	0.00	nd	0	12	25.00	0.00	0	8	nd	nd	25.00	0.00	nd	0	6	25.00	0.00	nd	0	15	25.00	0.00	nd	0	5	63.50	17.00	90	10	nd	nd
Sb	1.50	0.00	nd	0	7	1.50	0.00	0	8	nd	nd	46.80	0.84	nd	100	5	1.50	0.00	nd	0	15	1.50	0.00	nd	0	5	1.50	0.00	0	10	nd	nd
As*	5.26	0.82	S	100	7	3.79	0.35	100	8	P	<0.001	166.00	3.74	S	100	5	5.20	1.34	S	100	15	5.58	2.75	S	100	5	1.11	0.16	100	10	NP	<0.001
Ba	50.00	0.00	nd	0	7	50.00	0.00	0	8	nd	nd	50.00	0.00	nd	0	5	50.00	0.00	nd	0	15	50.00	0.00	nd	0	5	85.00	110.68	10	10	nd	nd
Be	0.50	0.00	nd	0	7	0.50	0.00	0	8	nd	nd	0.50	0.00	nd	0	5	0.50	0.00	nd	0	15	0.50	0.00	nd	0	5	0.50	0.00	0	10	nd	nd
Cd	0.05	0.00	nd	0	7	0.05	0.00	0	8	nd	nd	0.44	0.09	nd	100	5	0.10	0.12	nd	20	15	0.22	0.28	nd	60	5	0.05	0.00	0	10	nd	nd
Cr	0.50	0.00	nd	0	7	0.50	0.00	0	8	nd	nd	0.50	0.00	nd	0	5	0.50	0.00	nd	0	15	0.50	0.00	nd	0	5	0.50	0.00	0	10	nd	nd
Co	0.25	0.00	nd	0	7	0.25	0.00	0	8	nd	nd	0.25	0.00	nd	0	5	0.25	0.00	nd	0	15	0.25	0.00	nd	0	5	0.30	0.14	10	10	nd	nd
Cu*	1.86	0.38	NS	100	7	2.00	0.00	100	8	NP	0.694	5.40	0.55	S	100	5	1.60	0.83	NS	100	15	2.20	1.10	NS	100	5	1.85	0.47	90	10	NP	<0.001
Fe*	68.57	14.64	S	100	7	46.25	5.18	100	8	P	0.005	10.00	0.00	S	0	5	83.33	49.81	S	100	15	80.00	22.36	S	100	5	248.00	103.90	100	10	NP	<0.001
Pb*	1.04	0.24	S	100	7	0.28	0.09	100	8	NP	<0.001	1.50	0.24	S	100	5	1.53	1.20	S	100	15	1.38	0.36	S	100	5	0.25	0.00	0	10	NP	<0.001
Mn*	51.43	10.69	S	100	7	28.75	3.54	100	8	NP	0.002	270.00	10.00	S*	100	5	64.33	52.74	NS	93	15	36.00	11.40	NS	100	5	296.00	900.97	40	10	NP	<0.001
Hg	0.01	0.00	nd	0	7	0.01	0.01	0	8	nd	nd	0.04	0.01	nd	100	5	0.01	0.00	nd	20	15	0.01	0.00	nd	0	5	0.01	0.00	0	10	nd	nd
Ni	5.00	0.00	nd	0	7	5.00	0.00	0	8	nd	nd	5.00	0.00	nd	0	5	5.00	0.00	nd	0	15	5.00	0.00	nd	0	5	5.00	0.00	0	10	nd	nd
Se	0.50	0.00	nd	0	7	0.50	0.00	0	8	nd	nd	11.60	0.55	nd	100	5	0.50	0.00	nd	0	15	3.20	2.46	nd	0	5	0.50	0.00	0	10	nd	nd
Ag	0.25	0.00	nd	0	7	0.25	0.00	0	8	nd	nd	0.25	0.00	nd	0	5	0.25	0.00	nd	0	15	0.25	0.00	nd	0	5	0.25	0.00	0	10	nd	nd
Tl	0.10	0.00	nd	0	7	0.10	0.00	0	8	nd	nd	6.50	0.22	nd	100	5	0.10	0.00	nd	0	15	0.10	0.00	nd	0	5	0.10	0.00	0	10	nd	nd
V	50.00	0.00	nd	0	7	50.00	0.00	0	8	nd	nd	50.00	0.00	nd	0	5	50.00	0.00	nd	0	15	50.00	0.00	nd	0	5	50.00	0.00	0	10	nd	nd
Zn*	28.57	3.78	NS	100	7	33.75	7.44	100	8	NP	0.152	5.00	0.00	NS	0	5	15.67	7.53	S*	80	15	18.00	4.47	S*	100	5	8.50	11.07	10	10	NP	<0.001

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

Samples designated with an asterisks (*) indicate samples in which concentrations were above reporting limits for at least 50% of the sample sites and thus were evaluated statistically (As shown above)

nd = no statistical analysis was conducted (not determined)

PPC was compared to PPC upstream reference sites

UL/ULM, WD, and LL were compared to WCP/WCM

S-significant, NS- not significant, S-significant using NP, but not significant using P*

FOD = frequency of detection (%)

Table E-7. Statistical comparison of on-site surface water metals (total recoverable) concentrations to reference areas.

	Prickly Pear Creek					Prickly Pear Creek (upstream)						Lower Lake					Upper Lake/Marsh					Wilson Ditch					Walker Creek (Pond/Marsh)					
Metal	mean (ug/L)	stdev	S/NS	FOD	*n*	mean (ug/L)	stdev	FOD	n	Test	*p value*	mean (ug/L)	stdev	S/NS	FOD	*n*	mean (ug/L)	stdev	S/NS	FOD	*n*	mean (ug/L)	stdev	S/NS	FOD	*n*	mean (ug/L)	stdev	FOD	*n*	Test	*p* value
Al*	43.57	18.64	S	57.14	7	68.75	9.91	100	8	NP	0.009	30.00	11.18	S*	20	5	185.00	481.06	S*	37.5	16	39.00	20.43	S*	40	5	4936.67	15986.63	100	12	NP	<0.001
Sb	1.50	0.00	nd	0.00	7	1.50	0.00	0	8	nd	nd	53.20	7.76	nd	100	5	1.59	0.38	nd	6.25	16	1.50	0.00	nd	0	5	1.71	0.72	8.33	12	nd	nd
As*	6.39	0.92	S	100.00	7	4.86	0.43	100	8	NP	0.006	185.80	8.32	S	100	5	8.01	5.98	S*	100	16	6.56	3.04	NS	100	5	9.52	28.99	100	13	NP	<0.001
Ba	50.00	0.00	nd	0.00	7	50.00	0.00	0	8	nd	nd	-	-	nd	-	-	50.00	0.00	nd	0	16	50.00	0.00	nd	0	5	637.50	2035.16	8.33	12	nd	nd
Be	0.50	0.00	nd	0.00	7	0.50	0.00	0	8	nd	nd	0.50	0.00	nd	0	5	0.50	0.00	nd	0	16	0.50	0.00	nd	0	5	0.54	0.14	0	12	nd	nd
Cd*	0.26	0.05	NS	100.00	7	0.20	0.00	100	8	NP	0.07	2.30	2.24	S	100	5	0.53	0.84	S*	100	16	0.46	0.48	S*	100	5	0.20	0.54	7.69	13	NP	<0.001
Cr	0.50	0.00	nd	0.00	7	0.50	0.00	0	8	nd	nd	0.50	0.00	nd	0	5	0.59	0.38	nd	6.25	16	0.50	0.00	nd	0	5	4.63	14.29	8.33	12	nd	nd
Co	0.25	0.00	nd	0.00	7	0.25	0.00	0	8	nd	nd	0.03	0.00	nd	0	5	0.38	0.54	nd	6.25	16	0.25	0.00	nd	0	5	7.40	24.75	8.33	12	nd	nd
Cu*	3.00	0.00	NS	100.00	7	3.00	0.00	100	8	NP	1.00	19.20	22.83	S*	100	5	7.06	12.69	NS	100	16	4.80	3.03	NS	100	5	25.85	81.77	100	13	NP	0.019
Fe*	268.57	21.16	NS	100.00	7	247.50	19.09	100	8	P	0.063	168.00	147.04	S*	100	5	552.50	972.45	S*	100	16	224.00	36.47	S*	100	5	27203.85	95486.13	100	13	NP	<0.001
Pb*	5.46	1.23	S	100.00	7	3.05	0.42	100	8	NP	0.002	19.34	20.53	S*	100	5	26.89	70.15	S*	100	16	5.86	1.66	S*	100	5	6.21	20.37	30.77	13	NP	<0.001
Mn*	82.86	14.96	S	100.00	7	43.75	5.18	100	8	NP	<0.001	416.00	164.56	S*	100	5	157.50	239.37	S*	100	16	54.00	5.48	NS	100	5	5719.17	19676.37	100	12	NP	0.001
Hg	nm	nm	nm	nm	nm	0.01	0.01	62.5	8	nd	nd	0.04	0.01	nd	100	5	0.01	0.00	nd	18.75	16	0.01	0.00	nd	0	5	0.01	0.00	0	12	nd	nd
Ni	5.00	0.00	nd	0.00	7	5.00	0.00	0	8	nd	nd	5.00	0.00	nd	0	5	5.00	0.00	nd	0	16	5.00	0.00	nd	0	5	10.42	18.76	8.33	12	nd	nd
Se	0.50	0.00	nd	0.00	7	0.50	0.00	0	8	nd	nd	12.00	0.00	nd	100	5	0.50	0.00	nd	0	16	0.50	0.00	nd	0	5	1.06	2.02	7.69	13	nd	nd
Ag	0.25	0.00	nd	0.00	7	0.25	0.00	0	8	nd	nd	0.25	0.00	nd	0	5	0.33	0.31	nd	6.25	16	0.25	0.00	nd	0	5	0.65	1.37	0	12	nd	nd
Tl	0.10	0.00	nd	0.00	7	0.10	0.00	0	8	nd	nd	9.00	3.41	nd	100	5	0.10	0.00	nd	0	16	0.10	0.00	nd	0	5	0.13	0.12	0	12	nd	nd
V	50.00	0.00	nd	0.00	7	50.00	0.00	0	8	nd	nd	50.00	0.00	nd	0	5	50.00	0.00	nd	0	16	50.00	0.00	nd	0	5	70.83	72.17	8.33	12	nd	nd
Zn*	45.71	5.35	S	100.00	7	58.75	6.41	100	8	P	<0.001	10.00	11.18	NS	20	5	51.25	64.07	S*	100	16	28.00	4.47	NS	100	5	37.69	117.87	7.69	13	NP	<0.001

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

Samples designated with an asterisks (*) indicate samples in which concentrations were above reporting limits for at least 50% of the sample sites and thus were evaluated statistically (As shown above)

nd = no statistical analysis was conducted (not determined)

PPC was compared to PPC upstream reference sites

UL/ULM, WD, and LL were compared to WCP/WCM

S-significant, NS- not significant, S-significant using NP, but not significant using P*

FOD = frequency of detection (%)

Table E-8. Statistical comparison of on-site benthic invertebrate metals concentrations to reference areas.

	Prickly Pear Creek					Prickly Pear Creek (upstream)						Lower Lake					Upper Lake/Marsh					Wilson Ditch			Walker Creek (Pond/Marsh)					
	mean (mg/kg)	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg)**	**stdev**	**FOD**	***n***	**Test**	***p* value**	**mean (mg/kg)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg)**	**stdev**	**S/NS**	**FOD**	***n***	**mean (mg/kg)**	**FOD**	***n***	**mean (mg/kg)**	**stdev**	**FOD**	***n***	**Test**	***p* value**
Al	209.17	33.68	NS	100	6	226.40	31.03	100	5	P	0.404	109.50	90.22	NS	100	5	99.91	50.15	NS	100	10	138.00	100	1	164.50	59.39	100	10	P	0.138
Sb	0.22	0.05	S	100	6	0.14	0.02	100	5	P	0.007	2.76	1.58	S	100	5	0.57	0.74	NS	100	10	0.37	100	1	0.10	0.02	10	10	NP	0.005
As	4.93	2.94	NS	100	6	2.59	0.38	100	5	P	0.114	7.84	6.77	S	100	5	2.43	1.45	S	100	10	2.01	100	1	0.42	0.12	100	10	NP	<0.001
Ba	8.97	4.23	NS	100	6	5.79	1.43	100	5	P	0.146	3.46	2.06	S	100	5	15.44	7.84	S	100	10	24.10	100	1	36.69	11.76	100	10	P	<0.001
Be	0.01	0.00	NS	100	6	0.02	0.00	100	5	P	0.166	0.02	0.01	NS	60	5	0.03	0.01	NS	30	10	0.03	0	1	0.02	0.00	20	10	NP	0.21
Cd	0.83	0.20	NS	100	6	0.73	0.20	100	5	P	0.422	6.46	2.30	S	100	5	1.41	1.32	S	100	10	1.87	100	1	0.11	0.06	100	10	NP	<0.001
Cr	0.41	0.12	NS	100	6	0.38	0.06	100	5	P	0.632	0.27	0.13	NS	100	5	0.16	0.04	NS	100	10	0.42	100	1	0.30	0.18	100	10	P	0.039
Co	0.40	0.06	NS	100	6	0.43	0.08	100	5	P	0.494	0.18	0.12	S	100	5	0.17	0.05	NS	100	10	0.17	100	1	0.31	0.10	100	10	NP	0.016
Cu	10.14	1.69	NS	100	6	8.93	1.35	100	5	P	0.232	18.65	10.06	NS	100	5	12.42	4.42	NS	100	10	14.90	100	1	4.46	1.23	100	10	NP	<0.001
Fe	552.00	107.53	NS	100	6	495.40	87.46	100	5	P	0.37	218.60	166.50	S	100	5	188.16	71.30	S	100	10	224.00	100	1	447.40	198.54	100	10	P	0.002
Pb	12.30	3.70	S	100	6	6.61	1.13	100	5	P	0.009	42.48	29.01	S	100	5	31.55	40.96	S	100	10	26.60	100	1	0.33	0.35	100	10	NP	<0.001
Mn	186.42	63.51	NS	100	6	115.54	33.85	100	5	P	0.053	77.96	51.36	NS	100	5	68.02	18.02	NS	100	10	157.00	100	1	98.23	38.68	100	10	P	0.03
Hg	0.04	0.02	S	100	6	0.01	0.00	100	5	NP	0.004	0.26	0.28	S	100	5	0.13	0.14	NS	100	10	0.13	100	1	0.01	0.00	100	10	NP	<0.001
Ni	0.41	0.14	NS	100	6	0.45	0.09	100	5	P	0.637	0.33	0.19	NS	100	5	0.16	0.04	NS	100	10	0.26	100	1	0.21	0.07	100	10	NP	0.143
Se	0.33	0.06	NS	100	6	0.26	0.05	100	5	P	0.077	3.72	1.71	S	100	5	0.35	0.12	S	100	10	0.29	100	1	0.11	0.03	100	10	NP	<0.001
Ag	0.11	0.02	S	100	6	0.08	0.01	100	5	P	0.019	0.47	0.31	S	100	5	0.27	0.32	S	100	10	0.19	100	1	0.01	0.00	100	10	NP	<0.001
Tl	0.02	0.01	NS	40	6	0.03	0.00	0	5	NP	0.662	0.97	0.56	S	100	5	0.03	0.03	NS	90	10	0.03	0	1	0.03	0.00	0	10	NP	0.004
V	1.19	0.24	S	100	6	0.62	0.34	100	5	P	0.01	0.47	0.31	NS	100	5	0.38	0.10	NS	100	10	0.59	100	1	0.55	0.24	100	10	NP	0.319
Zn	147.20	43.58	NS	100	6	163.40	50.96	100	5	P	0.583	72.42	21.66	S	100	5	52.42	15.00	S	100	10	53.20	100	1	20.99	3.90	100	10	NP	<0.001

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

Samples designated with an asterisks (*) indicate samples in which concentrations were above reporting limits for at least 50% of the sample sites and thus were evaluated statistically (As shown above)

nd = no statistical analysis was conducted (not determined)

PPC was compared to PPC upstream reference sites

UL/ULM, WD, and LL were compared to WCP/WCM

S-significant, NS- not significant, S-significant using NP, but not significant using P*

FOD = frequency of detection (%)

Table E-9. Statistical comparison of on-site fish tissue metals concentrations to reference areas.

	Prickly Pear Creek					Prickly Pear Creek (upstream)						Upper Lake/Marsh					Walker Creek (Pond/Marsh)					
Metal	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	FOD	*n*	Test	*p* value	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	FOD	*n*	Test	*p* value
Al	1.81	1.79	NS	40	5	1.78	0.40	100	6	NP	0.662	0.68	0.35	S	0	5	1.42	0.08	100	5	NP	0.008
Sb	0.10	0.00	NS	0	5	0.10	0.00	0	6	NP	1	0.10	0.00	NS	0	5	0.11	0.01	100	5	P	0.207
As	0.28	0.17	NS	100	5	0.43	0.08	100	6	NP	0.126	0.13	0.03	NS	100	5	0.33	0.19	100	5	NP	0.008
Ba	0.27	0.32	NS	40	5	0.37	0.09	100	6	P	0.509	0.19	0.17	NS	40	5	0.11	0.03	100	5	P	0.317
Be	0.03	0.00	NS	0	5	0.03	0.00	0	6	NP	1	0.03	0.00	NS	0	5	0.03	0.00	0	5	NP	1
Cd	0.04	0.01	S	80	5	0.15	0.09	100	6	P	0.018	0.02	0.01	S	80	5	0.03	0.00	0	5	P	0.029
Cr	0.12	0.07	NS	80	5	0.12	0.05	80	6	NP	0.931	0.25	0.33	NS	80	5	0.09	0.01	20	5	NP	0.841
Co	0.03	0.01	S	100	5	0.06	0.01	100	6	NP	0.03	0.01	0.00	NS	100	5	0.02	0.00	100	5	P	0.209
Cu	0.66	0.12	NS	100	5	0.54	0.17	100	6	P	0.239	0.51	0.17	NS	100	5	0.55	0.22	100	5	P	0.721
Fe	10.90	8.61	NS	100	5	8.58	1.16	100	6	NP	0.792	6.82	4.65	NS	100	5	8.02	1.35	100	5	NP	0.151
Pb	0.25	0.25	NS	100	5	0.17	0.05	100	6	P	0.49	0.20	0.11	NS	100	5	0.11	0.07	100	5	P	0.155
Mn	1.28	1.15	NS	100	5	1.42	0.57	100	6	P	0.803	0.68	0.11	NS	100	5	0.96	0.93	100	5	NP	1
Hg	0.12	0.04	S	100	5	0.05	0.03	100	6	P	0.013	0.17	0.12	S	100	5	0.07	0.06	100	5	NP	0.008
Ni	0.15	0.01	NS	20	5	0.14	0.03	20	6	NP	1	0.15	0.00	NS	0	5	0.16	0.02	20	5	NP	0.69
Se	0.47	0.10	NS	100	5	0.37	0.06	100	6	P	0.053	0.33	0.04	S	100	5	0.13	0.03	100	5	P	<0.001
Ag	0.01	0.00	NS	0	5	0.01	0.00	20	6	P	0.13	0.01	0.00	NS	20	5	0.02	0.00	0	5	NP	0.69
Tl	0.03	0.00	NS	20	5	0.02	0.01	20	6	NP	0.429	0.03	0.00	NS	0	5	0.03	0.00	0	5	NP	1
V	0.09	0.21	NS	100	5	0.08	0.01	100	6	P	0.803	0.05	0.01	NS	100	5	0.05	0.01	80	5	NP	0.151
Zn	12.75	2.01	NS	100	5	12.08	3.97	100	6	NP	0.662	11.00	3.22	NS	100	5	8.66	2.37	100	5	P	0.227

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

Samples designated with an asterisks (*) indicate samples in which concentrations were above reporting limits for at least 50% of the sample sites and thus were evaluated statistically (As shown above)

nd = no statistical analysis was conducted (not determined)

PPC was compared to PPC upstream reference sites

UL/ULM, WD, and LL were compared to WCP/WCM

S-significant, NS- not significant, S-significant using NP, but not significant using P*

FOD = frequency of detection (%)

Table E-10. Fish Tissue Chemistry Compared to Critical Body Residues

								Total Metals (mg/kg wet weight)																									
							% Solids	Al		As		Be		Cd		Cr		Cu		Fe		Pb		Hg		Se		Tl		V		Zn	
CSM Unit	**Date**	**Location ID**	**Sample ID**	**Species**	**Sample Type**	**Tissue Type**		**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Forage Fish Samples				Critical Body Residue (LOEC) (mg/kg-ww) =				12.5		0.62		5.13		0.183		1.28		44.1		54		4.02		0.2		1.58		2.72		2.7		50	
Canyon Ferry (Ref)	2003	CF	CF	NR	FF	WC	nr	nm		2.00	U	nm		0.20	U	nm		2.10		nm		0.80	U	0.03		5.00	U	nm		nm		35.00	
Lower Lake	2010	LL-24/25	FF-13	Fathead minnow	FF	WC	20.7	2.57	J	0.44		0.01	U	0.11		0.03	J	0.76		7.74		0.54		0.01		1.73		0.68		0.03	J	14.41	
Lower Lake	2010	LL-24/21	FF-14	Fathead minnow	FF	WC	19.5	2.75	J	0.37		0.01	U	0.11		0.04	J	0.82		7.64		0.47		0.01		1.40		0.50		0.03	J	11.17	
Lower Lake	2010	LL-22/25	FF-15	YOY/fathead minnow	FF	WC	18.5	72.71		3.42		0.04	U	3.02		0.09	J	5.24		150.41		30.34		0.08		0.67		0.52		0.22		22.94	J
Prickly Pear Creek	2010	PPC-22	FF-01	Mottled sculpin	FF	WC	19.8	4.30		0.16		0.01	U	0.02		0.02	J	0.18		10.36	J	0.19		0.005		0.11		0.01	U	0.07		8.00	
Prickly Pear Creek	2010	PPC-22	FF-02	Mottled sculpin	FF	WC	21.9	3.92		0.15		0.01	U	0.02		0.05		0.20		8.85	J	0.24		0.01		0.10		0.01	U	0.08		6.75	
Prickly Pear Creek	2010	PPC-22	FF-03	Mottled sculpin	FF	WC	20.9	3.43		0.12		0.01	U	0.02		0.03	J	0.19		8.53	J	0.27		0.01		0.09		0.01	U	0.08		6.33	
Upper Lake/Marsh	2010	UL-21B	FF-06	White sucker	FF	WC	21.6	6.87	J	0.11		0.01	U	0.06		0.14		0.71		9.12		0.69		0.02		0.10	J	0.01	U	0.03	J	6.67	
Upper Lake/Marsh	2010	UL-21B	FF-07	Fathead minnow	FF	WC	21.9	4.27	J	0.25		0.01	U	0.04		0.02	J	0.54		9.64		0.71		0.02		0.08	J	0.01	U	0.04	J	9.02	
Upper Lake/Marsh	2010	UL-21A	FF-08	White sucker	FF	WC	20.3	5.68	J	0.10		0.01	U	0.04		0.02	J	0.40		9.99		0.86		0.02		0.08	J	0.01	U	0.04	J	6.07	
Upper Lake/Marsh	2010	UL-21A	FF-09	Fathead minnow	FF	WC	21.3	8.73	J	0.34		0.02	U	0.05		0.04	J	0.81		17.34		1.09		0.01		0.09	J	0.02	U	0.07	J	10.14	
Upper Lake/Marsh	2010	UL-21A	FF-10	White sucker	FF	WC	19.9	3.70	J	0.08		0.01	U	0.02		0.02	J	0.29		6.97		0.64		0.02		0.07	J	0.01	U	0.03	J	5.43	
Upper Lake/Marsh	2003	ULM	ULM	Forage fish	FF	WC	nr	nm		2.00	U	nm		1.40		nm		9.10		nm		25.00		0.07		5.00	U	nm		nm		66.00	
Upper Lake/Marsh	2010	ULM-3	FF-04	YOY	FF	WC	25.8	10.84	J	0.26		0.05	U	0.03	J	0.08	J	0.70		28.90		0.35		0.01		0.14		0.05	U	0.09	J	16.80	
Upper Lake/Marsh	2010	ULM-5	FF-05	YOY	FF	WC	18.2	15.09		0.17		0.01	U	0.04		0.02	J	0.49		34.58		0.95		0.01		0.07		0.01	U	0.07	J	12.78	
Upper Lake/Marsh	2010	ULM-2	FF-11	Fathead minnow	FF	WC	24.3	2.36	J	0.29		0.01	U	0.02		0.03	J	0.57		7.78		0.29		0.02		0.12	J	0.01	U	0.05	J	10.86	
Upper Lake/Marsh	2010	ULM-2	FF-12	Longnose dace	FF	WC	25.1	1.81	J	0.05		0.01	U	0.04		0.04	J	0.34		7.58		0.19		0.03		0.16	J	0.01	U	0.03	J	11.85	
Wilson Ditch	2010	WD-2	FF-16	YOY	FF	WC	14.8	10.54		0.14		0.01	U	0.07		0.02	J	0.40		24.42		2.96		0.01	J	0.04	J	0.003	J	0.06	J	8.87	
Piscivorous Fish Samples																																	
Prickly Pear Creek	2010	PPC-22	PF-01	Brown trout	PF	WI	23.9	1.58		0.06		0.01	U	0.03		0.02	J	0.45		5.33	J	0.11		0.01		0.11		0.01	U	0.03		9.27	
Prickly Pear Creek	2010	PPC-22	PF-02	Brown trout	PF	WI	25.8	0.77	J	0.12		0.01	U	0.09		0.05	U	0.57		6.58	J	0.11		0.01		0.21		0.01	U	0.03		20.61	
Prickly Pear Creek	2010	PPC-22	PF-03	Brown trout	PF	WI	24.5	3.11		0.14		0.01	U	0.05		0.01	J	0.81		10.36	J	0.14		0.08		0.14		0.002	J	0.03		8.94	
Prickly Pear Creek	2010	PPC-102/103	PF-04	Brown trout	PF	WI	21.8	0.52	J	0.09		0.01	U	0.07		0.04	U	0.44		4.03	J	0.08		0.01		0.17		0.01	U	0.02		19.82	
Prickly Pear Creek	2010	PPC-24	PF-10	Brown trout	PF	WI	22.6	2.37	J	0.15		0.01	U	0.03		0.03	J	1.02		15.73		0.15		0.01	J	0.10	J	0.01	U	0.06	J	6.69	
Upper Lake/Marsh	2010	UL-21	PF-05	White sucker	PF	WC	24.3	7.29	J	0.09		0.01	U	0.02		0.78		0.34		20.39		0.36		0.03	J	0.07	J	0.01	U	0.05	J	4.47	J
Upper Lake/Marsh	2010	UL-21	PF-06	White sucker	PF	WC	23.8	3.12	J	0.07		0.01	U	0.02		0.03	J	0.28		6.45		0.50		0.02	J	0.06	J	0.01	U	0.04	J	3.52	J
Upper Lake/Marsh	2010	UL-21	PF-07	White sucker	PF	WC	23.1	5.75	J	0.11		0.01	U	0.02		0.02	J	0.32		11.80		0.40		0.01	J	0.07	J	0.01	U	0.04	J	4.34	J
Upper Lake/Marsh	2010	UL-21	PF-08	White sucker	PF	WC	22.8	3.28	J	0.08		0.01	U	0.02		0.02	J	0.30		7.30		0.27		0.03	J	0.06	J	0.01	U	0.04	J	3.56	J
Upper Lake/Marsh	2010	UL-21	PF-09	White sucker	PF	WC	22.5	9.74	J	0.12		0.01	U	0.04		0.02	J	0.36		18.50		0.81		0.02	J	0.06	J	0.01	U	0.05	J	4.01	J
Upper Lake/Marsh	2010	UL-23	GF-09-Whole	Rainbow trout	PF	WI	32.8	0.57		0.04		0.02	U	0.02		0.07	U	0.50		3.44		0.05		0.05		0.12		0.01		0.02		4.59	
Upper Lake/Marsh	2010	UL-21	GF-10-Whole	Brown trout	PF	WI	26.7	1.55		0.06		0.01	U	0.01		0.03		0.65		4.15		0.14		0.05		0.11		0.01	U	0.02		8.46	
Upper Lake/Marsh	2010	UL-21	GF-11-Whole	Brown trout	PF	WI	26.1	1.45		0.06		0.01	U	0.01		0.02		0.52		3.82		0.21		0.03		0.10		0.01	U	0.02		12.09	
Upper Lake/Marsh	2010	UL-23	GF-13-Whole	Brown trout	PF	WI	23.3	0.69		0.04		0.01	U	0.02		0.12		0.84		5.62		0.12		0.06		0.12		0.01	U	0.02		6.36	
Upper Lake/Marsh	2010	UL-23	GF-14-Whole	Rainbow trout	PF	WI	27.6	0.55		0.04		0.01	U	0.01		0.06		0.49		2.83		0.33		0.03		0.12		0.01		0.02		9.11	
Game Fish Samples																																	
Prickly Pear Creek	2010	PPC-102/103	GF-07	Brown trout	GFF	FI	22.2	0.75	J	0.11		0.01	U	0.01	J	0.02	J	0.11		2.44		0.08		0.04		0.12		0.01	J	0.02	J	2.00	
Prickly Pear Creek	2010	PPC-102/103	GF-08	Brown trout	GFF	FI	22.8	0.27	J	0.06		0.01	U	0.01	U	0.05	U	0.16		1.14		0.02		0.03		0.14	J	0.01	U	0.02	J	1.80	
Prickly Pear Creek	2010	PPC-24	GF-15	Brown trout	GFF	FI	20.8	0.17	UJ	0.02	J	0.01	U	0.01	J	0.02	J	0.12		1.56	J	0.02		0.03	J	0.08		0.01	U	0.01	J	3.35	
Prickly Pear Creek	2010	PPC-24	GF-16	Brown trout	GFF	FI	28	0.20	UJ	0.03	J	0.01	U	0.01	J	0.07		0.20		1.48	J	0.02		0.02	J	0.11		0.01	U	0.02	J	3.08	
Prickly Pear Creek	2010	PPC-24	GF-17	Brown trout	GFF	FI	19.7	0.79	J	0.07		0.01	U	0.01	J	0.02	J	0.16		5.06	J	0.13		0.01	J	0.08		0.01	U	0.02		3.23	
Prickly Pear Creek (Ref)	2010	PPC-REF-4	GF-01	Brown trout	GFF	FI	25.1	0.60	J	0.13		0.01	U	0.04		0.05	U	0.15		2.31		0.07		0.01		0.07		0.01	U	0.02	J	4.02	
Prickly Pear Creek (Ref)	2010	PPC-REF-4	GF-02	Brown trout	GFF	FI	23.2	0.37	J	0.10		0.01	U	0.05		0.03	J	0.20		2.30		0.03		0.02		0.10		0.00	J	0.02	J	2.85	
Prickly Pear Creek (Ref)	2010	PPC-REF-4	GF-03	Brown trout	GFF	FI	20.9	0.38	J	0.11		0.01	U	0.02		0.05		0.10		2.03		0.03		0.01		0.08		0.01	U	0.02	J	2.40	
Prickly Pear Creek (Ref)	2010	PPC-REF-4	GF-04	Brown trout	GFF	FI	19.6	0.24	J	0.07		0.01	U	0.02		0.04	U	0.08		1.49		0.02		0.01		0.07		0.01	U	0.02	J	2.16	
Prickly Pear Creek (Ref)	2010	PPC-REF-4	GF-05	Brown trout	GFF	FI	21.9	0.37	J	0.07		0.01	U	0.06		0.02	J	0.11		1.58		0.04		0.01		0.08		0.01	U	0.02	J	3.15	
Prickly Pear Creek (Ref)	2010	PPC-REF-4	GF-06	Brown trout	GFF	FI	20.3	0.41	J	0.08		0.01	U	0.01	J	0.02	J	0.08		1.60		0.04		0.001		0.07		0.01	U	0.02	J	2.29	
Upper Lake/Marsh	2003	ULM	ULM	Rainbow trout	GFF	FI	nr	nm		2	U	nm		0.2	U	nm		1.6		nm		0.8	U	nm		5	U	nm		nm		13	
Upper Lake/Marsh	2003	ULM	ULM	Rainbow trout	GFF	FI	nr	nm		2	U	nm		0.2	U	nm		1.3		nm		0.8	U	nm		5	U	nm		nm		5	
Upper Lake/Marsh	2003	ULM	ULM	Rainbow trout	GFF	FI	nr	nm		-		nm		-		nm		nm		nm		nm		0.217		nm		nm		nm		nm	
Upper Lake/Marsh	2010	UL-23	GF-09-Fillet	Rainbow trout	GFF	FI	29.6	0.30	UJ	0.03	J	0.01	U	0.01	U	0.06	U	0.10		1.39	J	0.02		0.05	J	0.08		0.01	U	0.01	J	1.72	
Upper Lake/Marsh	2010	UL-21	GF-10-Fillet	Brown trout	GFF	FI	26.4	0.69	J	0.05		0.01	U	0.003		0.04	J	0.12		1.43	J	0.10		0.05	J	0.09		0.01	U	0.02	J	2.72	
Upper Lake/Marsh	2010	UL-21	GF-11-Fillet	Brown trout	GFF	FI	24.3	0.27	J	0.04		0.01	U	0.002		0.01	J	0.10		1.00	J	0.03		0.03	J	0.08		0.01	U	0.01	J	3.45	
Upper Lake/Marsh	2010	UL-23	GF-13-Fillet	Brown trout	GFF	FI	22.5	0.27	J	0.03		0.01	U	0.005		0.19		0.17		3.40	J	0.04		0.06	J	0.08		0.01	U	0.01	J	2.72	
Upper Lake/Marsh	2010	UL-23	GF-14-Fillet	Rainbow trout	GFF	FI	27.6	0.25	J	0.04	J	0.01	U	0.01		0.02		0.16		1.32	J	0.07		0.03	J	0.11		0.01	J	0.01		3.48	
Walker Pond (Ref)	2010	WP	GF-18	Rainbow trout	GFF	FI	17.1	0.26	J	0.04		0.01	U	0.01	U	0.03	U	0.06		1.30		0.02		0.02		0.02		0.01	U	0.02	U	0.89	J
Walker Pond (Ref)	2010	WP	GF-19	Rainbow trout	GFF	FI	17.7	0.27	J	0.04		0.01	U	0.01	U	0.04	U	0.08		1.27		0.04		0.01		0.02		0.01	U	0.01	J	1.49	J
Walker Pond (Ref)	2010	WP	GF-20	Rainbow trout	GFF	FI	17.2	0.24	J	0.07		0.01	U	0.01	U	0.03	U	0.11		1.72		0.01		0.01		0.03		0.01	U	0.01	J	1.70	J

Table E-10. Fish Tissue Chemistry Compared to Critical Body Residues

								Total Metals (mg/kg wet weight)																									
								Al		As		Be		Cd		Cr		Cu		Fe		Pb		Hg		Se		Tl		V		Zn	
CSM Unit	Date	Location ID	Sample ID	Species	Sample Type	Tissue Type	% Solids	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q
Walker Pond (Ref)	2010	WP	GF-21	Rainbow trout	GFF	FI	16.3	0.21	J	0.10		0.01	U	0.01	U	0.01	J	0.15		1.42		0.01		0.01		0.02		0.01	U	0.01	J	1.89	J
Walker Pond (Ref)	2010	WP	GF-22	Rainbow trout	GFF	FI	17.2	0.24	J	0.03	J	0.01	U	0.01	U	0.03	U	0.07		1.14		0.01		0.01		0.03		0.01	U	0.01	J	1.41	J
Miscellaneous Fish Samples																																	
Upper Lake/Marsh	2003	ULM	ULM	Rainbow trout	Whole Fish	WI	nm	nm		-		nm		-		nm		-		nm		-		0.106		-		nm		nm		-	
Upper Lake/Marsh	2010	UL-23	GF-09-Carcass	Rainbow trout	GFC	IND	38.1	1.10	J	0.08	0	0.02	U	0.03		0.08	J	1.29		7.51		0.12		0.06	J	0.20	J	0.00	U	0.02	J	10.33	J
Upper Lake/Marsh	2010	UL-21	GF-10-Carcass	Brown trout	GFC	IND	27.3	2.29	J	0.08	0	0.01	U	0.02		0.02	J	1.11		6.47		0.19		0.04		0.13		0.01	J	0.02	J	13.35	
Upper Lake/Marsh	2010	UL-21	GF-11-Carcass	Brown trout	GFC	IND	31.2	2.46	J	0.09	0	0.02	U	0.02		0.02	J	0.89		6.30		0.36		0.04		0.14		0.02	U	0.02	J	19.75	
Upper Lake/Marsh	2010	UL-23	GF-13-Carcass	Brown trout	GFC	IND	25.3	1.06	J	0.06	0	0.01	U	0.04	U	0.07	U	1.41		7.69		0.19		0.05		0.15	J	0.01	U	0.02	J	9.56	
Upper Lake/Marsh	2010	UL-23	GF-14-Carcass	Rainbow trout	GFC	IND	27.6	0.99	J	0.06	0	0.01	U	0.03	J	0.12	J	0.96		5.00	J	0.69		0.03	J	0.15		0.00	U	0.03		17.19	

Notes:
nr = not reported
nm = not measured
U = not detected
J = estimated value
R = rejected
FF = forage fish
PF = piscivorous fish
GFF = game fish fillet
GFC = game fish carcass
FI = Individual fish fillet
IND = individual fish sample
WC = whole body composite
WI = whole body individual

Table E-11. Dietary Benchmark Screening for Fish (using 95% UCL)

Metal	LOAEL (mg/kg-ww)[a]	Benthic Invertebrates (mg/kg-ww)				Other Aquatic Invertebrates (mg/kg-ww)				Aquatic Plants (mg/kg-ww) [a]				Forage Fish (mg/kg-ww)				Rainbow Trout Stomach Contents (mg/kg-ww)	Sediment (mg/kg-ww) [b]			
		PPC	ULM	WD	LL	PPC	ULM	WD	LL	PPC	ULM	WD	LL	PPC	ULM	WD	LL	ULM	PPC	ULM	WD	LL
Arsenic	27.4	1.38	0.53	0.35	2.91	2.05	1.81	0.76	129.87	9.89	12.36	6.91	224.64	0.16	0.25	0.14	3.42	3.00	7.54	14.10	3.18	216.24
Cadmium	33	0.20	4.46	0.32	1.84	0.70	0.50	0.15	19.55	1.91	2.54	3.03	202.47	0.02	0.77	0.07	3.02	9.60	1.10	6.13	1.40	194.03
Copper	132	2.26	40.12	2.56	5.88	25.43	7.01	1.90	96.32	24.73	12.66	13.01	192.44	0.20	5.13	0.40	5.24	18.50	19.04	38.85	6.06	107.69
Lead	102	2.90	41.29	4.58	14.94	7.19	10.89	6.86	261.14	45.61	37.00	100.35	579.34	0.27	13.70	2.96	30.34	159.80	37.44	215.36	59.13	622.60
Selenium [c]	3	0.37	0.36	0.25	5.48	0.58	0.73	0.26	10.16	1.78	12.5 [d]	1.07	195.86	0.55	0.51	0.27	8.38	0.77	0.23	1.39	0.13	43.20
Zinc	900	34.22	25.54	9.15	20.18	41.87	30.22	16.87	240.19	138.62	69.11	61.05	335.04	8.00	40.45	8.87	22.94	188.00	125.53	141.96	34.31	339.72

Notes:

(a) Dry weight converted to wet weight based on an assumed 80% moisture.

(b) Incidental sediment ingestion rate for fish assumed to be 10%, therefore the concentration represents the 95% UCL multiplied by 0.1.

(c) All concentrations in dry weight.

(d) Value represents ½ the detection limit, as no samples had detected concentrations.

Table E-12. Risk Analysis for Amphibians Exposed to Sediments

		Sediment				HQ (TEC)				HQ (PEC)			
CSM Unit	Metal	Mean	95% UCL [a]		Max	TEC	Mean	95% UCL	Max	PEC	Mean	95% UCL	Max
PPC	Al	4604.17	6510.03	b1	10100.00	25,519	<1	<1	<1	59,572	<1	<1	<1
	Sb	1.54	2.27	b2	4.50	2	<1	1	2	25	<1	<1	<1
	As	54.68	93.64	b1	250.00	9.79	6	10	26	33	2	3	8
	Ba	125.39	174.71	b3	352.00	none	-	-	-	none	-	-	-
	Be	1.11	1.40	b4	1.40	none	-	-	-	none	-	-	-
	Cd	6.90	15.08	b1	36.80	0.99	7	15	37	4.98	1	3	7
	Cr	9.55	12.13	b5	21.20	43.4	<1	<1	<1	111	<1	<1	<1
	Co	7.08	10.88	b1	21.20	50	<1	<1	<1	none	-	-	-
	Cu	87.33	259.16	b6	480.00	31.6	3	8	15	149	<1	2	3
	Fe	14176.67	19532.04	b1	38100.00	188,400	<1	<1	<1	247,600	<1	<1	<1
	Hg	0.65	2.52	b7, c	3.10	0.18	4	14	17	0.18	4	14	17
	Mn	1406.75	4690.08	b6	9030.00	460	3	10	20	1100	1	4	8
	Ni	7.16	9.19	b3	16.10	22.7	<1	<1	<1	48.6	<1	<1	<1
	Pb	280.50	511.58	b1	1090.00	35.8	8	14	30	128	2	4	9
	Se	1.61	2.33	b3	5.30	none	-	-	-	none	-	-	-
	Ag	0.87	1.23	b5	2.50	1	<1	1	3	2.2	<1	<1	1
	Tl	3.00	3.00	b8	3.00	none	-	-	-	none	-	-	-
	V	28.68	34.63	b3	55.20	none	-	-	-	none	-	-	-
	Zn	794.83	1759.29	b9	3930.00	121	7	15	32	459	2	4	9
UL&M	Al	10321.15	11840.68	b10	20000.00	25,519	<1	<1	<1	59,572	<1	<1	<1
	Sb	20.61	33.49	b1	112.00	2	10	17	56	25	<1	1	4
	As	187.60	251.42	b1	581.00	9.79	19	26	59	33	6	8	18
	Ba	148.96	166.31	b2	282.00	none	-	-	-	none	-	-	-
	Be	1.60	1.80	b3	2.10	none	-	-	-	none	-	-	-
	Cd	71.10	111.36	b1	338.00	0.99	72	112	341	4.98	14	22	68
	Cr	14.65	16.88	b1	27.30	43.4	<1	<1	<1	111	<1	<1	<1
	Co	10.67	12.98	b1	24.10	50	<1	<1	<1	none	-	-	-
	Cu	492.88	706.37	b1	2290.00	31.6	16	22	72	149	3	5	15
	Fe	18492.31	21078.44	b10	34400.00	188,400	<1	<1	<1	247,600	<1	<1	<1
	Hg	41.79	93.01	b7, c	230.00	0.18	232	517	1278	0.18	232	517	1278
	Mn	688.23	833.55	b1	2520.00	460	1	2	5	1100	<1	<1	2
	Ni	12.42	14.32	b5	24.80	22.7	<1	<1	1	48.6	<1	<1	<1
	Pb	2543.62	3837.00	b1	10800.00	35.8	71	107	302	128	20	30	84
	Se	5.63	13.88	b7	21.80	none	-	-	-	none	-	-	-
	Ag	23.19	51.85	b7	127.00	1	23	52	127	2.2	11	24	58
	Tl	1.63	2.27	b3	5.00	none	-	-	-	none	-	-	-
	V	37.23	41.71	b1	59.40	none	-	-	-	none	-	-	-
	Zn	2005.73	2609.04	b1	6550.00	121	17	22	54	459	4	6	14
WD	Al	5990.00	6951.06	b10	7070.00	25,519	<1	<1	<1	59,572	<1	<1	<1
	Sb	2.86	4.59	b10	5.90	2	1	2	3	25	<1	<1	<1
	As	41.60	62.88	b10	79.00	9.79	4	6	8	33	1	2	2
	Ba	50.00	50.00	b8	50.00	none	-	-	-	none	-	-	-
	Be	5.00	5.00	b8	5.00	none	-	-	-	none	-	-	-
	Cd	19.06	25.13	b10	27.70	0.99	19	25	28	4.98	4	5	6
	Cr	6.60	7.53	b3	8.00	43.4	<1	<1	<1	111	<1	<1	<1
	Co	5.00	5.67	b10	6.00	50	<1	<1	<1	none	-	-	-
	Cu	86.80	126.92	b10	154.00	31.6	3	4	5	149	<1	<1	1
	Fe	10484.00	11856.03	b10	12200.00	188,400	<1	<1	<1	247,600	<1	<1	<1
	Hg	30.22	120.00	b4, c	120.00	0.18	168	667	667	0.18	168	667	667
	Mn	935.60	1062.03	b10	1120.00	460	2	2	2	1100	<1	<1	1
	Ni	5.20	5.74	b3	6.00	22.7	<1	<1	<1	48.6	<1	<1	<1
	Pb	754.20	1228.68	b10	1610.00	35.8	21	34	45	128	6	10	13
	Se	0.90	1.32	b3	1.60	none	-	-	-	none	-	-	-
	Ag	5.68	8.98	b10	11.10	1	6	9	11	2.2	3	4	5
	Tl	1.20	1.74	b3	2.00	none	-	-	-	none	-	-	-
	V	20.80	25.39	b10	27.00	none	-	-	-	none	-	-	-

Table E-12. Risk Analysis for Amphibians Exposed to Sediments

		Sediment				HQ (TEC)				HQ (PEC)			
CSM Unit	**Metal**	**Mean**	**95% UCL [a]**		**Max**	**TEC**	**Mean**	**95% UCL**	**Max**	**PEC**	**Mean**	**95% UCL**	**Max**
	Zn	597.60	707.32	b10	720.00	121	5	6	6	459	1	2	2
LL	Al	6705.00	9045.49	b10	13000.00	25,519	<1	<1	<1	59,572	<1	<1	<1
	Sb	273.13	798.38	b1	990.00	2	137	399	495	25	11	32	40
	As	1113.63	3008.03	b1	3030.00	9.79	114	307	309	33	34	91	92
	Ba	171.50	205.74	b3	245.00	none	-	-	-	none	-	-	-
	Be	1.22	1.80	b4	1.80	none	-	-	-	none	-	-	-
	Cd	683.63	2680.00	b4	2680.00	0.99	691	2707	2707	4.98	137	538	538
	Cr	12.55	17.09	b10	22.10	43.4	<1	<1	<1	111	<1	<1	<1
	Co	16.66	25.54	b10	35.10	50	<1	<1	<1	none	-	-	-
	Cu	1025.25	2532.90	b6	2600.00	31.6	32	80	82	149	7	17	17
	Fe	19412.50	25708.18	b10	35200.00	188,400	<1	<1	<1	247,600	<1	<1	<1
	Hg	24.66	38.14	b10, c	53.30	0.18	137	212	296	0.18	137	212	296
	Mn	733.38	1002.40	b10	1370.00	460	2	2	3	1100	<1	<1	1
	Ni	16.89	25.61	b3	36.40	22.7	<1	1	2	48.6	<1	<1	<1
	Pb	5026.50	8618.88	b10	14400.00	35.8	140	241	402	128	39	67	113
	Se	128.19	432.00	b4	432.00	none	-	-	-	none	-	-	-
	Ag	49.75	86.19	b10	141.00	1	50	86	141	2.2	23	39	64
	Tl	468.00	1980.00	b4	1980.00	none	-	-	-	none	-	-	-
	V	32.94	47.57	b1	57.70	none	-	-	-	none	-	-	-
	Zn	3069.25	4690.19	b10	6930.00	121	25	39	57	459	7	10	15

Notes:

na = No data available

(a) 95% Upper confidence levels (UCLs) estimated using US EPA's ProUCL Software (V4.00.05). ProUCL Output presented at the end of this appendix.

(b)

(1) ProUCL recommended a 95% UCL estimated assuming a gamma distribution.
(2) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (percentile bootstrap) method.
(3) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (t) method.

(4) ProUCL recommended a 95% UCL greater than the maximum detected value, therefore the maximum detected value was substituted as the 95% UCL.
(5) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (BCA) method.
(6) ProUCL recommended a 95% UCL estimated using the non-parametric Chebyshev method.
(7) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (Chebyshev) method.
(8) All samples were non-detected, therefore ½ of the maximum detection limit was used as the exposure point concentration.
(9) ProUCL recommended a 95% UCL estimated using the lognormal (H-UCL) method.
(10) ProUCL recommended a 95% UCL estimated using the normal (Student's-t) method.
(11) ProUCL recommended a 95% UCL estimated using the non-paranetric (Hall's bootstrap) method.
(12) Sample size was less than 5, therefore a 95% UCL could not be calculated, exposure concentrations estimated using ½ the detection limit for non-detects, and the maximum value was selected as the 95% UCL.

(c) Methyl mercury concentrations assumed to be the same as total mercury concentrations.
(d) Aquatic plant tissue concentrations estimated based on the following relationship: Log (plant conc. dw) = -0.08+0.9(Log sediment conc. dw). (Jackson et al., 1991; 1998).*
Dry weight converted to wet weight based on an assumed 80% moisture.

Table E-13. Risk Evaluation for Plants, Soil Invertebrates, and Wildlife Exposed to Soil.

	Soil EPC (mg/kg$_{dw}$)					Plant HQs				Soil Invertebrate HQs				Wildlife HQs			
CSM Unit	**Metal**	**Mean**	**95% UCL** [a]		**Max**	**Benchmark (mg/kg$_{dw}$)**	**Mean**	**95% UCL**	**Max**	**Benchmark (mg/kg$_{dw}$)**	**Mean**	**95% UCL**	**Max**	**Benchmark (mg/kg$_{dw}$)**	**Mean**	**95% UCD**	**Max**
PPC (Riparian Zone)	Al	6326.67	7820.66	b10	7890.00	-	-	-	-	-	-	-	-	-	-	-	-
	Sb	14.68	48.63	b1	56.00	5	3	10	11	78	<1	<1	<1	0.27	54	180	208
	As	91.05	193.84	b9	232.00	18	5	11	13	60	2	3	4	43	2	5	5
	Ba	248.33	912.00	b5	912.00	500	<1	2	2	330	<1	3	3	2000	<1	<1	<1
	Be	5.00	5.00	b8	5.00	10	<1	<1	<1	40	<1	<1	<1	21	<1	<1	<1
	Cd	19.03	43.21	b1	57.70	32	<1	1	2	140	<1	<1	<1	0.36	53	120	160
	Cr	14.33	17.35	b10	21.00	1	14	17	21	0.4	36	43	53	26	<1	<1	<1
	Co	8.17	11.75	b10	16.00	13	<1	<1	1	1000	<1	<1	<1	120	<1	<1	<1
	Cu	340.50	843.48	b1	1030.00	70	5	12	15	80	4	11	13	28	12	30	37
	Fe	22100.00	30954.45	b10	43800.00	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	2.70	11.00	b4, c	11.00	0.3	9	37	37	0.1	27	110	110	0.1	27	110	110
	Mn	872.00	1142.60	b10	1350.00	220	4	5	6	450	2	3	3	4000	<1	<1	<1
	Ni	8.33	10.19	b10	12.00	38	<1	<1	<1	280	<1	<1	<1	130	<1	<1	<1
	Pb	1053.50	2737.20	b1	3590.00	120	9	23	30	1700	<1	2	2	11	96	249	326
	Se	6.25	33.00	b4	33.00	1	12	64	64	4.1	2	8	8	0.63	10	52	52
	Ag	14.00	47.22	b1	54.00	560	<1	<1	<1	50	<1	<1	1	4.2	3	11	13
	Tl	0.98	2.44	b7	2.60	1	<1	3	3	1	<1	3	3	0.057	17	43	46
	V	39.67	44.16	b10	46.00	2	20	22	23	20	2	2	2	7.8	5	6	6
	Zn	1206.33	2276.24	b1	3010.00	160	8	14	19	120	10	19	25	46	26	50	66
UL&M (Banks)	Al	8780.00	13417.69	b10	13100.00	-	-	-	-	-	-	-	-	-	-	-	-
	Sb	24.82	53.00	b10	61.00	5	5	11	12	78	<1	<1	<1	0.27	92	196	226
	As	163.00	317.53	b10	393.00	18	9	18	22	60	3	5	7	43	4	7	9
	Ba	133.60	140.43	b3	143.00	500	<1	<1	<1	330	<1	<1	<1	2000	<1	<1	<1
	Be	5.00	5.00	b8	5.00	10	<1	<1	<1	40	<1	<1	<1	21	<1	<1	<1
	Cd	109.96	260.76	b10	380.00	32	4	8	12	140	<1	2	3	0.36	306	724	1056
	Cr	13.80	15.93	b3	17.00	1	14	16	17	0.4	35	40	43	26	<1	<1	<1
	Co	6.20	10.10	b10	13.00	13	<1	<1	1	1000	<1	<1	<1	120	<1	<1	<1
	Cu	296.80	635.78	b10	882.00	70	4	9	13	80	4	8	11	28	11	23	32
	Fe	14230.00	20632.61	b10	20300.00	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	21.26	46.84	b3, c	58.00	0.3	71	156	193	0.1	213	468	580	0.1	213	468	580
	Mn	417.80	681.03	b10	861.00	220	2	3	4	450	<1	2	2	4000	<1	<1	<1
	Ni	9.80	13.02	b3	15.00	38	<1	<1	<1	280	<1	<1	<1	130	<1	<1	<1
	Pb	2596.40	6001.95	b10	8690.00	120	22	50	73	1700	2	4	5	11	236	546	790
	Se	20.36	54.00	b4	54.00	1	39	104	104	4.1	5	13	13	0.63	32	86	86
	Ag	18.80	44.13	b3	61.00	560	<1	<1	<1	50	<1	<1	1	4.2	5	11	15
	Tl	2.96	5.83	b3	7.00	1	3	6	7	1	3	6	7	0.057	52	102	123
	V	33.00	48.00	b4	48.00	2	17	24	24	20	2	2	2	7.8	4	6	6
	Zn	838.40	1814.01	b10	2620.00	160	5	11	16	120	7	15	22	46	18	40	57

Table E-13. Risk Evaluation for Plants, Soil Invertebrates, and Wildlife Exposed to Soil.

	Soil EPC (mg/kg_{dw})					Plant HQs				Soil Invertebrate HQs				Wildlife HQs			
CSM Unit	Metal	Mean	95% UCL [a]		Max	Benchmark (mg/kg_{dw})	Mean	95% UCL	Max	Benchmark (mg/kg_{dw})	Mean	95% UCL	Max	Benchmark (mg/kg_{dw})	Mean	95% UCD	Max
LL	Al	8980.00	12400.00	b12	12400.00	-	-	-	-	-	-	-	-	-	-	-	-
(Banks)	Sb	32.18	115.00	b12	115.00	5	7	23	23	78	<1	2	2	0.27	119	426	426
	As	324.00	1190.00	b12	1190.00	18	18	66	66	60	5	20	20	43	8	28	28
	Ba	168.75	351.00	b12	351.00	500	<1	<1	<1	330	<1	1	1	2000	<1	<1	<1
	Be	5.00	5.00	b8	5.00	10	<1	<1	<1	40	<1	<1	<1	21	<1	<1	<1
	Cd	103.53	350.00	b12	350.00	32	3	11	11	140	<1	3	3	0.36	288	972	972
	Cr	14.00	17.00	b12	17.00	1	14	17	17	0.4	35	43	43	26	<1	<1	<1
	Co	9.00	21.00	b12	21.00	13	<1	2	2	1000	<1	<1	<1	120	<1	<1	<1
	Cu	705.50	2410.00	b12	2410.00	70	10	35	35	80	9	30	30	28	25	86	86
	Fe	18900.00	27500.00	b12	27500.00	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	8.00	28.00	b12, c	28.00	0.3	27	93	93	0.1	80	280	280	0.1	80	280	280
	Mn	488.25	1040.00	b12	1040.00	220	2	5	5	450	1	2	2	4000	<1	<1	<1
	Ni	16.50	36.00	b12	36.00	38	<1	<1	<1	280	<1	<1	<1	130	<1	<1	<1
	Pb	2283.00	8130.00	b12	8130.00	120	19	68	68	1700	1	5	5	11	208	739	739
	Se	7.34	23.00	b12	23.00	1	14	44	44	4.1	2	6	6	0.63	12	37	37
	Ag	27.00	90.00	b12	90.00	560	<1	<1	<1	50	<1	2	2	4.2	7	22	22
	Tl	8.13	29.00	b12	29.00	1	8	29	29	1	8	29	29	0.057	143	509	509
	V	40.00	48.00	b12	48.00	2	20	24	24	20	2	2	2	7.8	5	6	6
	Zn	1484.75	5270.00	b12	5270.00	160	9	33	33	120	12	44	44	46	32	115	115
Tito Park	Al	11800.00	12646.96	b3	13400.00	-	-	-	-	-	-	-	-	-	-	-	-
	Sb	20.02	67.00	b4	67.00	5	4	13	13	78	<1	<1	<1	0.27	74	248	248
	As	1614.07	2899.84	b1	8091.00	18	90	161	450	60	27	48	135	43	38	68	188
	Ba	142.83	165.45	b3	178.00	500	<1	<1	<1	330	<1	<1	<1	2000	<1	<1	<1
	Be	5.00	5.00	b8	5.00	10	<1	<1	<1	40	<1	<1	<1	21	<1	<1	<1
	Cd	1705.84	5666.99	b7	14725.00	32	53	177	460	140	12	41	105	0.36	4739	15742	40903
	Cr	15.83	17.74	b3	18.00	1	16	18	18	0.4	40	44	45	26	<1	<1	<1
	Co	6.33	9.00	b4	9.00	13	<1	<1	<1	1000	<1	<1	<1	120	<1	<1	<1
	Cu	3379.58	6296.90	b1	23599.00	70	48	90	337	80	42	79	295	28	121	225	843
	Fe	16266.67	18480.57	b3	20100.00	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	3.44	10.00	b4, c	10.00	0.3	12	33	33	0.1	34	100	100	0.1	34	100	100
	Mn	319.00	421.27	b3	493.00	220	2	2	2	450	<1	<1	1	4000	<1	<1	<1
	Ni	13.83	19.02	b3	24.00	38	<1	<1	<1	280	<1	<1	<1	130	<1	<1	<1
	Pb	13409.65	29594.24	b6	71196.00	120	112	247	593	1700	8	18	42	11	1219	2690	6472
	Se	4.43	8.84	b3	13.00	1	9	17	25	4.1	1	2	3	0.63	7	14	21
	Ag	16.17	33.52	b3	42.00	560	<1	<1	<1	50	<1	<1	<1	4.2	4	8	10
	Tl	2.26	8.00	b4	8.00	1	2	8	8	1	2	8	8	0.057	40	140	140
	V	41.50	43.12	b3	45.00	2	21	22	23	20	2	2	2	7.8	5	6	6
	Zn	7827.29	12158.24	b1	44050.00	160	49	76	275	120	65	101	367	46	170	264	958

Table E-13. Risk Evaluation for Plants, Soil Invertebrates, and Wildlife Exposed to Soil.

	Soil EPC (mg/kg$_{dw}$)					Plant HQs				Soil Invertebrate HQs				Wildlife HQs			
CSM Unit	**Metal**	**Mean**	**95% UCL [a]**		**Max**	**Benchmark (mg/kg$_{dw}$)**	**Mean**	**95% UCL**	**Max**	**Benchmark (mg/kg$_{dw}$)**	**Mean**	**95% UCL**	**Max**	**Benchmark (mg/kg$_{dw}$)**	**Mean**	**95% UCD**	**Max**
Site Perimeter (East)	Al	6325.00	6820.00	b12	6820.00	-	-	-	-	-	-	-	-	-	-	-	-
	Sb	16.75	28.00	b12	28.00	5	3	6	6	78	<1	<1	<1	0.27	62	104	104
	As	423.50	2319.04	b7	3121.00	18	24	129	173	60	7	39	52	43	10	54	73
	Ba	78.50	107.00	b12	107.00	500	<1	<1	<1	330	<1	<1	<1	2000	<1	<1	<1
	Be	5.00	5.00	b8	5.00	10	<1	<1	<1	40	<1	<1	<1	21	<1	<1	<1
	Cd	40.45	61.69	b3	92.00	32	1	2	3	140	<1	<1	<1	0.36	112	171	256
	Cr	12.50	15.00	b12	15.00	1	13	15	15	0.4	31	38	38	26	<1	<1	<1
	Co	7.00	8.00	b12	8.00	13	<1	<1	<1	1000	<1	<1	<1	120	<1	<1	<1
	Cu	2235.30	12288.12	b7	16375.00	70	32	176	234	80	28	154	205	28	80	439	585
	Fe	18900.00	22700.00	b12	22700.00	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	5.98	11.00	b12, c	11.00	0.3	20	37	37	0.1	60	110	110	0.1	60	110	110
	Mn	796.00	830.00	b12	830.00	220	4	4	4	450	2	2	2	4000	<1	<1	<1
	Ni	7.00	8.00	b12	8.00	38	<1	<1	<1	280	<1	<1	<1	130	<1	<1	<1
	Pb	1339.70	2032.76	b10	3811.00	120	11	17	32	1700	<1	1	2	11	122	185	347
	Se	2.65	4.10	b12	4.10	1	5	8	8	4.1	<1	1	1	0.63	4	7	7
	Ag	11.00	18.00	b12	18.00	560	<1	<1	<1	50	<1	<1	<1	4.2	3	4	4
	Tl	2.10	3.70	b12	3.70	1	2	4	4	1	2	4	4	0.057	37	65	65
	V	41.00	50.00	b12	50.00	2	21	25	25	20	2	3	3	7.8	5	7	7
	Zn	1532.00	2131.35	b10	3560.00	160	10	13	22	120	13	18	30	46	33	46	77
Site Perimeter (West)	Al	8177.50	12000.00	b12	12000.00	-	-	-	-	-	-	-	-	-	-	-	-
	Sb	35.40	92.00	b12	92.00	5	7	18	18	78	<1	1	1	0.27	131	341	341
	As	172.36	377.76	b7	829.00	18	10	21	46	60	3	6	14	43	4	9	19
	Ba	307.25	838.00	b12	838.00	500	<1	2	2	330	<1	3	3	2000	<1	<1	<1
	Be	5.00	5.00	b8	5.00	10	<1	<1	<1	40	<1	<1	<1	21	<1	<1	<1
	Cd	116.67	246.82	b7	532.00	32	4	8	17	140	<1	2	4	0.36	324	686	1478
	Cr	15.13	26.00	b12	26.00	1	15	26	26	0.4	38	65	65	26	<1	1	1
	Co	15.75	46.00	b12	46.00	13	1	4	4	1000	<1	<1	<1	120	<1	<1	<1
	Cu	1381.80	4893.47	b7	9750.00	70	20	70	139	80	17	61	122	28	49	175	348
	Fe	24540.00	57500.00	b12	57500.00	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	3.68	8.20	b12, c	8.20	0.3	12	27	27	0.1	37	82	82	0.1	37	82	82
	Mn	1098.75	3290.00	b12	3290.00	220	5	15	15	450	3	7	7	4000	<1	<1	<1
	Ni	27.38	82.00	b12	82.00	38	<1	2	2	280	<1	<1	<1	130	<1	<1	<1
	Pb	3196.00	4980.48	b1	11600.00	120	27	42	97	1700	2	3	7	11	291	453	1055
	Se	8.63	27.00	b12	27.00	1	17	52	52	4.1	2	7	7	0.63	14	43	43
	Ag	70.25	233.00	b12	233.00	560	<1	<1	<1	50	2	5	5	4.2	17	56	56
	Tl	3.00	6.00	b12	6.00	1	3	6	6	1	3	6	6	0.057	53	105	105
	V	35.25	53.00	b12	53.00	2	18	27	27	20	2	3	3	7.8	5	7	7
	Zn	2523.10	4324.03	b1	14100.00	160	16	27	88	120	21	36	118	46	55	94	307

Table E-13. Risk Evaluation for Plants, Soil Invertebrates, and Wildlife Exposed to Soil.

	Soil EPC (mg/kg$_{dw}$)				Plant HQs			Soil Invertebrate HQs			Wildlife HQs		
CSM Unit	Metal	Mean	95% UCL ^{a}	Max	Benchmark (mg/kg$_{dw}$)	Mean 95% UCL	Max	Benchmark (mg/kg$_{dw}$)	Mean 95% UCL	Max	Benchmark (mg/kg$_{dw}$)	Mean 95% UCD	Max

Notes:

HQ> 1.0

na = No data available

(a) 95% Upper confidence levels (UCLs) estimated using US EPA's ProUCL Software (V4.00.05). ProUCL Output presented at the end of this appendix.

(b)

(1) ProUCL recommended a 95% UCL estimated assuming a gamma distribution.
(2) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (percentile bootstrap) method.
(3) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (t) m
(4) ProUCL recommended a 95% UCL greater than the maximum detected val
(5) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (BC.
(6) ProUCL recommended a 95% UCL estimated using the non-parametric Ch
(7) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (Che
(8) All samples were non-detected, therefore ½ of the maximum detection limit
(9) ProUCL recommended a 95% UCL estimated using the lognormal (H-UCL
(10) ProUCL recommended a 95% UCL estimated using the normal (Student's-

(11) ProUCL recommended a 95% UCL estimated using the non-parametric (Hall's bootstrap) method.
(12) Sample size was less than 5, therefore a 95% UCL could not be calculated, exposure concentrations estimated using ½ the detection limit for non-detects,
and the maximum value was selected as the 95% UCL.
(c) Methyl mercury concentrations assumed to be the same as total mercury concentrations.
(d) Terrestrial plant and earthworm tissue concentrations estimated from soil concentrations based on the regressioon equations presented in Table X.
Dry weight converted to wet weight based on an assumed 80% moisture.
(e) Soil Invertebrate concentrations for unpaved areas within the smelter facility assumed to be the average of samples collected from the site perimeter and Tito Park which surrounds the facility.
(f)

(11) ProUCL recommended a 95% UCL estimated using the non-parametric (Hall's bootstrap) method.
(12) Sample size was less than 5, therefore a 95% UCL could not be calculated, exposure concentrations estimated using ½ the detection limit for non-detects,
and the maximum value was selected as the 95% UCL.

(c) Methyl mercury concentrations assumed to be the same as total mercury concentrations.

(d) Terrestrial plant and earthworm tissue concentrations estimated from soil concentrations based on the regressioon equations presented in Table X.
Dry weight converted to wet weight based on an assumed 80% moisture.

(e) Soil Invertebrate concentrations for unpaved areas within the smelter facility assumed to be the average of samples collected from the site perimeter and Tito Park which surrounds the facility.

(f)

(1) Aerial/Foliar Invertebrate concentrations for Prickly Pear Creek assumed to be the same as those collected from the east side of the facility perimeter which is adjacent to Prickly Pear Creek.
(2) Aerial/Foliar Invertebrate concentrations for Upper Lake and Marsh assumed to be the same as those collected from Tito Park which is adjacent to Upper Lake.
(3) Aerial/Foliar Invertebrate concentrations for Lower Lake assumed to be the same as those collected from Tito Park which is adjacent to Lower Lake.
(4) Aerial/Foliar Invertebrate concentrations for unpaved areas within the smelter facility assumed to be the average of samples collected from the site perimeter and Tito Park which surrounds the facility.

Table E-14. Statistical comparison of on-site soil metals concentrations to reference areas.

	Lower Lake (Banks)					Site Perimeter										Prickly Pear Creek (Riparian Soils)					Upper Lake (Banks)					Tito Park					Walker Creek					
						West					East																									
	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	*p value*	Test	FOD	*n*
Al	8980.00	2620.27	NS	100	4	8177.50	3732.38	NS	100	4	6325.00	700.04	NS	100	2	6334.00	2030.35	NS	100	5	8780.00	4864.42	NS	100	5	11480.00	746.32	NS	100	5	7603.33	1359.29	0.103	P	100	6
Sb	32.18	55.29	S*	100	4	35.40	39.63	NS	100	4	16.75	15.91	NS	100	2	16.92	22.23	NS	100	5	24.82	29.56	NS	100	5	23.94	30.19	NS	100	5	0.05	0.00	0.008	NP	0	6
As	324.00	577.50	NS	100	4	285.80	365.39	S*	100	4	127.00	101.82	NS	100	2	98.66	75.81	NS	100	5	163.00	162.08	NS	100	5	130.60	128.29	NS	100	5	3.65	1.86	0.007	NP	100	6
Ba	168.75	129.17	NS	75	4	307.25	358.97	NS	75	4	78.50	40.31	NS	50	2	250.20	371.61	NS	60	5	102.00	47.73	NS	60	5	135.80	23.95	NS	100	5	89.67	50.22	0.273	NP	50	6
Be	5.00	0.00	NS	0	4	5.00	0.00	NS	0	4	5.00	0.00	NS	0	2	5.00	0.00	NS	0	5	5.00	0.00	NS	0	5	5.00	0.00	NS	0	5	5.00	0.00	1	NP	0	6
Cd	103.53	164.84	NS	100	4	128.33	159.92	S*	100	4	42.75	43.91	NS	100	2	21.26	20.76	NS	100	5	109.96	158.17	S*	100	5	51.46	60.09	NS	100	5	0.15	0.18	0.007	NP	33.33	6
Cr	14.00	2.16	NS	100	4	15.13	9.95	NS	75	4	125.00	3.54	NS	100	2	14.80	3.90	NS	100	5	11.90	5.59	NS	80	5	15.60	2.51	NS	100	5	8.67	3.67	0.874	P	100	6
Co	9.00	8.00	NS	100	4	15.75	20.37	NS	100	4	7.00	1.41	NS	100	2	8.80	4.55	NS	100	5	6.20	4.09	NS	100	5	6.60	2.19	NS	100	5	5.33	1.63	0.467	NP	100	6
Cu	705.50	1138.65	NS	100	4	2309.25	2717.30	S*	100	4	412.00	12.73	NS	100	2	388.40	371.37	NS	100	5	296.80	355.55	NS	100	5	337.60	348.61	NS	100	5	36.67	17.91	0.023	NP	100	6
Fe	18900.00	5894.06	NS	100	4	24540.00	23009.21	NS	100	4	18900.00	5374.01	NS	100	2	23520.00	11388.24	NS	100	5	14230.00	6715.62	NS	100	5	16240.00	3007.99	NS	100	5	15066.67	2845.82	0.352	NP	100	6
Pb	2283.00	3902.97	NS	100	4	3920.25	4563.84	S*	100	4	1435.50	1052.88	NS	100	2	1197.00	1350.54	NS	100	5	2596.40	3572.04	NS	100	5	1680.80	2102.96	NS	100	5	6.00	2.61	0.007	NP	83.333	6
Mn	488.25	368.47	NS	100	4	1098.75	1462.45	NS	100	4	796.00	48.08	NS	100	2	874.20	367.71	NS	100	5	417.80	276.10	NS	100	5	334.80	132.08	NS	100	5	325.33	182.98	0.052	NP	100	6
Hg	8.00	13.36	NS	100	4	3.68	3.14	NS	100	4	5.98	7.11	NS	100	2	3.07	4.44	NS	100	5	21.24	26.00	S	80	5	4.10	4.83	NS	100	5	0.03	0.00	0.024	NP	0	6
Ni	16.50	13.08	S*	100	4	27.38	36.78	NS	75	4	7.00	1.41	NS	100	2	8.60	2.41	NS	100	5	8.90	4.59	NS	80	5	14.20	6.98	S*	100	5	3.42	2.25	0.026	NP	16.67	6
Se	7.34	10.53	NS	75	4	8.63	12.38	S*	100	4	2.65	2.05	NS	100	2	7.38	14.32	NS	100	5	20.36	26.79	S*	100	5	5.14	5.54	NS	100	5	0.25	0.00	0.025	NP	0	6
Ag	27.00	42.20	NS	75	4	70.25	109.06	S*	100	4	11.00	9.90	NS	100	2	16.40	21.23	NS	100	5	18.60	25.89	NS	100	5	17.40	21.15	NS	60	5	1.00	0.00	0.035	NP	0	6
Tl	8.13	13.93	NS	100	4	3.00	2.45	S*	100	4	2.10	2.26	NS	100	2	1.04	0.88	NS	100	5	2.96	2.91	NS	80	5	7.10	10.48	S*	80	5	0.18	0.11	0.009	NP	66.67	6
V	40.00	9.76	NS	100	4	35.25	17.67	NS	100	4	41.00	12.73	NS	100	2	39.60	6.11	NS	100	5	33.00	16.78	NS	100	5	40.80	1.10	NS	100	5	34.00	5.66	0.674	NP	100	6
Zn	1484.75	2525.81	NS	100	4	4202.50	6652.45	S*	100	4	2405.00	1633.42	S*	100	2	1334.20	968.00	S*	100	5	838.40	1023.30	NS	100	5	541.40	607.27	NS	100	5	29.67	12.89	0.002	NP	100	6

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

Samples designated with an asterisks (*) indicate samples in which concentrations were above reporting limits for at least 50% of the sample sites and thus were evaluated statistically (As shown above)

nd = no statistical analysis was conducted (not determined)

PPC was compared to PPC upstream reference sites

UL/ULM, WD, and LL were compared to WCP/WCM

S-significant, NS- not significant, S-significant using NP, but not significant using P*

FOD = frequency of detection (%)

Table E-15. Dietary Assessment for Amphibians

CSM Unit	Metal	Dietary NOAEL mg/kg$_{ww}$	Dietary LOAEL mg/kg$_{ww}$	Aquatic Plants (mg/kg$_{ww}$) 95% UCL ^{a}	NOAEL HQ	LOAEL HQ	Benthic Invertebrates (mg/kg$_{ww}$) 95% UCL ^{a}	NOAEL HQ	LOAEL HQ	Other Aq. Invertebrates (mg/kg$_{ww}$) 95% UCL ^{a}	NOAEL HQ	LOAEL HQ	Forage Fish (mg/kg$_{ww}$) 95% UCL ^{a}	NOAEL HQ	LOAEL HQ
PPC	Cd	-	0.94	1.91	-	2	0.20	-	<1	0.70	-	<1	0.02	-	<1
	Hg	0.11	0.366	0.38	3	1	0.009	<1	<1	0.03	<1	<1	0.009	<1	<1
	MeHg	0.00036	0.0007	0.38	1061	546	0.0038	11	5	0.0018	5	3	0.009	25	13
	Pb	65.04	-	45.61	<1	-	2.90	<1	-	7.19	<1	-	0.27	<1	-
	Se	6.54	-	0.36	<1	-	0.07	<1	-	0.12	<1	-	0.11	<1	-
	V	2.0	21.8	4.04	2	<1	0.28	<1	<1	0.72	<1	<1	0.08	<1	<1
UL&M	Cd	-	0.94	2.54	-	3	4.46	-	5	0.50	-	<1	0.77	-	<1
	Hg	0.11	0.366	9.83	89	27	0.05	<1	<1	0.14	1	<1	0.03	<1	<1
	MeHg	0.00036	0.0007	9.83	27315	14048	0.010	29	15	0.002	6	3	0.03	89	46
	Pb	65.04	-	37.00	<1	-	41.29	<1	-	10.89	<1	-	13.70	<1	-
	Se	6.54	-	2.50	<1	-	0.07	<1	-	0.15	<1	-	0.12	<1	-
	V	2.0	21.8	4.78	2	<1	0.08	<1	<1	0.18	<1	<1	0.06	<1	<1
WD Site Perimeter (West)	Cd	-	0.94	3.03	-	3	0.32	-	<1	0.15	-	<1	0.07	-	<1
	Hg	0.11	0.366	12.37	112	34	0.02	<1	<1	0.02	<1	<1	0.013	<1	<1
	MeHg	0.00036	0.0007	12.37	34355	17668	0.01	15	8	0.001	2	1	0.013	35	18
	Pb	65.04	-	100.35	2	-	4.58	<1	-	6.86	<1	-	2.96	<1	-
	Se	6.54	-	0.21	<1	-	0.05	<1	-	0.05	<1	-	0.04	<1	-
	V	2.0	21.8	3.06	2	<1	0.10	<1	<1	0.09	<1	<1	0.06	<1	<1
LL	Cd	-	0.94	202.47	-	215	1.84	-	2	19.55	-	21	3.02	-	3
	Hg	0.11	0.366	4.41	40	12	0.16	1	<1	0.74	7	2	0.08	<1	<1
	MeHg	0.00036	0.0007	4.41	12246	6298	0.02	47	24	0.001	4	2	0.08	215	111
	Pb	65.04	-	579.34	9	-	14.94	<1	-	261.14	4	-	30.34	<1	-
	Se	6.54	-	39.17	6	-	1.10	<1	-	2.03	<1	-	1.73	<1	-
	V	2.0	21.8	5.38	3	<1	0.17	<1	<1	4.96	2	<1	0.22	<1	<1
Tito Park	Cd	-	0.94	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	0.11	0.366	-	-	-	-	-	-	-	-	-	-	-	-
	MeHg	0.00036	0.0007	-	-	-	-	-	-	-	-	-	-	-	-
	Pb	65.04	-	-	-	-	-	-	-	-	-	-	-	-	-
	Se	6.54	-	-	-	-	-	-	-	-	-	-	-	-	-
	V	2.0	21.8	-	-	-	-	-	-	-	-	-	-	-	-
Site Perimeter (East)	Cd	-	0.94	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	0.11	0.366	-	-	-	-	-	-	-	-	-	-	-	-
	MeHg	0.00036	0.0007	-	-	-	-	-	-	-	-	-	-	-	-
	Pb	65.04	-	-	-	-	-	-	-	-	-	-	-	-	-
	Se	6.54	-	-	-	-	-	-	-	-	-	-	-	-	-
	V	2.0	21.8	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

(a) If methylmercury data was not collected for a group of organisms, than the mercury concentration was adjusted by the percentage of methylmercury for that group of organism on average in which data was available.

(1) average % of methylmercury in benthic invertebrates 25.1%
(2) average % of methylmercury in other invertebrates 3.30%
(3) average % of methylmercury in soil invertebrates 6.27%
(4) average % of methylmercury in aerial/foliar invertebrates 10.9%
(5) average % of methylmercury in earthworms 14.0%

Table E-15. Dietary Assessment for Amphibians

CSM Unit	Metal	Dietary NOAEL mg/kg$_{ww}$	Dietary LOAEL mg/kg$_{ww}$	Terrestrial Plants (mg/kg$_{ww}$) 95% UCL^{a}	NOAEL HQ	LOAEL HQ	Earthworms (mg/kg$_{ww}$) 95% UCL^{a}	NOAEL HQ	LOAEL HQ	Soil Invertebrates (mg/kg$_{ww}$) 95% UCL^{a}	NOAEL HQ	LOAEL HQ	Aerial/Foliar Invertebrates (mg/kg$_{ww}$) 95% UCL^{a}	NOAEL HQ	LOAEL HQ
PPC	Cd	-	0.94	0.97	-	1	2.91	-	3	5.28	-	6	1.37	-	1
	Hg	0.11	0.366	2.20	20	6	0.03	<1	<1	0.09	<1	<1	0.005	<1	<1
	MeHg	0.00036	0.0007	2.20	6111	3143	0.003	9	4	0.01	16	8	0.001	2	<1
	Pb	65.04	-	4.49	<1	-	4.34	<1	-	57.73	<1	-	3.06	<1	-
	Se	6.54	-	4.82	<1	-	0.26	<1	-	0.45	<1	-	0.37	<1	-
	V	2.0	21.8	0.04	<1	<1	1.23	<1	<1	0.58	<1	<1	0.19	<1	<1
UL&M	Cd	-	0.94	2.59	-	3	138.05	-	147	4.15	-	4	2.19	-	2
	Hg	0.11	0.366	9.37	85	26	9.37	85	26	0.21	2	<1	0.17	2	<1
	MeHg	0.00036	0.0007	9.37	26021	13382	9.37	26021	13382	0.01	37	19	0.019	52	27
	Pb	65.04	-	6.98	<1	-	180.07	3	-	39.27	<1	-	15.34	<1	-
	Se	6.54	-	8.31	1	-	3.45	<1	-	2.22	<1	-	1.35	<1	-
	V	2.0	21.8	0.05	<1	<1	0.41	<1	<1	0.68	<1	<1	0.73	<1	<1
WD Site Perimeter (West)	Cd	-	0.94	2.52	-	3	132.15	-	141	9.66	-	10	1.61	-	2
	Hg	0.11	0.366	1.64	15	4	1.64	15	4	0.09	<1	<1	0.03	<1	<1
	MeHg	0.00036	0.0007	1.64	4556	2343	1.64	4556	2343	0.01	15	8	0.003	8	4
	Pb	65.04	-	6.29	<1	-	154.90	2	-	39.96	<1	-	11.48	<1	-
	Se	6.54	-	3.87	<1	-	2.08	<1	-	1.14	<1	-	0.50	<1	-
	V	2.0	21.8	0.05	<1	<1	0.45	<1	<1	1.26	<1	<1	0.10	<1	<1
LL	Cd	-	0.94	3.05	-	3	174.45	-	186	8.82	-	9	2.19	-	2
	Hg	0.11	0.366	5.60	51	15	5.60	51	15	0.46	4	1	0.17	2	<1
	MeHg	0.00036	0.0007	5.60	15556	8000	5.60	15556	8000	0.03	80	41	0.019	52	27
	Pb	65.04	-	8.28	<1	-	230.04	4	-	127.60	2	-	15.34	<1	-
	Se	6.54	-	3.24	<1	-	1.85	<1	-	5.02	<1	-	1.35	<1	-
	V	2.0	21.8	0.05	<1	<1	0.40	<1	<1	3.22	2	<1	0.73	<1	<1
Tito Park	Cd	-	0.94	13.93	-	15	1596.04	-	1698	6.66	-	7	2.19	-	2
	Hg	0.11	0.366	2.00	18	5	2.00	18	5	0.10	<1	<1	0.17	2	<1
	MeHg	0.00036	0.0007	2.00	5556	2857	2.00	5556	2857	0.01	17	9	0.019	52	27
	Pb	65.04	-	17.09	<1	-	652.56	10	-	18.32	<1	-	15.34	<1	-
	Se	6.54	-	1.13	<1	-	0.92	<1	-	3.21	<1	-	1.35	<1	-
	V	2.0	21.8	0.04	<1	<1	0.36	<1	<1	1.23	<1	<1	0.73	<1	<1
Site Perimeter (East)	Cd	-	0.94	1.18	-	1	43.89	-	47	24.34	-	26	1.37	-	1
	Hg	0.11	0.366	2.20	20	6	2.20	20	6	1.21	11	3	0.005	<1	<1
	MeHg	0.00036	0.0007	2.20	6111	3143	2.20	6111	3143	0.08	212	109	0.001	2	<1
	Pb	65.04	-	3.80	<1	-	75.16	1	-	448.74	7	-	3.06	<1	-
	Se	6.54	-	0.48	<1	-	0.52	<1	-	2.36	<1	-	0.37	<1	-
	V	2.0	21.8	0.05	<1	<1	0.42	<1	<1	4.35	2	<1	0.19	<1	<1

Notes:

(a) If methylmercury data was not collected for a group of organisms, than the mercury concentration was adjusted by the percentage of methylmercury for that group of organism on average in which data was available.

(1) average % of methylmercury in benthic invertebrates 25.1%
(2) average % of methylmercury in other invertebrates 3.30%
(3) average % of methylmercury in soil invertebrates 6.27%
(4) average % of methylmercury in aerial/foliar invertebrates 10.9%
(5) average % of methylmercury in earthworms 14.0%

Table E-16. Statistical comparison of on-site earthworm metals concentrations to reference areas.

	Earthworm site samples					Earthworm reference samples					
	mean (mg/kg)	stdev	S/NS	FOD	*n*	mean (mg/kg)	stdev	FOD	*n*	Test	*p* value
Al	473.67	301.29	S	100	6	935.67	183.11	100	6	P	0.009
Sb	0.62	0.41	S	100	6	0.14	0.04	100	6	NP	0.002
As	23.22	9.51	S	100	6	1.31	0.40	100	6	NP	0.002
Ba	6.34	3.44	S	100	6	17.05	4.21	100	6	P	<0.001
Be	0.08	0.04	S	0	6	0.04	0.01	66.7	6	NP	0.004
Cd	14.82	5.82	S	100	6	0.92	0.27	100	6	NP	0.002
Cr	0.63	0.33	NS	100	6	0.94	0.17	100	6	NP	0.071
Co	0.34	0.20	S	100	6	1.16	0.18	100	6	P	<0.001
Cu	10.40	3.32	S	100	6	4.97	1.45	100	6	P	0.004
Fe	869.50	538.37	S	100	6	1510.00	336.87	100	6	P	0.033
Pb	22.85	7.04	S	100	6	0.98	0.31	100	6	NP	0.002
Mn	76.98	35.26	NS	100	6	52.17	19.61	100	6	P	0.163
Hg	0.13	0.08	S*	100	6	0.06	0.03	100	6	NP	0.041
Ni	0.50	0.32	NS	83	6	0.65	0.18	100	6	P	0.335
Se	1.47	0.77	NS	100	6	0.97	0.46	100	6	P	0.202
Ag	0.28	0.07	S	100	6	0.04	0.02	100	6	NP	0.002
Tl	0.09	0.04	S	17	6	0.03	0.01	66.7	6	NP	0.004
V	2.90	3.18	NS	100	6	3.28	0.48	100	6	NP	0.093
Zn	170.83	60.39	S	100	6	45.57	8.09	100	6	NP	0.002

Notes:

Frequency of detection (FOD)-corresponds to the % of samples above reporting limits.

Samples designated with an asterisks (*) indicate samples in which concentrations were above reporting limits for at least 50% of the sample sites and thus were evaluated statistically (As shown above)

nd = no statistical analysis was conducted (not determined)

S-significant, NS- not significant, S-significant using NP, but not significant using P*

FOD = frequency of detection (%)

Table E-17. Exposure Point Concentrations for Aquatic Media

		Sediment (mg/kg$_{dw}$)				Sediment (mg/kg$_{ww}$)				Surface Water (mg/L, Total)				Aquatic Plants (mg/kg$_{ww}$)				Benthic Invertebrates (mg/kg$_{ww}$)				Other Aq. Invertebrates (mg/kg$_{ww}$)				Forage Fish (mg/kg$_{ww}$)				Piscivorous Fish (mg/kg$_{ww}$)				Amphibians (mg/kg$_{ww}$)			
CSM Unit	Metal	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max
PPC	Al	4604.17	6510.03	b1	10100.00	3369.84	4751.86	b1	7423.50	0.139	0.161	b3	0.300	329.51	450.04	d	668.22	39.65	47.13	b10	55.68	54.10	78.12	b12	78.12	3.88	4.30	b12	4.30	1.67	2.71	b10	3.11	1.30	2.56	b12	2.56
	Sb	1.54	2.27	b2	4.50	1.12	1.64	b2	3.31	0.007	0.030	b8	0.030	0.24	0.35	d	0.64	0.04	0.05	b10	0.06	0.05	0.08	b12	0.08	0.01	0.02	b12	0.02	0.03	0.03	b8	0.03	0.02	0.02	b12	0.02
	As	54.68	93.64	b1	250.00	40.08	75.37	b9	183.75	0.007	0.007	b5	0.040	6.10	9.89	d	23.94	0.93	1.38	b10	1.67	1.42	2.05	b12	2.05	0.15	0.16	b12	0.16	0.11	0.15	b10	0.15	0.07	0.13	b12	0.13
	Ba	125.39	174.71	b3	352.00	92.16	128.41	b3	258.72	0.030	0.039	b3	0.050	12.87	17.34	d	32.58	1.66	2.24	b10	2.64	1.99	2.95	b12	2.95	0.31	0.36	b12	0.36	0.12	0.18	b1	0.20	0.27	0.32	b12	0.32
	Be	1.11	1.40	b4	1.40	0.81	1.03	b4	1.03	0.046	0.050	b12	0.050	0.18	0.23	d	0.23	0.00	0.00	b10	0.00	0.01	0.01	b12	0.01	0.01	0.01	b12	0.01	0.10	0.10	b8	0.10	0.01	0.01	b12	0.01
	Cd	6.90	15.08	b1	36.80	5.04	11.00	b1	27.05	0.0002	0.0003	b3	0.0004	0.95	1.91	d	4.27	0.16	0.20	b10	0.22	0.36	0.70	b12	0.70	0.02	0.02	b12	0.02	0.05	0.08	b10	0.09	0.26	0.39	b12	0.39
	Cr	9.55	12.13	b5	21.20	6.91	8.88	b5	15.58	0.002	0.005	b8	0.005	1.27	1.57	d	2.60	0.08	0.10	b10	0.13	0.13	0.25	b12	0.25	0.03	0.05	b12	0.05	0.02	0.03	b4	0.03	0.04	0.07	b12	0.07
	Co	7.08	10.88	b1	21.20	5.19	7.96	b1	15.58	0.007	0.025	b8	0.025	0.97	1.43	d	2.60	0.08	0.09	b10	0.10	0.11	0.21	b12	0.21	0.01	0.01	b12	0.01	0.01	0.02	b10	0.02	0.01	0.01	b12	0.01
	Cu	87.33	259.16	b6	480.00	63.96	190.35	b6	352.80	0.003	0.003	b3	0.007	9.29	24.73	d	43.07	1.92	2.26	b10	2.42	13.06	25.43	b12	25.43	0.19	0.20	b12	0.20	0.66	0.89	b10	1.02	0.92	1.20	b12	1.20
	Fe	14176.67	19532.04	b1	38100.00	10393.28	14303.03	b1	28003.50	0.321	0.343	b5	0.700	906.66	1209.77	d	2207.31	104.03	121.99	b10	130.73	134.75	197.82	b12	197.82	9.24	10.36	b12	10.36	8.41	12.91	b10	15.73	4.46	6.86	b12	6.86
	Hg	0.65	2.52	b7, c	3.10	0.47	1.85	b7, c	2.28	0.001	0.003	b12	0.003	0.11	0.38	d	0.46	0.01	0.01	b10	0.01	0.02	0.03	b12	0.03	0.01	0.01	b12, c	0.01	0.02	0.08	b4, c	0.08	0.01	0.01	b12, c	0.01
	MeHg	0.65	2.52	b7, c	3.10	0.47	1.85	b7, c	2.28	0.001	0.003	b12, c	0.003	0.11	0.38	d	0.46	0.003	0.004	b12	0.004	0.002	0.002	b12	0.002	0.007	0.009	b12, c	0.009	0.024	0.079	b4, c	0.079	0.008	0.011	b12, c	0.011
	Mn	1406.75	4690.08	b6	9030.00	1032.66	3446.51	b6	6637.05	0.071	0.074	b5	0.130	113.35	335.04	d	604.16	34.79	44.27	b10	50.55	33.56	52.27	b12	52.27	2.96	3.47	b12	3.47	1.72	2.24	b10	2.44	11.77	14.56	b12	14.56
	Ni	7.16	9.19	b3	16.10	5.36	6.82	b3	11.83	0.007	0.020	b12	0.020	0.98	1.22	d	2.03	0.08	0.11	b10	0.12	0.12	0.22	b12	0.22	0.03	0.03	b12	0.03	0.04	0.04	b8	0.04	0.02	0.09	b12	0.09
	Pb	280.50	511.58	b1	1090.00	205.50	374.44	b1	801.15	0.005	0.005	b3	0.020	26.56	45.61	d	90.10	2.31	2.90	b10	2.96	4.14	7.19	b12	7.19	0.23	0.27	b12	0.27	0.12	0.15	b10	0.15	0.37	0.48	b12	0.48
	Se	1.61	2.33	b3	5.30	1.18	1.71	b3	3.90	0.001	0.002	b3	0.004	0.26	0.36	d	0.75	0.06	0.07	b10	0.09	0.06	0.12	b12	0.12	0.10	0.11	b12	0.11	0.15	0.19	b10	0.21	0.07	0.08	b12	0.08
	Ag	0.87	1.23	b5	2.50	0.63	0.90	b5	1.84	0.002	0.005	b8	0.005	0.15	0.20	d	0.38	0.02	0.02	b10	0.02	0.09	0.15	b12	0.15	0.00	0.00	b12	0.00	0.00	0.01	b10	0.01	0.01	0.01	b12	0.01
	Tl	3.00	3.00	b8	3.00	2.39	2.39	b8	2.39	0.003	0.013	b8	0.013	0.45	0.45	d	0.45	0.00	0.01	b3	0.01	0.01	0.01	b12	0.01	0.01	0.01	b12	0.01	0.01	0.01	b12	0.01	0.01	0.01	b12	0.01
	V	28.68	34.63	b3	55.20	21.03	25.46	b3	40.57	0.008	0.025	b8	0.025	3.41	4.04	d	6.15	0.23	0.28	b10	0.31	0.35	0.72	b12	0.72	0.08	0.08	b12	0.08	0.04	0.05	b10	0.06	0.01	0.03	b12	0.03
	Zn	794.83	1759.29	b9	3930.00	581.66	1255.29	b9	2888.55	0.050	0.054	b5	0.095	67.81	138.62	d	285.75	27.60	34.22	b10	39.94	25.05	41.87	b12	41.87	7.03	8.00	b12	8.00	13.07	19.37	b10	20.61	6.07	7.63	b12	7.63
UL&M	Al	10321.15	11840.68	b10	20000.00	5531.00	6463.70	b1	10820.00	0.315	0.524	b3	1.620	681.37	771.03	d	1235.83	16.73	21.25	b3	32.49	20.62	34.47	b10	42.30	6.59	9.28	b3	15.09	3.40	5.25	b10	9.74	1.30	2.56	b12	2.56
	Sb	20.61	33.49	b1	112.00	11.52	18.91	b1	60.59	0.026	0.030	b8	0.030	2.53	3.92	d	11.62	0.09	0.25	b7	0.33	0.11	0.18	b10	0.23	0.02	0.02	b2	0.03	0.02	0.02	b3	0.03	0.02	0.02	b12	0.02
	As	187.60	251.42	b1	581.00	103.77	140.96	b1	314.32	0.013	0.016	b2	0.032	8.50	12.36	b3	17.00	0.40	0.53	b3	0.80	1.17	1.81	b10	2.51	0.18	0.25	b3	0.34	0.07	0.09	b10	0.09	0.07	0.13	b12	0.13
	Ba	148.96	166.31	b2	282.00	79.23	90.97	b3	152.56	0.038	0.045	b3	0.064	15.02	16.59	d	26.68	2.69	3.60	b3	5.14	0.83	1.25	b10	1.51	0.81	1.13	b3	1.88	0.36	0.43	b10	0.55	0.27	0.32	b12	0.32
	Be	1.60	1.80	b3	2.10	0.87	0.97	b3	1.14	0.002	0.003	b8	0.003	0.25	0.28	d	0.32	0.00	0.01	b5	0.01	0.01	0.01	b4	0.01	0.03	0.03	b8	0.03	0.28	0.28	b8	0.28	0.01	0.01	b12	0.01
	Cd	71.10	111.36	b1	338.00	38.90	61.28	b1	182.86	0.004	0.007	b1	0.030	1.75	2.54	b10	4.20	1.06	4.46	b6	9.60	0.29	0.50	b10	0.76	0.17	0.77	b6	1.40	0.02	0.03	b1	0.04	0.26	0.39	b12	0.39
	Cr	14.65	16.88	b1	27.30	7.86	9.09	b1	14.77	0.002	0.003	b2	0.006	1.86	2.12	d	3.26	0.03	0.03	b3	0.04	0.07	0.22	b1	0.25	0.05	0.10	b6	0.14	0.11	0.58	b7	0.78	0.04	0.07	b12	0.07
	Co	10.67	12.98	b1	24.10	5.75	7.02	b1	13.04	0.002	0.003	b4	0.003	1.40	1.67	d	2.92	0.03	0.04	b3	0.05	0.06	0.08	b10	0.09	0.01	0.01	b3	0.02	0.01	0.01	b10	0.01	0.01	0.01	b12	0.01
	Cu	492.88	706.37	b1	2290.00	269.25	388.50	b1	1238.89	0.012	0.022	b7	0.028	9.03	12.66	b10	18.80	10.97	40.12	b6	79.50	4.37	7.01	b10	9.91	1.40	5.13	b6	9.10	0.46	0.56	b10	0.84	0.92	1.20	b12	1.20
	Fe	18492.31	21078.44	b10	34400.00	9992.84	11582.71	b1	18610.40	1.361	3.914	b6	8.370	1151.65	1295.64	d	2013.41	32.27	40.46	b5	69.89	46.82	72.11	b10	105.79	14.65	29.55	b7	34.58	8.43	13.24	b1	20.39	4.46	6.86	b12	6.86
	Hg	41.79	93.01	b7, c	230.00	22.83	51.74	b7, c	143.75	0.00004	0.0005	b10	0.0005	4.79	9.83	d	22.21	0.02	0.05	b7	0.06	0.07	0.14	b10	0.18	0.02	0.03	b1, c	0.07	0.03	0.04	b10, c	0.06	0.01	0.01	b12, c	0.01
	MeHg	41.79	93.01	b7, c	230.00	22.83	51.74	b7, c	143.75	0.00004	0.0005	b12, c	0.0005	4.79	9.83	d	22.21	0.006	0.010	b12	0.010	0.001	0.002	b12	0.002	0.022	0.032	b1, c	0.065	0.032	0.041	b10, c	0.056	0.008	0.011	b12, c	0.011
	Mn	688.23	833.55	b1	2520.00	369.77	449.11	b1	1363.32	0.359	1.104	b6	2.180	59.56	70.77	d	191.55	11.60	13.73	b3	15.58	12.95	18.76	b10	21.04	4.35	6.14	b3	9.43	1.50	1.73	b10	1.96	11.77	14.56	b12	14.56
	Ni	12.42	14.32	b5	24.80	6.63	7.66	b5	13.42	0.018	0.020	b8	0.020	1.61	1.83	d	2.99	0.03	0.03	b3	0.05	0.06	0.09	b10	0.13	0.02	0.03	b3	0.04	0.04	0.05	b12	0.05	0.02	0.09	b12	0.09
	Pb	2543.62	3837.00	b1	10800.00	1412.86	2153.59	b1	6253.20	0.094	0.320	b7	0.800	25.88	37.00	b10	50.00	14.00	41.29	b1	105.10	6.41	10.89	b10	15.66	3.08	13.70	b6	25.00	0.32	0.45	b10	0.81	0.37	0.48	b12	0.48

Table E-17. Exposure Point Concentrations for Aquatic Media

		Sediment (mg/kg$_{dw}$)				Sediment (mg/kg$_{ww}$)				Surface Water (mg/L, Total)				Aquatic Plants (mg/kg$_{ww}$)				Benthic Invertebrates (mg/kg$_{ww}$)				Other Aq. Invertebrates (mg/kg$_{ww}$)				Forage Fish (mg/kg$_{ww}$)				Piscivorous Fish (mg/kg$_{ww}$)				Amphibians (mg/kg$_{ww}$)			
CSM Unit	Metal	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max	Mean	95% UCL[a]		Max
	Se	5.63	13.88	b7	21.80	3.08	7.65	b7	12.62	0.015	0.018	b8	0.018	2.50	2.50	b8	2.50	0.06	0.07	b3	0.10	0.11	0.15	b10	0.16	0.10	0.12	b3	0.16	0.09	0.11	b1	0.12	0.07	0.08	b12	0.08
	Ag	23.19	51.85	b7	127.00	12.80	28.47	b7	68.71	0.001	0.001	b3	0.001	2.82	5.81	d	13.02	0.04	0.11	b7	0.13	0.06	0.10	b10	0.13	0.01	0.01	b5	0.03	0.01	0.01	b10	0.01	0.01	0.01	b12	0.01
	Tl	1.63	2.27	b3	5.00	0.76	1.06	b3	2.90	0.011	0.013	b8	0.013	0.26	0.35	d	0.71	0.01	0.01	b7	0.02	0.01	0.01	b3	0.02	0.03	0.03	b8	0.03	0.01	0.01	b3	0.01	0.01	0.01	b12	0.01
	V	37.23	41.71	b1	59.40	19.99	22.26	b10	32.14	0.004	0.005	b3	0.006	4.31	4.78	d	6.57	0.06	0.08	b3	0.10	0.10	0.18	b3	0.28	0.05	0.06	b3	0.09	0.03	0.04	b10	0.05	0.01	0.03	b12	0.03
	Zn	2005.73	2609.04	b1	6550.00	1085.49	1419.55	b1	3543.55	0.090	0.128	b4	0.300	51.88	69.11	b10	94.00	15.44	25.54	b9	67.00	21.17	30.22	b10	39.73	15.56	40.45	b6	66.00	6.05	8.01	b1	12.09	6.07	7.63	b12	7.63
WD	Al	5990.00	6951.06	b10	7070.00	2996.13	3882.18	b10	4305.63	nm				417.56	477.39	d	484.74	23.74	23.74	b12	23.74	13.28	13.28	b12	13.28	10.54	10.54	b12	10.54	na				na			
	Sb	2.86	4.59	b10	5.90	1.38	2.21	b10	2.83	nm				0.43	0.66	d	0.82	0.06	0.06	b12	0.06	0.13	0.13	b12	0.13	0.03	0.03	b12	0.03	na				na			
	As	41.60	62.88	b10	79.00	20.78	31.83	b10	37.92	0.006	0.010	b12	0.010	4.77	6.91	d	8.49	0.35	0.35	b12	0.35	0.76	0.76	b12	0.76	0.14	0.14	b12	0.14	na				na			
	Ba	50.00	50.00	b8	50.00	30.45	30.45	b8	30.45	nm				5.62	5.62	d	5.62	4.15	4.15	b12	4.15	0.52	0.52	b12	0.52	0.48	0.48	b12	0.48	na				na			
	Be	5.00	5.00	b8	5.00	3.05	3.05	b8	3.05	nm				0.71	0.71	d	0.71	0.00	0.00	b12	0.00	0.01	0.01	b12	0.01	0.00	0.00	b12	0.00	na				na			
	Cd	19.06	25.13	b10	27.70	9.63	14.02	b10	16.87	0.002	0.003	b12	0.003	2.36	3.03	d	3.31	0.32	0.32	b12	0.32	0.15	0.15	b12	0.15	0.07	0.07	b12	0.07	na				na			
	Cr	6.60	7.53	b3	8.00	2.96	4.12	b3	4.26	nm				0.91	1.02	d	1.08	0.07	0.07	b12	0.07	0.05	0.05	b12	0.05	0.02	0.02	b12	0.02	na				na			
	Co	5.00	5.67	b10	6.00	2.49	3.17	b10	3.65	nm				0.71	0.79	d	0.83	0.03	0.03	b12	0.03	0.04	0.04	b12	0.04	0.01	0.01	b12	0.01	na				na			
	Cu	86.80	126.92	b10	154.00	41.91	60.60	b10	73.92	0.005	0.010	b12	0.010	9.24	13.01	d	15.48	2.56	2.56	b12	2.56	1.90	1.90	b12	1.90	0.40	0.40	b12	0.40	na				na			
	Fe	10484.00	11856.03	b10	12200.00	5219.30	6569.38	b10	7125.30	0.275	0.300	b12	0.300	691.04	771.93	d	792.05	38.53	38.53	b12	38.53	51.38	51.38	b12	51.38	24.42	24.42	b12	24.42	na				na			
	Hg	30.22	120.00	b4, c	120.00	17.52	73.08	b4, c	73.08	0.00001	0.00001	b8	0.00001	3.58	12.37	d	12.37	0.02	0.02	b12	0.02	0.02	0.02	b12	0.02	0.01	0.01	b12, c	0.01	na				na			
	MeHg	30.22	120.00	b4, c	120.00	17.52	73.08	b4, c	73.08	0.00001	0.00001	b8, c	0.00001	3.58	12.37	d	12.37	0.005	0.005	g1	0.005	0.001	0.001	g2	0.001	0.013	0.013	b12, c	0.013	na				na			
	Mn	935.60	1062.03	b10	1120.00	454.36	500.77	b10	510.95	0.055	0.060	b12	0.060	78.53	88.01	d	92.33	27.00	27.00	b12	27.00	14.79	14.79	b12	14.79	10.33	10.33	b12	10.33	na				na			
	Ni	5.20	5.74	b3	6.00	3.05	3.06	b3	3.06	nm				0.73	0.80	d	0.83	0.04	0.04	b12	0.04	0.04	0.04	b12	0.04	0.01	0.01	b12	0.01	na				na			
	Pb	754.20	1228.68	b10	1610.00	365.25	591.31	b10	772.80	0.027	0.060	b2	0.060	64.68	100.35	d	127.99	4.58	4.58	b12	4.58	6.86	6.86	b12	6.86	2.96	2.96	b12	2.96	na				na			
	Se	0.90	1.32	b3	1.60	0.43	0.62	b3	0.77	nm				0.15	0.21	d	0.25	0.05	0.05	b12	0.05	0.05	0.05	b12	0.05	0.04	0.04	b12	0.04	na				na			
	Ag	5.68	8.98	b10	11.10	2.70	4.19	b10	5.33	nm				0.79	1.20	d	1.45	0.03	0.03	b12	0.03	0.02	0.02	b12	0.02	0.01	0.01	b12	0.01	na				na			
	Tl	1.20	1.74	b3	2.00	0.68	0.87	b3	0.96	nm				0.20	0.27	d	0.31	0.00	0.00	b12	0.00	0.00	0.00	b12	0.00	0.00	0.00	b12	0.00	na				na			
	V	20.80	25.39	b10	27.00	10.49	14.15	b10	15.23	nm				2.55	3.06	d	3.23	0.10	0.10	b12	0.10	0.09	0.09	b12	0.09	0.06	0.06	b12	0.06	na				na			
	Zn	597.60	707.32	b10	720.00	290.76	343.06	b10	355.05	0.050	0.100	b12	0.100	52.46	61.05	d	62.03	9.15	9.15	b12	9.15	16.87	16.87	b12	16.87	8.87	8.87	b12	8.87	na				na			
LL	Al	6705.00	9045.49	b10	13000.00	4841.08	6531.37	b10	9412.00	0.067	0.100	b12	0.100	462.16	605.09	d	838.65	23.14	43.94	b10	56.64	326.03	757.64	b12	757.64	26.01	72.71	b12	72.71	na				na			
	Sb	273.13	798.38	b1	990.00	197.86	579.11	b1	716.76	0.275	0.376	b10	0.437	25.93	68.08	d	82.62	0.55	0.86	b10	0.91	7.29	9.67	b12	9.67	0.32	0.87	b12	0.87	na				na			
	As	1113.63	3008.03	b1	3030.00	802.21	2162.43	b1	2193.72	0.159	0.225	b7	0.243	91.85	224.64	d	226.11	1.59	2.91	b10	3.65	68.06	129.87	b12	129.87	1.41	3.42	b12	3.42	na				na			
	Ba	171.50	205.74	b3	245.00	129.87	149.24	b3	177.38	0.042	0.044	b4	0.044	17.06	20.09	d	23.51	0.71	1.19	b10	1.40	14.62	20.84	b12	20.84	0.83	1.35	b12	1.35	na				na			
	Be	1.22	1.80	b4	1.80	0.88	1.30	b4	1.30	0.047	0.050	b8	0.050	0.20	0.28	d	0.28	0.00	0.01	b3	0.00	0.05	0.12	b12	0.12	0.01	0.02	b12	0.02	na				na			
	Cd	683.63	2680.00	b4	2680.00	493.87	1940.32	b4	1940.32	0.010	0.013	b1	0.040	59.21	202.47	d	202.47	1.29	1.84	b10	1.98	12.86	19.55	b12	19.55	1.08	3.02	b12	3.02	na				na			
	Cr	12.55	17.09	b10	22.10	9.20	14.04	b1	16.00	0.001	0.001	b3	0.001	1.62	2.14	d	2.70	0.05	0.09	b10	0.10	0.72	1.57	b12	1.57	0.05	0.09	b12	0.09	na				na			
	Co	16.66	25.54	b10	35.10	12.06	18.47	b10	25.41	0.013	0.025	b8	0.025	2.09	3.07	d	4.09	0.04	0.06	b10	0.07	0.82	1.50	b12	1.50	0.04	0.08	b12	0.08	na				na			
	Cu	1025.25	2532.90	b6	2600.00	738.18	1076.87	b11	1882.40	0.029	0.035	b10	0.070	85.27	192.44	d	197.02	3.75	5.88	b10	6.46	64.96	96.32	b12	96.32	2.27	5.24	b12	5.24	na				na			
	Fe	19412.50	25708.18	b10	35200.00	14074.38	18656.26	b10	25484.80	0.384	0.435	b3	0.710	1203.10	1549.15	d	2055.50	45.82	84.22	b10	106.04	830.55	1744.99	b12	1744.99	55.26	150.41	b12	150.41	na				na			
	Hg	24.66	38.14	b10, c	53.30	17.74	27.47	b10, c	38.59	0.00004	0.0001	b4	0.0001	2.98	4.41	d	5.96	0.05	0.16	b1	0.15	0.46	0.74	b12	0.74	0.03	0.08	b12, c	0.08	na				na			
	MeHg	24.66	38.14	b10, c	53.30	17.74	27.47	b10, c	38.59	0.00004	0.0001	b3, c	0.0001	2.98	4.41	d	5.96	0.014	0.017	b12	0.017	0.001	0.001	b12	0.001	0.032	0.078	b12, c	0.078	na				na			
	Mn	733.38	1002.40	b10	1370.00	529.08	723.10	b10	991.88	0.239	0.288	b10	0.500	63.07	83.55	d	110.68	15.99	27.20	b10	29.88	296.14	439.56	b12	439.56	9.39	19.43	b12	19.43	na				na			

Table E-17. Exposure Point Concentrations for Aquatic Media

		Sediment (mg/kg_{dw})				Sediment (mg/kg_{ww})				Surface Water (mg/L, Total)				Aquatic Plants (mg/kg_{ww})				Benthic Invertebrates (mg/kg_{ww})				Other Aq. Invertebrates (mg/kg_{ww})				Forage Fish (mg/kg_{ww})				Piscivorous Fish (mg/kg_{ww})			Amphibians (mg/kg_{ww})		
CSM Unit	Metal	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]		Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max
	Ni	16.89	25.61	b3	36.40	12.19	18.53	b3	26.35	0.004	0.004	b4	0.004	2.12	3.08	d	4.23	0.07	0.11	b10	0.11	0.90	1.65	b12	1.65	0.06	0.11	b12	0.11	na			na		
	Pb	5026.50	8618.88	b10	14400.00	3623.63	6226.04	b10	10425.60	0.069	0.085	b10	0.178	356.59	579.34	d	919.51	8.70	14.94	b10	16.05	144.41	261.14	b12	261.14	10.45	30.34	b12	30.34	na			na		
	Se	128.19	432.00	b4	432.00	92.88	312.77	b4	312.77	0.039	0.047	b10	0.054	13.12	39.17	d	39.17	0.74	1.10	b10	1.20	1.70	2.03	b12	2.03	1.27	1.73	b12	1.73	na			na		
	Ag	49.75	86.19	b10	141.00	35.87	62.27	b10	102.08	0.002	0.002	b4	0.002	5.60	9.18	d	14.30	0.09	0.15	b10	0.19	1.47	2.52	b12	2.52	0.06	0.16	b12	0.16	na			na		
	Tl	468.00	1980.00	b4	1980.00	338.82	1433.52	b4	1433.52	0.053	0.070	b10	0.077	42.10	154.18	d	154.18	0.19	0.30	b10	0.29	3.98	6.09	b12	6.09	0.57	0.68	b12	0.68	na			na		
	V	32.94	47.57	b1	57.70	24.27	45.39	b6	46.37	0.014	0.025	b8	0.025	3.86	5.38	d	6.40	0.10	0.17	b10	0.19	2.27	4.96	b12	4.96	0.09	0.22	b12	0.22	na			na		
	Zn	3069.25	4690.19	b10	6930.00	2224.12	3397.23	b10	5017.32	0.069	0.090	b3	0.200	228.75	335.04	d	476.09	14.50	20.18	b10	22.82	127.64	240.19	b12	240.19	16.17	22.94	b12	22.94	na			na		

Notes:

n = No data available

(a) 95% Upper confidence levels (UCLs) estimated using US EPA's ProUCL Software (V4.00.05). ProUCL Output presented at the end of this appendix.

(b)

(1) ProUCL recommended a 95% UCL estimated assuming a gamma distribution.

(2) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (percentile bootstrap) method.

(3) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (t) method.

(4) ProUCL recommended a 95% UCL greater than the maximum detected value, therefore the maximum detected value was substituted as the 95% UCL.

(5) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (BCA) method.

(6) ProUCL recommended a 95% UCL estimated using the non-parametric Chebyshev method.

(7) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (Chebyshev) method.

(8) All samples were non-detected, therefore ½ of the maximum detection limit was used as the exposure point concentration.

(9) ProUCL recommended a 95% UCL estimated using the lognormal (H-UCL) method.

(10) ProUCL recommended a 95% UCL estimated using the normal (Student's-t) method.

(11) ProUCL recommended a 95% UCL estimated using the non-paranetric (Hall's bootstrap) method.

(12) Sample size was less than 5, therefore a 95% UCL could not be calculated, exposure concentrations estimated using ½ the detection limit for non-detects, and the maximum value was selected as the 95% UCL.

(c) Methyl mercury concentrations assumed to be the same as total mercury concentrations.

(d) Aquatic plant tissue concentrations estimated based on the following relationship: Log (plant conc. dw) = -0.08+0.9(Log sediment conc. dw). (Jackson et al., 1991; 1998). Dry weight converted to wet weight based on an assumed 80% moisture.*

(e) If methylmercury data was not collected for a group of organisms, than the mercury concentration was adjusted by the percentage of methylmercury for that group of organism on average in which data was available.

(1) average % of methylmercury in benthic invertebrates 25.1%

(2) average % of methylmercury in other invertebrates 3.30%

Table E-18. Exposure Point Concentrations for Terrestrial Media

		Soil (mg/kg$_{dw}$)				Soil (mg/kg$_{ww}$)				Terrestrial Plants (mg/kg$_{ww}$)				Earthworms (mg/kg$_{ww}$)				Soil Invertebrates (mg/kg$_{ww}$)				Aerial/Foliar Invertebrates (mg/kg$_{ww}$)			
CSM Unit	**Metal**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**
PPC (Riparian Zone)	Al	6326.67	7820.66	[b10]	7890.00	4818.91	6092.51	[b10]	7107.45	1265.33	1564.13	[d]	1578.00	72.58	118.62	[b10]	173.04	68.60	107.91	[b12]	107.91	33.04	33.04	[b12, f1]	33.04
	Sb	14.68	48.63	[b1]	56.00	13.05	49.04	[b1]	54.15	0.10	0.30	[d]	0.34	0.08	0.12	[b10]	0.18	1.09	1.67	[b12]	1.67	0.19	0.19	[b12, f1]	0.19
	As	91.05	193.84	[b9]	232.00	75.67	208.72	[b9]	224.34	0.68	1.45	[d]	1.74	3.23	4.15	[b10]	5.27	2.83	4.13	[b12]	4.13	1.28	1.28	[b12, f1]	1.28
	Ba	248.33	912.00	[b5]	912.00	217.63	516.94	[b3]	881.90	7.75	28.45	[d]	28.45	0.95	1.49	[b10]	2.15	3.51	5.61	[b12]	5.61	1.19	1.19	[b12, f1]	1.19
	Be	5.00	5.00	[b8]	5.00	3.83	4.84	[b8]	4.84	0.38	0.38	[d]	0.38	0.03	0.03	[b8]	0.03	0.05	0.07	[b12]	0.07	0.010	0.010	[b12, f1]	0.010
	Cd	19.03	43.21	[b1]	57.70	16.26	42.75	[b1]	55.80	0.62	0.97	[d]	1.14	2.13	2.91	[b10]	3.42	4.52	5.28	[b12]	5.28	1.37	1.37	[b12, f1]	1.37
	Cr	14.33	17.35	[b10]	21.00	11.33	15.29	[b10]	20.31	0.12	0.14	[d]	0.17	0.09	0.15	[b10]	0.20	0.22	0.36	[b12]	0.36	0.10	0.10	[b12, f1]	0.10
	Co	8.17	11.75	[b10]	16.00	6.53	11.79	[b1]	15.47	0.01	0.02	[d]	0.02	0.05	0.08	[b10]	0.12	0.13	0.18	[b12]	0.18	0.04	0.04	[b12, f1]	0.04
	Cu	340.50	843.48	[b1]	1030.00	289.31	814.07	[b1]	996.01	3.88	5.55	[d]	6.00	1.49	1.96	[b10]	2.28	16.32	16.89	[b12]	16.89	36.47	36.47	[b12, f1]	36.47
	Fe	22100.00	30954.45	[b10]	43800.00	17798.80	39342.65	[b6]	42354.60	4420.00	6190.89	[d]	8760.00	132.56	215.35	[b10]	314.16	225.27	387.04	[b12]	387.04	85.90	85.90	[b12, f1]	85.90
	Hg	2.70	11.00	[b4]	11.00	2.40	10.64	[b4]	10.64	0.54	2.20	[d]	2.20	0.02	0.03	[b10]	0.04	0.05	0.09	[b12]	0.09	0.005	0.005	[b12, f1]	0.005
	MeHg	2.70	11.00	[b4, c]	11.00	2.40	10.64	[b4, c]	10.64	0.54	2.20	[d]	2.20	0.003	0.003	[b12]	0.003	0.003	0.003	[b12]	0.003	0.001	0.001	[g4]	0.001
	Mn	872.00	1142.60	[b10]	1350.00	683.02	965.44	[b10]	1305.45	13.78	18.05	[d]	21.33	11.34	16.91	[b10]	24.19	151.66	170.48	[b12]	170.48	11.40	11.40	[b12, f1]	11.40
	Ni	8.33	10.19	[b10]	12.00	6.53	8.74	[b10]	11.60	1.67	2.04	[d]	2.40	0.06	0.09	[b3]	0.13	0.27	0.19	[b12]	0.19	0.07	0.07	[b12, f1]	0.07
	Pb	1053.50	2737.20	[b1]	3590.00	915.82	2746.65	[b1]	3471.53	2.63	4.49	[d]	5.23	3.28	4.34	[b10]	5.24	33.26	57.73	[b12]	57.73	3.06	3.06	[b12, f1]	3.06
	Se	6.25	33.00	[b4]	33.00	5.87	31.91	[b4]	31.91	0.77	4.82	[d]	4.82	0.20	0.26	[b10]	0.34	0.35	0.45	[b12]	0.45	0.37	0.37	[b12, f1]	0.37
	Ag	14.00	47.22	[b1]	54.00	12.43	47.46	[b1]	52.22	0.00	0.01	[d]	0.02	0.04	0.05	[b10]	0.06	0.46	0.75	[b12]	0.75	0.03	0.03	[b12, f1]	0.03
	Tl	0.98	2.44	[b7]	2.60	0.82	2.34	[b7]	2.51	0.20	0.49	[d]	0.52	0.013	0.03	[b12]	0.03	0.05	0.07	[b12]	0.07	0.004	0.004	[b12, f1]	0.004
	V	39.67	44.16	[b10]	46.00	30.21	34.08	[b10]	37.72	0.04	0.04	[d]	0.04	0.45	1.23	[b1]	1.55	0.36	0.58	[b12]	0.58	0.19	0.19	[b12, f1]	0.19
	Zn	1206.33	2276.24	[b1]	3010.00	993.87	2770.40	[b9]	2910.67	49.22	69.97	[d]	81.69	25.59	36.14	[b10]	40.99	86.53	108.24	[b12]	108.24	36.96	36.96	[b12, f1]	36.96
UL&M (Banks)	Al	8780.00	13417.69	[b10]	13100.00	7951.40	12091.30	[b4]	12091.30	1756.00	2683.54	[d]	2620.00	1756.00	2683.54	[d]	2620.00	313.42	313.42	[b12]	313.42	187.94	187.94	[b12, f2]	187.94
	Sb	24.82	53.00	[b10]	61.00	23.67	57.71	[b4]	57.71	0.16	0.33	[d]	0.37	4.96	10.60	[d]	12.20	0.66	0.66	[b12]	0.66	1.04	1.04	[b12, f2]	1.04
	As	163.00	317.53	[b10]	393.00	153.43	303.36	[b10]	371.78	1.22	2.38	[d]	2.95	1.76	2.82	[d]	3.28	4.44	4.44	[b12]	4.44	2.03	2.03	[b12, f2]	2.03
	Ba	133.60	140.43	[b3]	143.00	124.49	132.40	[b3]	134.71	4.17	4.38	[d]	4.46	2.43	2.56	[d]	2.60	4.26	4.26	[b12]	4.26	2.61	2.61	[b12, f2]	2.61
	Be	5.00	5.00	[b8]	5.00	4.50	4.90	[b8]	4.90	0.38	0.38	[d]	0.38	0.05	0.05	[d]	0.05	0.04	0.04	[b12]	0.04	0.013	0.013	[b12, f2]	0.013
	Cd	109.96	260.76	[b10]	380.00	104.43	247.48	[b10]	359.48	1.62	2.59	[d]	3.19	69.49	138.05	[d]	186.23	4.15	4.15	[b12]	4.15	2.19	2.19	[b12, f2]	2.19
	Cr	13.80	15.93	[b3]	17.00	11.85	15.09	[b3]	16.01	0.11	0.13	[d]	0.14	0.84	0.98	[d]	1.04	0.29	0.29	[b12]	0.29	0.37	0.37	[b12, f2]	0.37
	Co	6.20	10.10	[b10]	13.00	5.62	9.41	[b10]	12.30	0.01	0.02	[d]	0.02	0.15	0.25	[d]	0.32	0.15	0.15	[b12]	0.15	0.13	0.13	[b12, f2]	0.13
	Cu	296.80	635.78	[b10]	882.00	278.44	603.46	[b10]	834.37	3.68	4.96	[d]	5.64	30.57	65.48	[d]	90.85	11.93	11.93	[b12]	11.93	17.22	17.22	[b12, f2]	17.22
	Fe	14230.00	20632.61	[b10]	20300.00	12690.62	18760.38	[b10]	19203.80	2846.00	4126.52	[d]	4060.00	2846.00	4126.52	[d]	4060.00	333.60	333.60	[b12]	333.60	263.98	263.98	[b12, f2]	263.98
	Hg	21.26	46.84	[b3]	58.00	20.50	45.39	[b3]	56.84	4.25	9.37	[d]	11.60	4.25	9.37	[d]	11.60	0.21	0.21	[b12]	0.21	0.17	0.17	[b12, f2]	0.17
	MeHg	21.26	46.84	[b3, c]	58.00	20.50	45.39	[b3, c]	56.84	4.25	9.37	[d]	11.60	0.0033	0.0033	[b12]	0.0033	0.01	0.01	[g3]	0.01	0.02	0.02	[g4]	0.02
	Mn	417.80	681.03	[b10]	861.00	354.51	530.06	[b10]	613.03	6.60	10.76	[d]	13.60	5.46	7.62	[d]	8.94	17.87	17.87	[b12]	17.87	9.21	9.21	[b12, f2]	9.21
	Ni	9.80	13.02	[b3]	15.00	8.56	12.33	[b3]	14.19	1.96	2.60	[d]	3.00	1.96	2.60	[d]	3.00	0.37	0.37	[b12]	0.37	0.30	0.30	[b12, f2]	0.30
	Pb	2596.40	6001.95	[b10]	8690.00	2458.52	5694.91	[b10]	8220.74	4.36	6.98	[d]	8.59	91.57	180.07	[d]	242.74	39.27	39.27	[b12]	39.27	15.34	15.34	[b12, f2]	15.34
	Se	20.36	54.00	[b4]	54.00	19.53	51.08	[b4]	51.08	2.83	8.31	[d]	8.31	1.69	3.45	[d]	3.45	2.22	2.22	[b12]	2.22	1.35	1.35	[b12, f2]	1.35
	Ag	18.80	44.13	[b3]	61.00	17.77	41.95	[b3]	57.71	0.01	0.01	[d]	0.02	7.69	18.05	[d]	24.95	0.32	0.32	[b12]	0.32	0.24	0.24	[b12, f2]	0.24
	Tl	2.96	5.83	[b3]	7.00	2.83	5.58	[b3]	6.62	0.59	1.17	[d]	1.40	0.59	1.17	[d]	1.40	0.08	0.08	[b12]	0.08	0.168	0.168	[b12, f2]	0.168
	V	33.00	49.00	[b10]	48.00	29.15	43.63	[b10]	45.22	0.03	0.05	[d]	0.05	0.28	0.41	[d]	0.40	0.68	0.68	[b12]	0.68	0.73	0.73	[b12, f2]	0.73
	Zn	838.40	1814.01	[b10]	2620.00	770.55	2478.52	[b4]	2478.52	40.24	61.71	[d]	75.65	155.63	200.47	[d]	226.16	40.00	40.00	[b12]	40.00	30.65	30.65	[b12, f2]	30.65

Table E-18. Exposure Point Concentrations for Terrestrial Media

		Soil (mg/kg$_{dw}$)				Soil (mg/kg$_{ww}$)				Terrestrial Plants (mg/kg$_{ww}$)				Earthworms (mg/kg$_{ww}$)				Soil Invertebrates (mg/kg$_{ww}$)				Aerial/Foliar Invertebrates (mg/kg$_{ww}$)			
CSM Unit	**Metal**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**
LL (Banks)	Al	8980.00	12400.00	b12	12400.00	8070.77	11581.60	b12	11581.60	1796.00	2480.00	d	2480.00	1796.00	2480.00	d	2480.00	689.72	960.48	b12	960.48	187.94	187.94	b12, f3	187.94
	Sb	32.18	115.00	b12	115.00	30.34	109.25	b12	109.25	0.20	0.68	d	0.68	6.44	23.00	d	23.00	2.62	3.06	b12	3.06	1.04	1.04	b12, f3	1.04
	As	324.00	1190.00	b12	1190.00	305.77	1130.50	b12	1130.50	2.43	8.93	d	8.93	2.86	7.17	d	7.17	10.63	13.78	b12	13.78	2.03	2.03	b12, f3	2.03
	Ba	168.75	351.00	b12	351.00	154.71	333.45	b12	333.45	5.27	10.95	d	10.95	3.07	6.39	d	6.39	12.10	15.08	b12	15.08	2.61	2.61	b12, f3	2.61
	Be	5.00	5.00	b8	5.00	4.51	4.75	b8	4.75	0.38	0.38	d	0.38	0.05	0.05	d	0.05	0.07	0.12	b12	0.12	0.013	0.013	b12, f3	0.013
	Cd	103.53	350.00	b12	350.00	96.96	332.50	b12	332.50	1.57	3.05	d	3.05	66.24	174.45	d	174.45	7.36	8.82	b12	8.82	2.19	2.19	b12, f3	2.19
	Cr	14.00	17.00	b12	17.00	12.70	15.88	b12	15.88	0.11	0.14	d	0.14	0.86	1.04	d	1.04	1.05	1.39	b12	1.39	0.37	0.37	b12, f3	0.37
	Co	9.00	21.00	b12	21.00	8.31	19.95	b12	19.95	0.01	0.03	d	0.03	0.22	0.51	d	0.51	0.51	0.66	b12	0.66	0.13	0.13	b12, f3	0.13
	Cu	705.50	2410.00	b12	2410.00	661.67	2289.50	b12	2289.50	5.17	8.39	d	8.39	72.67	248.23	d	248.23	46.32	57.07	b12	57.07	17.22	17.22	b12, f3	17.22
	Fe	18900.00	27500.00	b12	27500.00	17262.15	26125.00	b12	26125.00	3780.00	5500.00	d	5500.00	3780.00	5500.00	d	5500.00	937.97	1238.88	b12	1238.88	263.98	263.98	b12, f3	263.98
	Hg	8.00	28.00	b12	28.00	7.51	26.60	b12	26.60	1.60	5.60	d	5.60	1.60	5.60	d	5.60	0.41	0.46	b12	0.46	0.17	0.17	b12, f3	0.17
	MeHg	8.00	28.00	b12, c	28.00	7.51	26.60	b12, c	26.60	1.60	5.60	d	5.60	1.60	5.60	d	5.60	0.03	0.04	b12	0.04	0.024	0.024	g4	0.024
	Mn	488.25	1040.00	b12	1040.00	448.29	988.00	b12	988.00	7.71	16.43	d	16.43	6.07	10.17	d	10.17	84.08	91.61	b12	91.61	9.21	9.21	b12, f3	9.21
	Ni	16.50	36.00	b12	36.00	15.16	34.20	b12	34.20	3.30	7.20	d	7.20	3.30	7.20	d	7.20	1.51	1.95	b12	1.95	0.30	0.30	b12, f3	0.30
	Pb	2283.00	8130.00	b12	8130.00	2147.01	7723.50	b12	7723.50	4.06	8.28	d	8.28	82.54	230.04	d	230.04	101.00	127.60	b12	127.60	15.34	15.34	b12, f3	15.34
	Se	7.34	23.00	b12	23.00	6.84	21.85	b12	21.85	0.92	3.24	d	3.24	0.80	1.85	d	1.85	4.69	5.02	b12	5.02	1.35	1.35	b12, f3	1.35
	Ag	27.00	90.00	b12	90.00	25.18	85.50	b12	85.50	0.01	0.03	d	0.03	11.04	36.81	d	36.81	1.97	2.64	b12	2.64	0.24	0.24	b12, f3	0.24
	Tl	8.13	29.00	b12	29.00	7.66	27.55	b12	27.55	1.63	5.80	d	5.80	1.63	5.80	d	5.80	0.57	0.60	b12	0.60	0.168	0.168	b12, f3	0.168
	V	40.00	48.00	b12	48.00	36.12	44.83	b12	44.83	0.04	0.05	d	0.05	0.34	0.40	d	0.40	2.35	3.22	b12	3.22	0.73	0.73	b12, f3	0.73
	Zn	1484.75	5270.00	b12	5270.00	1397.61	5006.50	b12	5006.50	55.23	111.41	d	111.41	187.72	284.42	d	284.42	78.72	87.23	b12	87.23	30.65	30.65	b12, f3	30.65
Tito Park	Al	11800.00	12646.96	b3	13400.00	10450.22	11262.91	b3	11952.80	2360.00	2529.39	d	2680.00	2360.00	2529.39	d	2680.00	244.22	244.22	b12	244.22	187.94	187.94	b12	187.94
	Sb	20.02	67.00	b4	67.00	18.07	60.57	b4	60.57	0.13	0.41	d	0.41	4.00	13.40	d	13.40	1.23	1.23	b12	1.23	1.04	1.04	b12	1.04
	As	1614.07	2899.84	b1	8091.00	1428.74	2566.96	b1	7160.54	12.11	21.76	d	60.71	8.89	13.44	d	27.73	4.66	4.66	b12	4.66	2.03	2.03	b12	2.03
	Ba	142.83	165.45	b3	178.00	126.70	148.02	b3	158.78	4.46	5.16	d	5.55	2.60	3.01	d	3.24	5.55	5.55	b12	5.55	2.61	2.61	b12	2.61
	Be	5.00	5.00	b8	5.00	4.43	4.53	b8	4.53	0.38	0.38	d	0.38	0.05	0.05	d	0.05	0.08	0.08	b12	0.08	0.013	0.013	b12	0.013
	Cd	1705.84	5666.99	b7	14725.00	1509.81	5015.35	b6	13031.63	7.23	13.93	d	23.47	614.50	1596.04	d	3409.83	6.66	6.66	b12	6.66	2.19	2.19	b12	2.19
	Cr	15.83	17.74	b3	18.00	14.05	15.96	b3	16.31	0.13	0.15	d	0.15	0.97	1.09	d	1.10	0.42	0.42	b12	0.42	0.37	0.37	b12	0.37
	Co	6.33	9.00	b4	9.00	5.63	9.10	b7	8.15	0.01	0.01	d	0.01	0.15	0.22	d	0.22	0.16	0.16	b12	0.16	0.13	0.13	b12	0.13
	Cu	3379.58	6296.90	b1	23599.00	2991.75	5574.49	b1	20885.12	9.58	12.25	d	20.61	348.10	648.58	d	2430.70	15.22	15.22	b12	15.22	17.22	17.22	b12	17.22
	Fe	16266.67	18480.57	b3	20100.00	14440.85	16646.86	b3	18170.40	3253.33	3696.11	d	4020.00	3253.33	3696.11	d	4020.00	256.52	256.52	b12	256.52	263.98	263.98	b12	263.98
	Hg	3.44	10.00	b4	10.00	3.10	9.06	b4	9.06	0.69	2.00	d	2.00	0.69	2.00	d	2.00	0.10	0.10	b12	0.10	0.17	0.17	b12	0.17
	MeHg	3.44	10.00	b4, c	10.00	3.10	9.06	b4, c	9.06	0.69	2.00	d	2.00	0.69	2.00	d	2.00	0.01	0.01	g3	0.01	0.002	0.002	b12	0.002
	Mn	319.00	421.27	b3	493.00	283.93	378.93	b3	446.66	5.04	6.66	d	7.79	4.54	5.49	d	6.11	18.23	18.23	b12	18.23	9.21	9.21	b12	9.21
	Ni	13.83	19.02	b3	24.00	12.33	17.14	b3	21.70	2.77	3.80	d	4.80	2.77	3.80	d	4.80	0.93	0.93	b12	0.93	0.30	0.30	b12	0.30
	Pb	13409.65	29594.24	b6	71196.00	11872.51	26192.16	b6	63008.46	10.96	17.09	d	27.96	344.49	652.56	d	1325.21	18.32	18.32	b12	18.32	15.34	15.34	b12	15.34
	Se	4.43	8.84	b3	13.00	3.98	7.99	b3	11.75	0.53	1.13	d	1.73	0.55	0.92	d	1.22	3.21	3.21	b12	3.21	1.35	1.35	b12	1.35
	Ag	16.17	33.52	b3	42.00	14.55	30.31	b3	37.97	0.00	0.01	d	0.01	6.61	13.71	d	17.18	0.20	0.20	b12	0.20	0.24	0.24	b12	0.24
	Tl	2.26	8.00	b4	8.00	2.02	7.23	b4	7.23	0.45	1.60	d	1.60	0.45	1.60	d	1.60	0.12	0.12	b12	0.12	0.17	0.17	b12	0.17
	V	41.50	43.12	b3	45.00	36.75	38.45	b3	40.14	0.04	0.04	d	0.04	0.35	0.36	d	0.38	1.23	1.23	b12	1.23	0.73	0.73	b12	0.73
	Zn	7827.29	12158.24	b1	44050.00	6928.57	10762.61	b1	38984.25	138.71	177.04	d	361.24	323.83	374.15	d	570.72	64.45	64.45	b12	64.45	30.65	30.65	b12	30.65

Table E-18. Exposure Point Concentrations for Terrestrial Media

		Soil (mg/kg$_{dw}$)				Soil (mg/kg$_{ww}$)				Terrestrial Plants (mg/kg$_{ww}$)				Earthworms (mg/kg$_{ww}$)				Soil Invertebrates (mg/kg$_{ww}$)				Aerial/Foliar Invertebrates (mg/kg$_{ww}$)			
CSM Unit	**Metal**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**	**Mean**	**95% UCL [a]**		**Max**
Site Perimeter (East)	Al	6325.00	6820.00	b12	6820.00	6085.04	6485.82	b12	6485.82	1265.00	1364.00	d	1364.00	1265.00	1364.00	d	1364.00	1137.52	1137.52	b12	1137.52	33.04	33.04	b12	33.04
	Sb	16.75	28.00	b12	28.00	16.00	26.63	b12	26.63	0.11	0.18	d	0.18	3.35	5.60	d	5.60	11.57	11.57	b12	11.57	0.19	0.19	b12	0.19
	As	423.50	2319.04	b7	3121.00	401.29	2196.20	b7	2955.59	3.18	17.40	d	23.42	3.46	11.48	d	14.15	46.13	46.13	b12	46.13	1.28	1.28	b12	1.28
	Ba	78.50	107.00	b12	107.00	75.94	104.33	b12	104.33	2.45	3.34	d	3.34	1.43	1.95	d	1.95	14.60	14.60	b12	14.60	1.19	1.19	b12	1.19
	Be	5.00	5.00	b8	5.00	4.82	4.88	b8	4.88	0.38	0.38	d	0.38	0.05	0.05	d	0.05	0.12	0.12	b12	0.12	0.010	0.010	b12	0.010
	Cd	40.45	61.69	b3	92.00	38.37	58.49	b3	87.12	0.94	1.18	d	1.47	31.38	43.89	d	60.30	24.34	24.34	b12	24.34	1.37	1.37	b12	1.37
	Cr	12.50	15.00	b12	15.00	12.07	14.63	b12	14.63	0.10	0.12	d	0.12	0.77	0.92	d	0.92	2.02	2.02	b12	2.02	0.10	0.10	b12	0.10
	Co	7.00	8.00	b12	8.00	6.75	7.80	b12	7.80	0.01	0.01	d	0.01	0.17	0.20	d	0.20	1.06	1.06	b12	1.06	0.04	0.04	b12	0.04
	Cu	2235.30	12288.12	b7	16375.00	2118.13	11637.11	b7	15507.13	8.14	15.94	d	17.85	230.24	1265.68	d	1686.63	123.39	123.39	b12	123.39	36.47	36.47	b12	36.47
	Fe	18900.00	22700.00	b12	22700.00	18246.30	22132.50	b12	22132.50	3780.00	4540.00	d	4540.00	3780.00	4540.00	d	4540.00	2019.58	2019.58	b12	2019.58	85.90	85.90	b12	85.90
	Hg	5.98	11.00	b12	11.00	5.69	10.46	b12	10.46	1.20	2.20	d	2.20	1.20	2.20	d	2.20	1.21	1.21	b12	1.21	0.005	0.005	b12	0.005
	MeHg	5.98	11.00	b12, c	11.00	5.69	10.46	b12, c	10.46	1.20	2.20	d	2.20	1.20	2.20	d	2.20	0.08	0.08	g3	0.08	0.001	0.001	b12	0.001
	Mn	796.00	830.00	b12	830.00	766.96	809.25	b12	809.25	12.58	13.11	d	13.11	8.47	8.72	d	8.72	97.85	97.85	b12	97.85	11.40	11.40	b12	11.40
	Ni	7.00	8.00	b12	8.00	6.73	7.61	b12	7.61	1.40	1.60	d	1.60	1.40	1.60	d	1.60	2.07	2.07	b12	2.07	0.07	0.07	b12	0.07
	Pb	1339.70	2032.76	b10	3811.00	1271.50	1927.56	b10	3609.02	3.01	3.80	d	5.41	53.68	75.16	d	124.81	448.74	448.74	b12	448.74	3.06	3.06	b12	3.06
	Se	2.65	4.10	b12	4.10	2.53	3.90	b12	3.90	0.30	0.48	d	0.48	0.38	0.52	d	0.52	2.36	2.36	b12	2.36	0.37	0.37	b12	0.37
	Ag	11.00	18.00	b12	18.00	10.51	17.12	b12	17.12	0.00	0.01	d	0.01	4.50	7.36	d	7.36	5.16	5.16	b12	5.16	0.03	0.03	b12	0.03
	Tl	2.10	3.70	b12	3.70	2.00	3.52	b12	3.52	0.42	0.74	d	0.74	0.42	0.74	d	0.74	0.82	0.82	b12	0.82	0.004	0.004	b12	0.004
	V	41.00	50.00	b12	50.00	39.59	48.75	b12	48.75	0.04	0.05	d	0.05	0.34	0.42	d	0.42	4.35	4.35	b12	4.35	0.19	0.19	b12	0.19
	Zn	1532.00	2131.35	b10	3560.00	1461.27	2041.51	b10	3471.00	56.19	67.47	d	89.65	189.66	211.35	d	250.08	256.91	256.91	b12	256.91	36.96	36.96	b12	36.96
Site Perimeter (West)	Al	8177.50	12000.00	b12	12000.00	7723.99	11196.00	b12	11196.00	1635.50	2400.00	d	2400.00	1635.50	2400.00	d	2400.00	326.34	326.34	b12	326.34	28.61	28.61	b12	28.61
	Sb	35.40	92.00	b12	92.00	33.49	86.57	b12	86.57	0.22	0.55	d	0.55	7.08	18.40	d	18.40	1.85	1.85	b12	1.85	0.62	0.62	b12	0.62
	As	172.36	377.76	b7	829.00	163.07	356.78	b7	780.09	1.29	2.83	d	6.22	1.83	3.19	d	5.55	5.44	5.44	b12	5.44	2.56	2.56	b12	2.56
	Ba	307.25	838.00	b12	838.00	289.78	788.56	b12	788.56	9.59	26.15	d	26.15	5.59	15.25	d	15.25	7.59	7.59	b12	7.59	0.73	0.73	b12	0.73
	Be	5.00	5.00	b8	5.00	4.75	4.85	b8	4.85	0.38	0.38	d	0.38	0.05	0.05	d	0.05	0.02	0.02	b12	0.02	0.009	0.009	b12	0.009
	Cd	116.67	246.82	b7	532.00	110.42	233.46	b7	503.80	1.67	2.52	d	3.83	72.84	132.15	d	243.35	9.66	9.66	b12	9.66	1.61	1.61	b12	1.61
	Cr	15.13	26.00	b12	26.00	14.28	24.47	b12	24.47	0.12	0.21	d	0.21	0.93	1.59	d	1.59	0.52	0.52	b12	0.52	0.07	0.07	b12	0.07
	Co	15.75	46.00	b12	46.00	14.85	43.29	b12	43.29	0.02	0.07	d	0.07	0.38	1.12	d	1.12	0.21	0.21	b12	0.21	0.03	0.03	b12	0.03
	Cu	1381.80	4893.47	b7	9750.00	1309.61	4638.70	b7	9233.25	6.74	11.09	d	14.55	142.33	504.03	d	1004.25	17.58	17.58	b12	17.58	9.27	9.27	b12	9.27
	Fe	24540.00	57500.00	b12	57500.00	23161.85	54107.50	b12	54107.50	4908.00	11500.00	d	11500.00	4908.00	11500.00	d	11500.00	432.90	432.90	b12	432.90	48.05	48.05	b12	48.05
	Hg	3.68	8.20	b12	8.20	3.48	7.72	b12	7.72	0.74	1.64	d	1.64	0.74	1.64	d	1.64	0.09	0.09	b12	0.09	0.03	0.03	b12	0.03
	MeHg	3.68	8.20	b12, c	8.20	3.48	7.72	b12, c	7.72	0.74	1.64	d	1.64	0.74	1.64	d	1.64	0.01	0.01	g3	0.01	0.002	0.002	b12	0.002
	Mn	1098.75	3290.00	b12	3290.00	1036.36	3095.89	b12	3095.89	17.36	51.98	d	51.98	10.56	22.31	d	22.31	34.71	34.71	b12	34.71	3.21	3.21	b12	3.21
	Ni	27.38	82.00	b12	82.00	25.80	77.16	b12	77.16	5.48	16.40	d	16.40	5.48	16.40	d	16.40	0.56	0.56	b12	0.56	0.09	0.09	b12	0.09
	Pb	3196.00	4980.48	b1	11600.00	3025.77	4713.93	b1	10985.20	4.90	6.29	d	10.10	108.29	154.90	d	306.46	39.96	39.96	b12	39.96	11.48	11.48	b12	11.48
	Se	8.63	27.00	b12	27.00	8.14	25.41	b12	25.41	1.10	3.87	d	3.87	0.90	2.08	d	2.08	1.14	1.14	b12	1.14	0.50	0.50	b12	0.50
	Ag	70.25	233.00	b12	233.00	66.30	219.25	b12	219.25	0.02	0.07	d	0.07	28.73	95.30	d	95.30	0.45	0.45	b12	0.45	0.13	0.13	b12	0.13
	Tl	3.00	6.00	b12	6.00	2.84	5.65	b12	5.65	0.60	1.20	d	1.20	0.60	1.20	d	1.20	0.12	0.12	b12	0.12	0.041	0.041	b12	0.041
	V	35.25	53.00	b12	53.00	33.34	50.51	b12	50.51	0.03	0.05	d	0.05	0.30	0.45	d	0.45	1.26	1.26	b12	1.26	0.10	0.10	b12	0.10
	Zn	2523.10	4324.03	b1	14100.00	2385.99	4086.79	b1	13268.10	74.08	99.84	d	192.18	223.38	266.55	d	392.78	64.01	64.01	b12	64.01	26.11	26.11	b12	26.11

Table E-18. Exposure Point Concentrations for Terrestrial Media

		Soil (mg/kg$_{dw}$)			Soil (mg/kg$_{ww}$)			Terrestrial Plants (mg/kg$_{ww}$)			Earthworms (mg/kg$_{ww}$)			Soil Invertebrates (mg/kg$_{ww}$)			Aerial/Foliar Invertebrates (mg/kg$_{ww}$)		
CSM Unit	Metal	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max	Mean	95% UCL [a]	Max

Notes:

na = No data available

(a) 95% Upper confidence levels (UCLs) estimated using US EPA's ProUCL Software (V4.00.05). ProUCL Output presented at the end of this appendix.

(b)

(1) ProUCL recommended a 95% UCL estimated assuming a gamma distribution.
(2) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (percentile bootstrap) method.
(3) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (t) method.
(4) ProUCL recommended a 95% UCL greater than the maximum detected value, therefore the maximum detected value was substituted as the 95% UCL.
(5) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (BCA) method.
(6) ProUCL recommended a 95% UCL estimated using the non-parametric Chebyshev method.
(7) ProUCL recommended a 95% UCL estimated using the Kaplan-Meier (Chebyshev) method.
(8) All samples were non-detected, therefore ½ of the maximum detection limit was used as the exposure point concentration.
(9) ProUCL recommended a 95% UCL estimated using the lognormal (H-UCL) method.
(10) ProUCL recommended a 95% UCL estimated using the normal (Student's-t) method.
(11) ProUCL recommended a 95% UCL estimated using the non-paranetric (Hall's bootstrap) method.
(12) Sample size was less than 5, therefore a 95% UCL could not be calculated, exposure concentrations estimated using ½ the detection limit for non-detects, and the maximum value was selected as the 95% UCL.

(c) Methyl mercury concentrations assumed to be the same as total mercury concentrations.

(d) Terrestrial plant and earthworm tissue concentrations estimated from soil concentrations based on the regressioon equations presented in Table X. Dry weight converted to wet weight based on an assumed 80% moisture.

(e) Soil Invertebrate concentrations for unpaved areas within the smelter facility assumed to be the average of samples collected from the site perimeter and Tito Park which surrounds the facility.

(f)

(1) Aerial/Foliar Invertebrate concentrations for Prickly Pear Creek assumed to be the same as those collected from the east side of the facility perimeter which is adjacent to Prickly Pear Creek.
(2) Aerial/Foliar Invertebrate concentrations for Upper Lake and Marsh assumed to be the same as those collected from Tito Park which is adjacent to Upper Lake.
(3) Aerial/Foliar Invertebrate concentrations for Lower Lake assumed to be the same as those collected from Tito Park which is adjacent to Lower Lake.
(4) Aerial/Foliar Invertebrate concentrations for unpaved areas within the smelter facility assumed to be the average of samples collected from the site perimeter and Tito Park which surrounds the facility.

(g) If methylmercury data was not collected for a group of organisms, than the mercury concentration was adjusted by the percentage of methylmercury for that group of organism on average in which data was available.

(1) average % of methylmercury in benthic invertebrates 25.1%
(2) average % of methylmercury in other invertebrates 3.30%
(3) average % of methylmercury in soil invertebrates 6.27%
(4) average % of methylmercury in aerial/foliar invertebrates 10.9%
(5) average % of methylmercury in earthworms 14.0%

Table E-19. Risk Assessment Results for Avian Omnivores (Mallard)

		Dose: Sediment Ingestion (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Dose: Benthic Inverts (mg/kg-d_{ww})			Dose: Other Aq. Inverts (mg/kg-d_{ww})			Dose: Aquatic Plants (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	LOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max
PPC	Al	1.74E+01	2.46E+01	3.84E+01	8.08E-03	9.35E-03	1.75E-02	2.05E+00	2.44E+00	2.88E+00	2.80E+00	4.04E+00	4.04E+00	1.71E+01	2.33E+01	3.46E+01	3.94E+01	5.44E+01	8.00E+01	124	<1	<1	<1	No TRV	-	-	-
	As	2.07E-01	3.90E-01	9.51E-01	3.83E-04	4.27E-04	2.33E-03	4.80E-02	7.13E-02	8.65E-02	7.34E-02	1.06E-01	1.06E-01	3.16E-01	5.12E-01	1.24E+00	6.45E-01	1.08E+00	2.39E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	2.61E-02	5.70E-02	1.40E-01	1.30E-05	1.71E-05	2.10E-05	8.18E-03	1.02E-02	1.15E-02	1.85E-02	3.61E-02	3.61E-02	4.90E-02	9.90E-02	2.21E-01	1.02E-01	2.02E-01	4.09E-01	1.45	<1	<1	<1	20	<1	<1	<1
	Cr	3.58E-02	4.60E-02	8.07E-02	9.83E-05	2.91E-04	2.91E-04	4.09E-03	5.34E-03	6.65E-03	6.68E-03	1.31E-02	1.31E-02	6.56E-02	8.14E-02	1.35E-01	1.12E-01	1.46E-01	2.35E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	3.31E-01	9.86E-01	1.83E+00	1.79E-04	1.95E-04	4.08E-04	9.94E-02	1.17E-01	1.25E-01	6.76E-01	1.32E+00	1.32E+00	4.81E-01	1.28E+00	2.23E+00	1.59E+00	3.70E+00	5.50E+00	5.68	<1	<1	<1	10.9	<1	<1	<1
	Hg	2.46E-03	9.58E-03	1.18E-02	8.61E-05	1.75E-04	1.75E-04	3.48E-04	4.77E-04	6.03E-04	9.01E-04	1.37E-03	1.37E-03	5.83E-03	1.98E-02	2.38E-02	9.62E-03	3.14E-02	3.78E-02	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	2.46E-03	9.58E-03	1.18E-02	8.61E-05	1.75E-04	1.75E-04	1.29E-04	1.97E-04	1.97E-04	8.80E-05	9.32E-05	9.32E-05	5.83E-03	1.98E-02	2.38E-02	8.59E-03	2.98E-02	3.61E-02	0.032	<1	<1	1	0.5	<1	<1	<1
	Mn	5.35E+00	1.78E+01	3.44E+01	4.13E-03	4.33E-03	7.57E-03	1.80E+00	2.29E+00	2.62E+00	1.74E+00	2.71E+00	2.71E+00	5.87E+00	1.73E+01	3.13E+01	1.48E+01	4.02E+01	7.10E+01	26	<1	2	3	30	<1	1	2
	Pb	1.06E+00	1.94E+00	4.15E+00	2.87E-04	3.14E-04	1.16E-03	1.20E-01	1.50E-01	1.53E-01	2.14E-01	3.72E-01	3.72E-01	1.38E+00	2.36E+00	4.66E+00	2.77E+00	4.82E+00	9.34E+00	3.85	<1	1	3	11	<1	<1	<1
	Se	6.12E-03	8.87E-03	2.02E-02	8.07E-05	1.09E-04	2.33E-04	3.23E-03	3.79E-03	4.50E-03	3.23E-03	5.97E-03	5.97E-03	1.32E-02	1.84E-02	3.86E-02	2.59E-02	3.72E-02	6.95E-02	0.2	<1	<1	<1	0.4	<1	<1	<1
	Ag	3.27E-03	4.64E-03	9.51E-03	1.37E-04	2.91E-04	2.91E-04	1.06E-03	1.24E-03	1.28E-03	4.59E-03	7.57E-03	7.57E-03	7.59E-03	1.04E-02	1.96E-02	1.66E-02	2.41E-02	3.83E-02	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	1.24E-02	1.24E-02	1.24E-02	1.51E-04	7.28E-04	7.28E-04	2.08E-04	3.37E-04	3.15E-04	4.24E-04	7.27E-04	7.27E-04	2.32E-02	2.32E-02	2.32E-02	3.63E-02	3.73E-02	3.73E-02	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	1.09E-01	1.32E-01	2.10E-01	4.85E-04	1.46E-03	1.46E-03	1.18E-02	1.47E-02	1.61E-02	1.80E-02	3.74E-02	3.74E-02	1.77E-01	2.09E-01	3.18E-01	3.16E-01	3.95E-01	5.83E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	3.01E+00	6.50E+00	1.50E+01	2.90E-03	3.13E-03	5.52E-03	1.43E+00	1.77E+00	2.07E+00	1.30E+00	2.17E+00	2.17E+00	3.51E+00	7.18E+00	1.48E+01	9.25E+00	1.76E+01	3.40E+01	130	<1	<1	<1	No TRV	-	-	-
UL&M	Al	2.86E+01	3.35E+01	5.60E+01	1.84E-02	3.05E-02	9.44E-02	8.66E-01	1.10E+00	1.68E+00	1.07E+00	1.78E+00	2.19E+00	3.53E+01	3.99E+01	6.40E+01	6.59E+01	7.63E+01	1.24E+02	124	<1	<1	<1	No TRV	-	-	-
	As	5.37E-01	7.30E-01	1.63E+00	7.39E-04	9.49E-04	1.83E-03	2.08E-02	2.74E-02	4.13E-02	6.07E-02	9.37E-02	1.30E-01	4.40E-01	6.40E-01	8.80E-01	1.06E+00	1.49E+00	2.68E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	2.01E-01	3.17E-01	9.47E-01	2.07E-04	4.28E-04	1.75E-03	5.50E-02	2.31E-01	4.97E-01	1.51E-02	2.59E-02	3.91E-02	9.06E-02	1.32E-01	2.17E-01	3.62E-01	7.06E-01	1.70E+00	1.45	<1	<1	1	20	<1	<1	<1
	Cr	4.07E-02	4.71E-02	7.65E-02	1.19E-04	1.70E-04	3.49E-04	1.42E-03	1.69E-03	2.15E-03	3.49E-03	1.16E-02	1.30E-02	9.65E-02	1.10E-01	1.69E-01	1.42E-01	1.70E-01	2.61E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	1.39E+00	2.01E+00	6.41E+00	6.76E-04	1.25E-03	1.61E-03	5.68E-01	2.08E+00	4.12E+00	2.26E-01	3.63E-01	5.13E-01	4.67E-01	6.56E-01	9.73E-01	2.66E+00	5.11E+00	1.20E+01	5.68	<1	<1	2	10.9	<1	<1	1
	Hg	1.18E-01	2.68E-01	7.44E-01	2.27E-06	2.91E-05	2.91E-05	1.11E-03	2.71E-03	3.25E-03	3.75E-03	7.09E-03	9.36E-03	2.48E-01	5.09E-01	1.15E+00	3.71E-01	7.87E-01	1.91E+00	0.74	<1	1	3	1.5	<1	<1	1
	MeHg	1.18E-01	2.68E-01	7.44E-01	2.27E-06	2.91E-05	2.91E-05	3.00E-04	5.33E-04	5.33E-04	7.25E-05	1.19E-04	1.19E-04	2.48E-01	5.09E-01	1.15E+00	3.66E-01	7.78E-01	1.90E+00	0.032	12	24	59	0.5	<1	2	4
	Mn	1.91E+00	2.33E+00	7.06E+00	2.09E-02	6.43E-02	1.27E-01	6.01E-01	7.11E-01	8.07E-01	6.70E-01	9.71E-01	1.09E+00	3.08E+00	3.66E+00	9.92E+00	6.29E+00	7.74E+00	1.90E+01	26	<1	<1	<1	30	<1	<1	<1
	Pb	7.32E+00	1.12E+01	3.24E+01	5.46E-03	1.86E-02	4.66E-02	7.25E-01	2.14E+00	5.44E+00	3.32E-01	5.64E-01	8.11E-01	1.34E+00	1.92E+00	2.59E+00	9.72E+00	1.58E+01	4.13E+01	3.85	3	4	11	11	<1	2	4
	Se	1.59E-02	3.96E-02	6.54E-02	8.78E-04	1.02E-03	1.02E-03	3.02E-03	3.69E-03	5.24E-03	5.44E-03	7.54E-03	8.10E-03	1.29E-01	1.29E-01	1.29E-01	1.55E-01	1.81E-01	2.09E-01	0.2	<1	<1	1	0.4	<1	<1	<1
	Ag	6.63E-02	1.47E-01	3.56E-01	4.90E-05	5.20E-05	5.47E-05	2.23E-03	5.73E-03	6.86E-03	3.31E-03	5.40E-03	6.62E-03	1.46E-01	3.01E-01	6.74E-01	2.18E-01	4.60E-01	1.04E+00	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	3.95E-03	5.50E-03	1.50E-02	6.27E-04	7.28E-04	7.28E-04	2.70E-04	6.50E-04	8.02E-04	4.62E-04	6.62E-04	7.79E-04	1.34E-02	1.80E-02	3.67E-02	1.87E-02	2.56E-02	5.40E-02	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	1.03E-01	1.15E-01	1.66E-01	2.24E-04	2.90E-04	3.26E-04	3.33E-03	3.91E-03	5.23E-03	5.15E-03	9.25E-03	1.44E-02	2.23E-01	2.47E-01	3.40E-01	3.36E-01	3.76E-01	5.26E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	5.62E+00	7.35E+00	1.83E+01	5.26E-03	7.45E-03	1.75E-02	7.99E-01	1.32E+00	3.47E+00	1.10E+00	1.56E+00	2.06E+00	2.69E+00	3.58E+00	4.87E+00	1.02E+01	1.38E+01	2.88E+01	130	<1	<1	<1	No TRV	-	-	-
WD	Al	1.55E+01	2.01E+01	2.23E+01	not measured			1.23E+00	1.23E+00	1.23E+00	6.88E-01	6.88E-01	6.88E-01	2.16E+01	2.47E+01	2.51E+01	3.90E+01	4.67E+01	4.93E+01	124	<1	<1	<1	No TRV	-	-	-
	Sb	7.17E-03	1.14E-02	1.47E-02	not measured			3.30E-03	3.30E-03	3.30E-03	6.61E-03	6.61E-03	6.61E-03	2.22E-02	3.39E-02	4.26E-02	3.92E-02	5.53E-02	6.71E-02	No TRV	-	-	-	No TRV	-	-	-
	As	1.08E-01	1.65E-01	1.96E-01	3.20E-04	5.82E-04	5.82E-04	1.79E-02	1.79E-02	1.79E-02	3.94E-02	3.94E-02	3.94E-02	2.47E-01	3.58E-01	4.40E-01	4.12E-01	5.81E-01	6.94E-01	10	<1	<1	<1	40	<1	<1	<1
	Ba	1.58E-01	1.58E-01	1.58E-01	not measured			2.15E-01	2.15E-01	2.15E-01	2.68E-02	2.68E-02	2.68E-02	2.91E-01	2.91E-01	2.91E-01	6.90E-01	6.90E-01	6.90E-01	21	<1	<1	<1	42	<1	<1	<1
	Be	1.58E-02	1.58E-02	1.58E-02	not measured			2.23E-04	2.23E-04	2.23E-04	2.75E-04	2.75E-04	2.75E-04	3.67E-02	3.67E-02	3.67E-02	5.29E-02	5.29E-02	5.29E-02	No TRV	-	-	-	No TRV	-	-	-
	Cd	4.99E-02	7.26E-02	8.73E-02	8.74E-05	1.75E-04	1.75E-04	1.67E-02	1.67E-02	1.67E-02	7.56E-03	7.56E-03	7.56E-03	1.22E-01	1.57E-01	1.71E-01	1.96E-01	2.54E-01	2.83E-01	1.45	<1	<1	<1	20	<1	<1	<1
	Cr	1.53E-02	2.13E-02	2.21E-02	not measured			3.74E-03	3.74E-03	3.74E-03	2.36E-03	2.36E-03	2.36E-03	4.71E-02	5.30E-02	5.60E-02	6.85E-02	8.04E-02	8.41E-02	0.86	<1	<1	<1	4.32	<1	<1	<1
	Co	1.29E-02	1.64E-02	1.89E-02	not measured			1.54E-03	1.54E-03	1.54E-03	2.12E-03	2.12E-03	2.12E-03	3.67E-02	4.11E-02	4.32E-02	5.32E-02	6.12E-02	6.58E-02	4.1	<1	<1	<1	41	<1	<1	<1
	Cu	2.17E-01	3.14E-01	3.83E-01	3.06E-04	5.82E-04	5.82E-04	1.33E-01	1.33E-01	1.33E-01	9.84E-02	9.84E-02	9.84E-02	4.78E-01	6.74E-01	8.02E-01	9.27E-01	1.22E+00	1.42E+00	5.68	<1	<1	<1	10.9	<1	<1	<1
	Fe	2.70E+01	3.40E+01	3.69E+01	1.60E-02	1.75E-02	1.75E-02	1.99E+00	1.99E+00	1.99E+00	2.66E+00	2.66E+00	2.66E+00	3.58E+01	4.00E+01	4.10E+01	6.75E+01	7.87E+01	8.26E+01	No TRV	-	-	-	No TRV	-	-	-
	Hg	9.07E-02	3.78E-01	3.78E-01	2.91E-07	2.91E-07	2.91E-07	1.13E-03	1.13E-03	1.13E-03	1.13E-03	1.13E-03	1.13E-03	1.85E-01	6.40E-01	6.40E-01	2.78E-01	1.02E+00	1.02E+00	0.74	<1	1	1	1.5	<1	<1	<1
	MeHg	9.07E-02	3.78E-01	3.78E-01	2.91E-07	2.91E-07	2.91E-07	2.84E-04	2.84E-04	2.84E-04	3.71E-05	3.71E-05	3.71E-05	1.85E-01	6.40E-01	6.40E-01	2.76E-01	1.02E+00	1.02E+00	0.032	9	32	32	0.5	<1	2	2
	Mn	2.35E+00	2.59E+00	2.65E+00	3.20E-03	3.49E-03	3.49E-03	1.40E+00	1.40E+00	1.40E+00	7.66E-01	7.66E-01	7.66E-01	4.07E+00	4.56E+00	4.78E+00	8.59E+00	9.32E+00	9.59E+00	26	<1	<1	<1	30	<1	<1	<1
	Ni	1.58E-02	1.58E-02	1.58E-02	not measured			2.32E-03	2.32E-03	2.32E-03	2.20E-03	2.20E-03	2.20E-03	3.80E-02	4.15E-02	4.32E-02	5.83E-02	6.19E-02	6.36E-02	31	<1	<1	<1	135	<1	<1	<1
	Pb	1.89E+00	3.06E+00	4.00E+00	1.56E-03	3.49E-03	3.49E-03	2.37E-01	2.37E-01	2.37E-01	3.55E-01	3.55E-01	3.55E-01	3.35E+00	5.20E+00	6.63E+00	5.83E+00	8.85E+00	1.12E+01	3.85	2	2	3	11	<1	<1	1
	Se	2.24E-03	3.23E-03	3.98E-03	not measured			2.58E-03	2.58E-03	2.58E-03	2.68E-03	2.68E-03	2.68E-03	7.83E-03	1.10E-02	1.31E-02	1.53E-02	1.95E-02	2.24E-02	0.2	<1	<1	<1	0.4	<1	<1	<1
	Ag	1.40E-02	2.17E-02	2.76E-02	not measured			1.71E-03	1.71E-03	1.71E-03	1.26E-03	1.26E-03	1.26E-03	4.11E-02	6.21E-02	7.52E-02	5.81E-02	8.68E-02	1.06E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	3.52E-03	4.50E-03	4.97E-03	not measured			2.23E-04	2.23E-04	2.23E-04	2.36E-04	2.36E-04	2.36E-04	1.01E-02	1.42E-02	1.61E-02	1.41E-02	1.91E-02	2.15E-02	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	5.43E-02	7.33E-02	7.88E-02	not measured			5.25E-03	5.25E-03	5.25E-03	4.41E-03	4.41E-03	4.41E-03	1.32E-01	1.58E-01	1.67E-01	1.96E-01	2.41E-01	2.56E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	1.51E+00	1.78E+00	1.84E+00	2.91E-03	5.82E-03	5.82E-03	4.74E-01	4.74E-01	4.74E-01	8.74E-01	8.74E-01	8.74E-01	2.72E+00	3.16E+00	3.21E+00	5.57E+00	6.29E+00	6.40E+00	130	<1	<1	<1	No TRV	-	-	-

Table E-19. Risk Assessment Results for Avian Omnivores (Mallard)

		Dose: Sediment Ingestion (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Dose: Benthic Inverts (mg/kg-d$_{ww}$)			Dose: Other Aq. Inverts (mg/kg-d$_{ww}$)			Dose: Aquatic Plants (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	**Metal**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**NOAEL (mg/kg-d$_{ww}$)**	**Mean**	**95% UCL**	**Max**	**LOAEL (mg/kg-d$_{ww}$)**	**Mean**	**95% UCL**	**Max**
LL	Al	2.51E+01	3.38E+01	4.87E+01	3.89E-03	5.82E-03	5.82E-03	1.20E+00	2.27E+00	2.93E+00	1.69E+01	3.92E+01	3.92E+01	2.39E+01	3.13E+01	4.34E+01	6.71E+01	1.07E+02	1.34E+02	124	<1	<1	1	No TRV	-	-	-
	Sb	1.02E+00	3.00E+00	3.71E+00	1.60E-02	2.19E-02	2.55E-02	2.85E-02	4.45E-02	4.72E-02	3.77E-01	5.01E-01	5.01E-01	1.34E+00	3.52E+00	4.28E+00	2.79E+00	7.09E+00	8.56E+00	No TRV	-	-	-	No TRV	-	-	-
	As	4.15E+00	1.12E+01	1.14E+01	9.27E-03	1.31E-02	1.42E-02	8.23E-02	1.51E-01	1.89E-01	3.52E+00	6.72E+00	6.72E+00	4.76E+00	1.16E+01	1.17E+01	1.25E+01	2.97E+01	3.00E+01	10	1	3	3	40	<1	<1	<1
	Ba	6.72E-01	7.73E-01	9.18E-01	2.44E-03	2.56E-03	2.56E-03	3.67E-02	6.14E-02	7.25E-02	7.57E-01	1.08E+00	1.08E+00	8.83E-01	1.04E+00	1.22E+00	2.35E+00	2.96E+00	3.29E+00	21	<1	<1	<1	42	<1	<1	<1
	Be	4.57E-03	6.75E-03	6.75E-03	2.71E-03	2.91E-03	2.91E-03	1.80E-04	2.81E-04	2.50E-04	2.68E-03	6.05E-03	6.05E-03	1.03E-02	1.46E-02	1.46E-02	2.04E-02	3.06E-02	3.06E-02	No TRV	-	-	-	No TRV	-	-	-
	Cd	2.56E+00	1.00E+01	1.00E+01	5.79E-04	7.68E-04	2.33E-03	6.69E-02	9.52E-02	1.02E-01	6.66E-01	1.01E+00	1.01E+00	3.07E+00	1.05E+01	1.05E+01	6.36E+00	2.16E+01	2.16E+01	1.45	4	15	15	20	<1	1	1
	Cr	4.76E-02	7.27E-02	8.28E-02	4.78E-05	5.82E-05	5.82E-05	2.83E-03	4.42E-03	5.12E-03	3.75E-02	8.14E-02	8.14E-02	8.39E-02	1.11E-01	1.40E-01	1.72E-01	2.69E-01	3.09E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Co	6.24E-02	9.56E-02	1.32E-01	7.51E-04	1.46E-03	1.46E-03	1.86E-03	3.20E-03	3.53E-03	4.24E-02	7.78E-02	7.78E-02	1.08E-01	1.59E-01	2.12E-01	2.16E-01	3.37E-01	4.26E-01	4.1	<1	<1	<1	41	<1	<1	<1
	Cu	3.82E+00	5.58E+00	9.75E+00	1.70E-03	2.06E-03	4.08E-03	1.94E-01	3.05E-01	3.34E-01	3.36E+00	4.99E+00	4.99E+00	4.41E+00	9.96E+00	1.02E+01	1.18E+01	2.08E+01	2.53E+01	5.68	2	4	5	10.9	1	2	2
	Fe	7.29E+01	9.66E+01	1.32E+02	2.24E-02	2.53E-02	4.14E-02	2.37E+00	4.36E+00	5.49E+00	4.30E+01	9.04E+01	9.04E+01	6.23E+01	8.02E+01	1.06E+02	1.81E+02	2.72E+02	3.34E+02	No TRV	-	-	-	No TRV	-	-	-
	Hg	9.19E-02	1.42E-01	2.00E-01	2.18E-06	2.91E-06	2.91E-06	2.67E-03	8.12E-03	7.59E-03	2.37E-02	3.84E-02	3.84E-02	1.54E-01	2.28E-01	3.08E-01	2.72E-01	4.17E-01	5.54E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	9.19E-02	1.42E-01	2.00E-01	2.18E-06	2.91E-06	2.91E-06	7.35E-04	8.70E-04	8.70E-04	6.73E-05	6.73E-05	6.73E-05	1.54E-01	2.28E-01	3.08E-01	2.47E-01	3.71E-01	5.09E-01	0.032	8	12	16	0.5	<1	<1	1
	Mn	2.74E+00	3.74E+00	5.14E+00	1.39E-02	1.68E-02	2.91E-02	8.28E-01	1.41E+00	1.55E+00	1.53E+01	2.28E+01	2.28E+01	3.27E+00	4.33E+00	5.73E+00	2.22E+01	3.23E+01	3.52E+01	26	<1	1	1	30	<1	1	1
	Ni	6.31E-02	9.59E-02	1.36E-01	2.39E-04	2.50E-04	2.50E-04	3.40E-03	5.47E-03	5.93E-03	4.68E-02	8.56E-02	8.56E-02	1.10E-01	1.60E-01	2.19E-01	2.23E-01	3.47E-01	4.47E-01	31	<1	<1	<1	135	<1	<1	<1
	Pb	1.88E+01	3.22E+01	5.40E+01	4.04E-03	4.95E-03	1.04E-02	4.50E-01	7.73E-01	8.31E-01	7.48E+00	1.35E+01	1.35E+01	1.85E+01	3.00E+01	4.76E+01	4.52E+01	7.65E+01	1.16E+02	3.85	12	20	30	11	4	7	11
	Se	4.81E-01	1.62E+00	1.62E+00	2.26E-03	2.72E-03	3.15E-03	3.84E-02	5.68E-02	6.21E-02	8.82E-02	1.05E-01	1.05E-01	6.80E-01	2.03E+00	2.03E+00	1.29E+00	3.81E+00	3.82E+00	0.2	7	19	19	0.4	3	10	10
	Ag	1.86E-01	3.22E-01	5.29E-01	8.74E-05	1.22E-04	1.22E-04	4.85E-03	7.93E-03	9.59E-03	7.61E-02	1.31E-01	1.31E-01	2.90E-01	4.75E-01	7.40E-01	5.57E-01	9.36E-01	1.41E+00	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	1.75E+00	7.42E+00	7.42E+00	3.11E-03	4.08E-03	4.48E-03	9.99E-03	1.56E-02	1.52E-02	2.06E-01	3.15E-01	3.15E-01	2.18E+00	7.98E+00	7.98E+00	4.15E+00	1.57E+01	1.57E+01	0.237	18	67	67	23.7	<1	<1	<1
	V	1.26E-01	2.35E-01	2.40E-01	7.90E-04	1.46E-03	1.46E-03	5.03E-03	8.56E-03	9.86E-03	1.17E-01	2.57E-01	2.57E-01	2.00E-01	2.78E-01	3.31E-01	4.49E-01	7.80E-01	8.39E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	1.15E+01	1.76E+01	2.60E+01	4.04E-03	5.23E-03	1.16E-02	7.51E-01	1.04E+00	1.18E+00	6.61E+00	1.24E+01	1.24E+01	1.18E+01	1.73E+01	2.47E+01	3.07E+01	4.84E+01	6.43E+01	130	<1	<1	<1	No TRV	-	-	-

Mallard Exposure Factors:

Body weight = 1.04 kg
Food ingestion rate (wet weight) = 0.1632 kg/d
Water ingestion rate = 0.0606 L/d
Sediment ingestion rate (wet weight) = 0.0054 kg/d
Area use factor = 1

Diet Composition:

Benthic Invertebrates = 33%
Other Aquatic Invertebrates = 33%
Aquatic Plants = 33%
Sediment Ingestion (% of total diet) = 3.3%

Notes:

HQ> 1.0

Table E-20. Risk Assessment Results for Avian Carnivores/Piscivores (Belted Kingfisher)

		Dose: Sediment Ingestion (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Dose: Benthic Inverts (mg/kg-d$_{ww}$)			Dose: Other Aq. Inverts (mg/kg-d$_{ww}$)			Dose: Forage Fish (mg/kg-d$_{ww}$)			Dose: Piscivorous Fish (mg/kg-d$_{ww}$)			Dose: Amphibians (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max	(mg/kg-d$_{ww}$)	Mean	95% UCL	Max
PPC	Al	1.92E+01	2.70E+01	4.22E+01	1.53E-02	1.77E-02	3.31E-02	2.26E+00	2.68E+00	3.17E+00	3.08E+00	4.44E+00	4.44E+00	4.42E-01	4.89E-01	4.89E-01	4.76E-01	7.69E-01	8.85E-01	7.37E-02	1.46E-01	1.46E-01	2.55E+01	3.56E+01	5.14E+01	124	<1	<1	<1	No TRV	-	-	-
	As	2.28E-01	4.29E-01	1.05E+00	7.26E-04	8.10E-04	4.41E-03	5.28E-02	7.84E-02	9.50E-02	8.06E-02	1.17E-01	1.17E-01	1.66E-02	1.87E-02	1.87E-02	3.22E-02	4.19E-02	4.24E-02	4.08E-03	7.14E-03	7.14E-03	4.15E-01	6.92E-01	1.33E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	2.87E-02	6.26E-02	1.54E-01	2.46E-05	3.23E-05	3.97E-05	8.98E-03	1.12E-02	1.26E-02	2.03E-02	3.96E-02	3.96E-02	2.29E-03	2.38E-03	2.38E-03	1.51E-02	2.18E-02	2.42E-02	1.50E-02	2.20E-02	2.20E-02	9.04E-02	1.60E-01	2.55E-01	1.45	<1	<1	<1	20	<1	<1	<1
	Cr	3.93E-02	5.05E-02	8.86E-02	1.86E-04	5.52E-04	5.52E-04	4.50E-03	5.87E-03	7.31E-03	7.34E-03	1.44E-02	1.44E-02	3.95E-03	6.23E-03	6.23E-03	6.23E-03	7.71E-03	7.71E-03	2.16E-03	4.11E-03	4.11E-03	6.36E-02	8.94E-02	1.29E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	3.64E-01	1.08E+00	2.01E+00	3.40E-04	3.69E-04	7.72E-04	1.09E-01	1.29E-01	1.37E-01	7.43E-01	1.45E+00	1.45E+00	2.17E-02	2.29E-02	2.29E-02	1.87E-01	2.55E-01	2.89E-01	5.23E-02	6.85E-02	6.85E-02	1.48E+00	3.00E+00	3.97E+00	5.68	<1	<1	<1	10.9	<1	<1	<1
	Hg	2.70E-03	1.05E-02	1.30E-02	1.63E-04	3.31E-04	3.31E-04	3.82E-04	5.25E-04	6.63E-04	9.90E-04	1.51E-03	1.51E-03	7.48E-04	1.02E-03	1.02E-03	6.85E-03	2.24E-02	2.24E-02	4.69E-04	6.02E-04	6.02E-04	1.23E-02	3.69E-02	3.94E-02	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	2.70E-03	1.05E-02	1.30E-02	1.63E-04	3.31E-04	3.31E-04	1.42E-04	2.16E-04	2.16E-04	9.67E-05	1.02E-04	1.02E-04	7.48E-04	1.02E-03	1.02E-03	6.85E-03	2.24E-02	2.24E-02	4.69E-04	6.02E-04	6.02E-04	1.12E-02	3.52E-02	3.76E-02	0.032	<1	1	1	0.5	<1	<1	<1
	Mn	5.87E+00	1.96E+01	3.78E+01	7.83E-03	8.21E-03	1.43E-02	1.98E+00	2.52E+00	2.88E+00	1.91E+00	2.97E+00	2.97E+00	3.36E-01	3.95E-01	3.95E-01	4.88E-01	6.38E-01	6.93E-01	6.69E-01	8.28E-01	8.28E-01	1.13E+01	2.70E+01	4.55E+01	26	<1	1	2	30	<1	<1	2
	Pb	1.17E+00	2.13E+00	4.56E+00	5.44E-04	5.95E-04	2.21E-03	1.32E-01	1.65E-01	1.69E-01	2.35E-01	4.09E-01	4.09E-01	2.62E-02	3.02E-02	3.02E-02	3.39E-02	4.19E-02	4.31E-02	2.12E-02	2.75E-02	2.75E-02	1.62E+00	2.80E+00	5.24E+00	3.85	<1	<1	1	11	<1	<1	<1
	Se	6.72E-03	9.74E-03	2.22E-02	1.53E-04	2.06E-04	4.41E-04	3.55E-03	4.16E-03	4.95E-03	3.55E-03	6.55E-03	6.55E-03	1.16E-02	1.24E-02	1.24E-02	4.20E-02	5.42E-02	6.09E-02	3.76E-03	4.60E-03	4.60E-03	7.14E-02	9.19E-02	1.12E-01	0.2	<1	<1	<1	0.4	<1	<1	<1
	Ag	3.59E-03	5.10E-03	1.05E-02	2.60E-04	5.52E-04	5.52E-04	1.17E-03	1.36E-03	1.40E-03	5.04E-03	8.31E-03	8.31E-03	2.90E-04	3.83E-04	3.83E-04	1.23E-03	1.64E-03	1.88E-03	4.05E-04	4.60E-04	4.60E-04	1.20E-02	1.78E-02	2.34E-02	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	1.36E-02	1.36E-02	1.36E-02	2.86E-04	1.38E-03	1.38E-03	2.28E-04	3.70E-04	3.46E-04	4.66E-04	7.99E-04	7.99E-04	5.94E-04	6.23E-04	6.23E-04	1.48E-03	1.83E-03	1.83E-03	3.40E-04	6.74E-04	6.74E-04	1.70E-02	1.93E-02	1.92E-02	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	1.20E-01	1.45E-01	2.31E-01	9.20E-04	2.76E-03	2.76E-03	1.30E-02	1.61E-02	1.76E-02	1.98E-02	4.11E-02	4.11E-02	8.56E-03	9.22E-03	9.22E-03	1.00E-02	1.41E-02	1.74E-02	7.46E-04	1.95E-03	1.95E-03	1.73E-01	2.30E-01	3.21E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	3.31E+00	7.14E+00	1.64E+01	5.49E-03	5.92E-03	1.04E-02	1.57E+00	1.95E+00	2.27E+00	1.43E+00	2.38E+00	2.38E+00	7.99E-01	9.10E-01	9.10E-01	3.72E+00	5.51E+00	5.86E+00	3.45E-01	4.34E-01	4.34E-01	1.12E+01	1.83E+01	2.83E+01	130	<1	<1	<1	No TRV	-	-	-
UL&M	Al	3.15E+01	3.68E+01	6.16E+01	3.48E-02	5.78E-02	1.79E-01	9.51E-01	1.21E+00	1.85E+00	1.17E+00	1.96E+00	2.41E+00	7.50E-01	1.06E+00	1.72E+00	9.67E-01	1.49E+00	2.77E+00	7.37E-02	1.46E-01	1.46E-01	3.54E+01	4.27E+01	7.06E+01	124	<1	<1	<1	No TRV	-	-	-
	As	5.90E-01	8.02E-01	1.79E+00	1.40E-03	1.80E-03	3.48E-03	2.29E-02	3.01E-02	4.54E-02	6.67E-02	1.03E-01	1.43E-01	2.07E-02	2.80E-02	3.88E-02	2.05E-02	2.48E-02	2.48E-02	4.08E-03	7.14E-03	7.14E-03	7.27E-01	9.97E-01	2.05E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	2.21E-01	3.49E-01	1.04E+00	3.92E-04	8.12E-04	3.31E-03	6.05E-02	2.54E-01	5.46E-01	1.66E-02	2.85E-02	4.30E-02	1.98E-02	8.74E-02	1.59E-01	5.80E-03	7.17E-03	1.15E-02	1.50E-02	2.20E-02	2.20E-02	3.39E-01	7.48E-01	1.83E+00	1.45	<1	<1	1	20	<1	<1	<1
	Cr	4.47E-02	5.17E-02	8.40E-02	2.25E-04	3.22E-04	6.62E-04	1.56E-03	1.86E-03	2.37E-03	3.83E-03	1.27E-02	1.43E-02	5.29E-03	1.18E-02	1.60E-02	3.20E-02	1.66E-01	2.22E-01	2.16E-03	4.11E-03	4.11E-03	8.98E-02	2.48E-01	3.43E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Hg	1.30E-01	2.94E-01	8.18E-01	4.30E-06	5.52E-05	5.52E-05	1.22E-03	2.97E-03	3.57E-03	4.11E-03	7.79E-03	1.03E-02	2.55E-03	3.66E-03	7.40E-03	9.10E-03	1.16E-02	1.58E-02	4.69E-04	6.02E-04	6.02E-04	1.47E-01	3.21E-01	8.55E-01	0.74	<1	<1	1	1.5	<1	<1	<1
	MeHg	1.30E-01	2.94E-01	8.18E-01	4.30E-06	5.52E-05	5.52E-05	3.30E-04	5.86E-04	5.86E-04	7.96E-05	1.31E-04	1.31E-04	2.55E-03	3.66E-03	7.40E-03	9.10E-03	1.16E-02	1.58E-02	4.69E-04	6.02E-04	6.02E-04	1.42E-01	3.11E-01	8.42E-01	0.032	5	10	26	0.5	<1	<1	2
	Mn	2.10E+00	2.55E+00	7.76E+00	3.96E-02	1.22E-01	2.41E-01	6.60E-01	7.81E-01	8.86E-01	7.36E-01	1.07E+00	1.20E+00	4.95E-01	6.99E-01	1.07E+00	4.27E-01	4.91E-01	5.59E-01	6.69E-01	8.28E-01	8.28E-01	5.13E+00	6.54E+00	1.25E+01	26	<1	<1	<1	30	<1	<1	<1
	Pb	8.04E+00	1.23E+01	3.56E+01	1.03E-02	3.53E-02	8.83E-02	7.96E-01	2.35E+00	5.98E+00	3.65E-01	6.20E-01	8.91E-01	3.50E-01	1.56E+00	2.84E+00	9.09E-02	1.27E-01	2.30E-01	2.12E-02	2.75E-02	2.75E-02	9.67E+00	1.70E+01	4.56E+01	3.85	3	5	12	11	<1	2	4
	Se	1.75E-02	4.35E-02	7.18E-02	1.66E-03	1.93E-03	1.93E-03	3.32E-03	4.05E-03	5.76E-03	5.98E-03	8.28E-03	8.90E-03	1.15E-02	1.38E-02	1.80E-02	2.52E-02	3.10E-02	3.51E-02	3.76E-03	4.60E-03	4.60E-03	6.89E-02	1.07E-01	1.46E-01	0.2	<1	<1	<1	0.4	<1	<1	<1
	Ag	7.28E-02	1.62E-01	3.91E-01	9.29E-05	9.84E-05	1.04E-04	2.45E-03	6.30E-03	7.53E-03	3.63E-03	5.94E-03	7.27E-03	1.20E-03	1.67E-03	2.98E-03	1.63E-03	1.88E-03	2.19E-03	4.05E-04	4.60E-04	4.60E-04	8.22E-02	1.78E-01	4.11E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	4.34E-03	6.04E-03	1.65E-02	1.19E-03	1.38E-03	1.38E-03	2.97E-04	7.14E-04	8.81E-04	5.08E-04	7.28E-04	8.56E-04	2.84E-03	2.84E-03	2.84E-03	2.84E-03	3.26E-03	3.23E-03	3.40E-04	6.74E-04	6.74E-04	1.23E-02	1.56E-02	2.63E-02	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	1.14E-01	1.27E-01	1.83E-01	4.25E-04	5.49E-04	6.18E-04	3.66E-03	4.29E-03	5.74E-03	5.66E-03	1.02E-02	1.58E-02	5.86E-03	7.35E-03	9.98E-03	8.86E-03	1.12E-02	1.47E-02	7.46E-04	1.95E-03	1.95E-03	1.39E-01	1.62E-01	2.32E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	6.18E+00	8.08E+00	2.02E+01	9.96E-03	1.41E-02	3.31E-02	8.78E-01	1.45E+00	3.81E+00	1.20E+00	1.72E+00	2.26E+00	1.77E+00	4.60E+00	7.51E+00	1.72E+00	2.28E+00	3.44E+00	3.45E-01	4.34E-01	4.34E-01	1.21E+01	1.86E+01	3.76E+01	130	<1	<1	<1	No TRV	-	-	-
WD	Al	1.70E+01	2.21E+01	2.45E+01	not measured			1.35E+00	1.35E+00	1.35E+00	7.56E-01	7.56E-01	7.56E-01	1.20E+00	1.20E+00	1.20E+00	not measured			not measured			2.03E+01	2.54E+01	2.78E+01	124	<1	<1	<1	No TRV	-	-	-
	Sb	7.87E-03	1.26E-02	1.61E-02	not measured			3.62E-03	3.62E-03	3.62E-03	7.26E-03	7.26E-03	7.26E-03	3.20E-03	3.20E-03	3.20E-03	not measured			not measured			2.20E-02	2.66E-02	3.02E-02	No TRV	-	-	-	No TRV	-	-	-
	As	1.18E-01	1.81E-01	2.16E-01	6.07E-04	1.10E-03	1.10E-03	1.97E-02	1.97E-02	1.97E-02	4.33E-02	4.33E-02	4.33E-02	1.57E-02	1.57E-02	1.57E-02	not measured			not measured			1.97E-01	2.61E-01	2.95E-01	10	<1	<1	<1	40	<1	<1	<1
	Ba	1.73E-01	1.73E-01	1.73E-01	not measured			2.36E-01	2.36E-01	2.36E-01	2.94E-02	2.94E-02	2.94E-02	5.46E-02	5.46E-02	5.46E-02	not measured			not measured			4.93E-01	4.93E-01	4.93E-01	21	<1	<1	<1	42	<1	<1	<1
	Be	1.73E-02	1.73E-02	1.73E-02	not measured			2.45E-04	2.45E-04	2.45E-04	3.03E-04	3.03E-04	3.03E-04	5.05E-04	5.05E-04	5.05E-04	not measured			not measured			1.84E-02	1.84E-02	1.84E-02	No TRV	-	-	-	No TRV	-	-	-
	Cd	5.48E-02	7.98E-02	9.60E-02	1.66E-04	3.31E-04	3.31E-04	1.83E-02	1.83E-02	1.83E-02	8.30E-03	8.30E-03	8.30E-03	7.91E-03	7.91E-03	7.91E-03	not measured			not measured			8.95E-02	1.15E-01	1.31E-01	1.45	<1	<1	<1	20	<1	<1	<1
	Cr	1.68E-02	2.34E-02	2.43E-02	not measured			4.11E-03	4.11E-03	4.11E-03	2.59E-03	2.59E-03	2.59E-03	1.85E-03	1.85E-03	1.85E-03	not measured			not measured			2.54E-02	3.20E-02	3.28E-02	0.86	<1	<1	<1	4.32	<1	<1	<1
	Co	1.42E-02	1.80E-02	2.08E-02	not measured			1.69E-03	1.69E-03	1.69E-03	2.33E-03	2.33E-03	2.33E-03	1.25E-03	1.25E-03	1.25E-03	not measured			not measured			1.94E-02	2.33E-02	2.61E-02	4.1	<1	<1	<1	41	<1	<1	<1
	Cu	2.38E-01	3.45E-01	4.21E-01	5.79E-04	1.10E-03	1.10E-03	1.46E-01	1.46E-01	1.46E-01	1.08E-01	1.08E-01	1.08E-01	4.53E-02	4.53E-02	4.53E-02	not measured			not measured			5.38E-01	6.45E-01	7.21E-01	5.68	<1	<1	<1	10.9	<1	<1	<1
	Fe	2.97E+01	3.74E+01	4.05E+01	3.03E-02	3.31E-02	3.31E-02	2.19E+00	2.19E+00	2.19E+00	2.92E+00	2.92E+00	2.92E+00	2.78E+00	2.78E+00	2.78E+00	not measured			not measured			3.76E+01	4.53E+01	4.85E+01	No TRV	-	-	-	No TRV	-	-	-
	Hg	9.97E-02	4.16E-01	4.16E-01	5.52E-07	5.52E-07	5.52E-07	1.24E-03	1.24E-03	1.24E-03	1.24E-03	1.24E-03	1.24E-03	1.45E-03	1.45E-03	1.45E-03	not measured			not measured			1.04E-01	4.20E-01	4.20E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	9.97E-02	4.16E-01	4.16E-01	5.52E-07	5.52E-07	5.52E-07	3.12E-04	3.12E-04	3.12E-04	4.08E-05	4.08E-05	4.08E-05	1.45E-03	1.45E-03	1.45E-03	not measured			not measured			1.01E-01	4.18E-01	4.18E-01	0.032	3	13	13	0.5	<1	<1	<1
	Mn	2.58E+00	2.85E+00	2.91E+00	6.07E-03	6.62E-03	6.62E-03	1.54E+00	1.54E+00	1.54E+00	8.41E-01	8.41E-01	8.41E-01	1.18E+00	1.18E+00	1.18E+00	not measured			not measured			6.14E+00	6.41E+00	6.47E+00	26	<1	<1	<1	30	<1	<1	<1
	Ni	1.73E-02	1.74E-02	1.74E-02	not measured			2.54E-03	2.54E-03	2.54E-03	2.42E-03	2.42E-03	2.42E-03	1.52E-03	1.52E-03	1.52E-03	not measured			not measured			2.38E-02	2.39E-02	2.39E-02	31	<1	<1	<1	135	<1	<1	<1
	Pb	2.08E+00	3.36E+00	4.40E+00	2.95E-03	6.62E-03	6.62E-03	2.60E-01	2.60E-01	2.60E-01	3.90E-01	3.90E-01	3.90E-01	3.37E-01	3.37E-01	3.37E-01	not measured			not measured			3.07E+00	4.36E+00	5.39E+00	3.85	<1	1	2	11	<1	<1	<1
	Se	2.46E-03	3.55E-03	4.37E-03	not measured			2.84E-03	2.84E-03	2.84E-03	2.94E-03	2.94E-03	2.94E-03	4.55E-03	4.55E-03	4.55E-03	not measured			not measured			1.28E-02	1.39E-02	1.47E-02	0.2	<1	<1	<1	0.4	<1	<1	<1
	Ag	1.53E-02	2.38E-02	3.03E-02	not measured			1.88E-03	1.88E-03	1.88E-03	1.38E-03	1.38E-03	1.38E-03	1.43E-03	1.43E-03	1.43E-03	not measured			not measured			2.00E-02	2.85E-02	3.50E-02	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	3.86E-03	4.94E-03	5.46E-03	not measured			2.45E-04	2.45E-04	2.45E-04	2.59E-04	2.59E-04	2.59E-04	3.37E-04	3.37E-04	3.37E-04	not measured			not measured			4.70E-03	5.78E-03	6.30E-03	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	5.97E-02	8.05E-02	8.66E-02	not measured			5.77E-03	5.77E-03	5.77E-03	4.84E-03	4.84E-03	4.84E-03	6.90E-03	6.90E-03	6.90E-03	not measured			not measured			7.72E-02	9.80E-02	1.04E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	1.65E+00	1.95E+00	2.02E+00	5.52E-03	1.10E-02	1.10E-02	5.21E-01	5.21E-01	5.21E-01	9.60E-01	9.60E-01	9.60E-01	1.01E+00	1.01E+00	1.01E+00	not measured			not measured			4.15E+00	4.45E+00	4.52E+00	130	<1	<1	<1	No TRV	-	-	-

Table E-20. Risk Assessment Results for Avian Carnivores/Piscivores (Belted Kingfisher)

		Dose: Sediment Ingestion (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Dose: Benthic Inverts (mg/kg-d_{ww})			Dose: Other Aq. Inverts (mg/kg-d_{ww})			Dose: Forage Fish (mg/kg-d_{ww})			Dose: Piscivorous Fish (mg/kg-d_{ww})			Dose: Amphibians (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max
LL	Al	2.75E+01	3.72E+01	5.35E+01	7.38E-03	1.10E-02	1.10E-02	1.32E+00	2.50E+00	3.22E+00	1.85E+01	4.31E+01	4.31E+01	2.96E+00	8.27E+00	8.27E+00	not measured			not measured			5.04E+01	9.10E+01	1.08E+02	124	<1	<1	<1	No TRV	-	-	-
	As	4.56E+00	1.23E+01	1.25E+01	1.76E-02	2.48E-02	2.68E-02	9.04E-02	1.66E-01	2.07E-01	3.87E+00	7.39E+00	7.39E+00	1.61E-01	3.89E-01	3.89E-01	not measured			not measured			8.70E+00	2.03E+01	2.05E+01	10	<1	2	2	40	<1	<1	<1
	Cd	2.81E+00	1.10E+01	1.10E+01	1.10E-03	1.46E-03	4.41E-03	7.35E-02	1.05E-01	1.13E-01	7.32E-01	1.11E+00	1.11E+00	1.23E-01	3.43E-01	3.43E-01	not measured			not measured			3.74E+00	1.26E+01	1.26E+01	1.45	3	9	9	20	<1	<1	<1
	Cr	5.24E-02	7.99E-02	9.10E-02	9.06E-05	1.10E-04	1.10E-04	3.11E-03	4.86E-03	5.62E-03	4.12E-02	8.94E-02	8.94E-02	6.10E-03	1.05E-02	1.05E-02	not measured			not measured			1.03E-01	1.85E-01	1.97E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	4.20E+00	6.13E+00	1.07E+01	3.23E-03	3.91E-03	7.72E-03	2.14E-01	3.35E-01	3.68E-01	3.70E+00	5.48E+00	5.48E+00	2.59E-01	5.96E-01	5.96E-01	not measured			not measured			8.37E+00	1.25E+01	1.72E+01	5.68	2	2	3	10.9	<1	1	2
	Hg	1.01E-01	1.56E-01	2.20E-01	4.14E-06	5.52E-06	5.52E-06	2.93E-03	8.92E-03	8.34E-03	2.61E-02	4.22E-02	4.22E-02	3.66E-03	8.82E-03	8.82E-03	not measured			not measured			1.34E-01	2.16E-01	2.79E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	1.01E-01	1.56E-01	2.20E-01	4.14E-06	5.52E-06	5.52E-06	8.08E-04	9.56E-04	9.56E-04	7.40E-05	7.40E-05	7.40E-05	3.66E-03	8.82E-03	8.82E-03	not measured			not measured			1.05E-01	1.66E-01	2.29E-01	0.032	3	5	7	0.5	<1	<1	<1
	Mn	3.01E+00	4.11E+00	5.64E+00	2.64E-02	3.17E-02	5.52E-02	9.10E-01	1.55E+00	1.70E+00	1.68E+01	2.50E+01	2.50E+01	1.07E+00	2.21E+00	2.21E+00	not measured			not measured			2.19E+01	3.29E+01	3.46E+01	26	<1	1	1	30	<1	1	1
	Pb	2.06E+01	3.54E+01	5.93E+01	7.66E-03	9.37E-03	1.96E-02	4.95E-01	8.50E-01	9.13E-01	8.22E+00	1.49E+01	1.49E+01	1.19E+00	3.45E+00	3.45E+00	not measured			not measured			3.05E+01	5.46E+01	7.86E+01	3.85	8	14	21	11	3	5	7
	Se	5.28E-01	1.78E+00	1.78E+00	4.28E-03	5.15E-03	5.97E-03	4.22E-02	6.24E-02	6.82E-02	9.69E-02	1.16E-01	1.16E-01	1.44E-01	1.97E-01	1.97E-01	not measured			not measured			8.16E-01	2.16E+00	2.17E+00	0.2	4	11	11	0.4	2	5	6
	Ag	2.04E-01	3.54E-01	5.81E-01	1.66E-04	2.32E-04	2.32E-04	5.33E-03	8.71E-03	1.05E-02	8.37E-02	1.44E-01	1.44E-01	6.51E-03	1.77E-02	1.77E-02	not measured			not measured			3.00E-01	5.24E-01	7.53E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	1.93E+00	8.16E+00	8.16E+00	5.89E-03	7.72E-03	8.50E-03	1.10E-02	1.72E-02	1.67E-02	2.27E-01	3.46E-01	3.46E-01	6.45E-02	7.75E-02	7.75E-02	not measured			not measured			2.24E+00	8.60E+00	8.60E+00	0.237	10	36	36	23.7	<1	<1	<1
	V	1.38E-01	2.58E-01	2.64E-01	1.50E-03	2.76E-03	2.76E-03	5.53E-03	9.41E-03	1.08E-02	1.29E-01	2.82E-01	2.82E-01	1.06E-02	2.53E-02	2.53E-02	not measured			not measured			2.85E-01	5.78E-01	5.85E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	1.27E+01	1.93E+01	2.85E+01	7.66E-03	9.91E-03	2.21E-02	8.25E-01	1.15E+00	1.30E+00	7.26E+00	1.37E+01	1.37E+01	1.84E+00	2.61E+00	2.61E+00	not measured			not measured			2.26E+01	3.68E+01	4.61E+01	130	<1	<1	<1	No TRV	-	-	-

Belted Kingfisher Exposure Factors:

Body weight = 0.15 kg
Food ingestion rate (wet weight) = 0.0853 kg/d
Water ingestion rate = 0.0166 L/d
Sediment ingestion rate (wet weight) = 0.0009 kg/d
Area use factor = 1

Diet Composition:

Benthic Invertebrates = 10%
Other Aquatic Invertebrates = 10%
Forage Fish = 20%
Piscivorous Fish = 50%
Amphibians = 10%
Sediment Ingestion (% of total diet) = 1%

Notes:

HQ> 1.0

Table E-21. Risk Assessment Results for Avian Benthivores (Sandpiper)

		Dose: Sediment Ingestion (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Dose: Benthic Inverts (mg/kg-d$_{ww}$)			Dose: Other Aq. Inverts (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max	LOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max
PPC	Al	3.88E+02	5.47E+02	8.55E+02	2.18E-02	2.52E-02	4.71E-02	1.90E+01	2.26E+01	2.67E+01	8.65E+00	1.25E+01	1.25E+01	4.16E+02	5.82E+02	8.94E+02	124	3	5	7	No TRV	-	-	-
	As	4.61E+00	8.68E+00	2.12E+01	1.03E-03	1.15E-03	6.28E-03	4.45E-01	6.61E-01	8.01E-01	2.27E-01	3.28E-01	3.28E-01	5.29E+00	9.67E+00	2.23E+01	10	<1	<1	2	40	<1	<1	<1
	Cd	5.81E-01	1.27E+00	3.11E+00	3.50E-05	4.60E-05	5.65E-05	7.57E-02	9.42E-02	1.06E-01	5.71E-02	1.11E-01	1.11E-01	7.13E-01	1.47E+00	3.33E+00	1.45	<1	1	2	20	<1	<1	<1
	Cr	7.95E-01	1.02E+00	1.79E+00	2.65E-04	7.85E-04	7.85E-04	3.79E-02	4.95E-02	6.16E-02	2.06E-02	4.04E-02	4.04E-02	8.54E-01	1.11E+00	1.90E+00	0.86	<1	1	2	4.32	<1	<1	<1
	Cu	7.36E+00	2.19E+01	4.06E+01	4.83E-04	5.24E-04	1.10E-03	9.21E-01	1.08E+00	1.16E+00	2.09E+00	4.07E+00	4.07E+00	1.04E+01	2.71E+01	4.58E+01	5.68	2	5	8	10.9	<1	3	4
	Hg	5.46E-02	2.13E-01	2.62E-01	2.32E-04	4.71E-04	4.71E-04	3.22E-03	4.42E-03	5.59E-03	2.78E-03	4.23E-03	4.23E-03	6.09E-02	2.22E-01	2.73E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	5.46E-02	2.13E-01	2.62E-01	2.32E-04	4.71E-04	4.71E-04	1.20E-03	1.82E-03	1.82E-03	2.72E-04	2.88E-04	2.88E-04	5.64E-02	2.16E-01	2.65E-01	0.032	2	7	8	0.5	<1	<1	<1
	Mn	1.19E+02	3.97E+02	7.64E+02	1.11E-02	1.17E-02	2.04E-02	1.67E+01	2.12E+01	2.42E+01	5.37E+00	8.36E+00	8.36E+00	1.41E+02	4.26E+02	7.97E+02	26	6	16	31	30	5	14	27
	Pb	2.37E+01	4.31E+01	9.22E+01	7.74E-04	8.47E-04	3.14E-03	1.11E+00	1.39E+00	1.42E+00	6.61E-01	1.15E+00	1.15E+00	2.54E+01	4.56E+01	9.48E+01	3.85	7	12	25	11	2	4	9
	Se	1.36E-01	1.97E-01	4.48E-01	2.17E-04	2.93E-04	6.28E-04	2.99E-02	3.51E-02	4.17E-02	9.96E-03	1.84E-02	1.84E-02	1.76E-01	2.51E-01	5.09E-01	0.2	<1	1	3	0.4	<1	<1	1
	Ag	7.27E-02	1.03E-01	2.12E-01	3.69E-04	7.85E-04	7.85E-04	9.85E-03	1.15E-02	1.18E-02	1.42E-02	2.34E-02	2.34E-02	9.71E-02	1.39E-01	2.47E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	2.75E-01	2.75E-01	2.75E-01	4.07E-04	1.96E-03	1.96E-03	1.93E-03	3.12E-03	2.92E-03	1.31E-03	2.25E-03	2.25E-03	2.79E-01	2.82E-01	2.82E-01	0.237	1	1	1	23.7	<1	<1	<1
	V	2.42E+00	2.93E+00	4.67E+00	1.31E-03	3.92E-03	3.92E-03	1.10E-01	1.36E-01	1.49E-01	5.57E-02	1.15E-01	1.15E-01	2.59E+00	3.19E+00	4.94E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	6.70E+01	1.45E+02	3.33E+02	7.80E-03	8.43E-03	1.49E-02	1.32E+01	1.64E+01	1.92E+01	4.01E+00	6.69E+00	6.69E+00	8.42E+01	1.68E+02	3.58E+02	130	<1	1	3	No TRV	-	-	-
UL&M	Al	6.37E+02	7.44E+02	1.25E+03	4.94E-02	8.23E-02	2.54E-01	8.02E+00	1.02E+01	1.56E+01	3.30E+00	5.51E+00	6.76E+00	6.48E+02	7.60E+02	1.27E+03	124	5	6	10	No TRV	-	-	-
	As	1.19E+01	1.62E+01	3.62E+01	1.99E-03	2.56E-03	4.94E-03	1.93E-01	2.54E-01	3.83E-01	1.88E-01	2.89E-01	4.01E-01	1.23E+01	1.68E+01	3.70E+01	10	1	2	4	40	<1	<1	<1
	Cd	4.48E+00	7.05E+00	2.10E+01	5.57E-04	1.15E-03	4.71E-03	5.10E-01	2.14E+00	4.60E+00	4.66E-02	8.01E-02	1.21E-01	5.04E+00	9.28E+00	2.58E+01	1.45	4	6	18	20	<1	<1	1
	Cr	9.05E-01	1.05E+00	1.70E+00	3.20E-04	4.58E-04	9.42E-04	1.32E-02	1.57E-02	1.99E-02	1.08E-02	3.57E-02	4.03E-02	9.29E-01	1.10E+00	1.76E+00	0.86	1	1	2	4.32	<1	<1	<1
	Cu	3.10E+01	4.47E+01	1.43E+02	1.82E-03	3.38E-03	4.35E-03	5.26E+00	1.92E+01	3.81E+01	6.99E-01	1.12E+00	1.58E+00	3.70E+01	6.51E+01	1.82E+02	5.68	7	12	32	10.9	3	6	17
	Hg	2.63E+00	5.96E+00	1.65E+01	6.12E-06	7.85E-05	7.85E-05	1.03E-02	2.51E-02	3.01E-02	1.16E-02	2.19E-02	2.89E-02	2.65E+00	6.00E+00	1.66E+01	0.74	4	8	23	1.5	2	4	11
	MeHg	2.63E+00	5.96E+00	1.65E+01	6.12E-06	7.85E-05	7.85E-05	2.78E-03	4.94E-03	4.94E-03	2.24E-04	3.68E-04	3.68E-04	2.63E+00	5.96E+00	1.66E+01	0.032	82	186	517	0.5	5	12	33
	Mn	4.26E+01	5.17E+01	1.57E+02	5.63E-02	1.73E-01	3.42E-01	5.56E+00	6.58E+00	7.47E+00	2.07E+00	3.00E+00	3.36E+00	5.03E+01	6.15E+01	1.68E+02	26	2	2	7	30	2	2	6
	Pb	1.63E+02	2.48E+02	7.20E+02	1.47E-02	5.02E-02	1.26E-01	6.71E+00	1.98E+01	5.04E+01	1.02E+00	1.74E+00	2.50E+00	1.70E+02	2.70E+02	7.73E+02	3.85	44	70	201	11	16	25	70
	Se	3.54E-01	8.80E-01	1.45E+00	2.37E-03	2.75E-03	2.75E-03	2.80E-02	3.42E-02	4.86E-02	1.68E-02	2.33E-02	2.50E-02	4.02E-01	9.40E-01	1.53E+00	0.2	2	5	8	0.4	1	2	4
	Ag	1.47E+00	3.28E+00	7.91E+00	1.32E-04	1.40E-04	1.48E-04	2.07E-02	5.31E-02	6.35E-02	1.02E-02	1.67E-02	2.04E-02	1.50E+00	3.35E+00	7.99E+00	6.8	<1	<1	1	21	<1	<1	<1
	Tl	8.78E-02	1.22E-01	3.33E-01	1.69E-03	1.96E-03	1.96E-03	2.50E-03	6.02E-03	7.43E-03	1.43E-03	2.05E-03	2.40E-03	9.34E-02	1.32E-01	3.45E-01	0.237	<1	<1	2	23.7	<1	<1	<1
	V	2.30E+00	2.56E+00	3.70E+00	6.04E-04	7.80E-04	8.79E-04	3.09E-02	3.62E-02	4.84E-02	1.59E-02	2.85E-02	4.43E-02	2.35E+00	2.63E+00	3.79E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	1.25E+02	1.63E+02	4.08E+02	1.42E-02	2.01E-02	4.71E-02	7.41E+00	1.22E+01	3.21E+01	3.38E+00	4.83E+00	6.35E+00	1.36E+02	1.81E+02	4.46E+02	130	1	1	4	No TRV	-	-	-
WD	Al	3.45E+02	4.47E+02	4.96E+02	not measured			1.14E+01	1.14E+01	1.14E+01	2.12E+00	2.12E+00	2.12E+00	3.58E+02	4.60E+02	5.09E+02	124	3	4	4	No TRV	-	-	-
	Sb	1.59E-01	2.54E-01	3.26E-01	not measured			3.05E-02	3.05E-02	3.05E-02	2.04E-02	2.04E-02	2.04E-02	2.10E-01	3.05E-01	3.77E-01	No TRV	-	-	-	No TRV	-	-	-
	As	2.39E+00	3.66E+00	4.37E+00	8.63E-04	1.57E-03	1.57E-03	1.66E-01	1.66E-01	1.66E-01	1.22E-01	1.22E-01	1.22E-01	2.68E+00	3.95E+00	4.65E+00	10	<1	<1	<1	40	<1	<1	<1
	Ba	3.51E+00	3.51E+00	3.51E+00	not measured			1.99E+00	1.99E+00	1.99E+00	8.26E-02	8.26E-02	8.26E-02	5.58E+00	5.58E+00	5.58E+00	21	<1	<1	<1	42	<1	<1	<1
	Be	3.51E-01	3.51E-01	3.51E-01	not measured			2.06E-03	2.06E-03	2.06E-03	8.51E-04	8.51E-04	8.51E-04	3.53E-01	3.53E-01	3.53E-01	No TRV	-	-	-	No TRV	-	-	-
	Cd	1.11E+00	1.61E+00	1.94E+00	2.35E-04	4.71E-04	4.71E-04	1.54E-01	1.54E-01	1.54E-01	2.33E-02	2.33E-02	2.33E-02	1.29E+00	1.79E+00	2.12E+00	1.45	<1	1	2	20	<1	<1	<1
	Cr	3.41E-01	4.74E-01	4.91E-01	not measured			3.47E-02	3.47E-02	3.47E-02	7.29E-03	7.29E-03	7.29E-03	3.83E-01	5.16E-01	5.33E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Co	2.87E-01	3.65E-01	4.21E-01	not measured			1.43E-02	1.43E-02	1.43E-02	6.54E-03	6.54E-03	6.54E-03	3.07E-01	3.86E-01	4.41E-01	4.1	<1	<1	<1	41	<1	<1	<1
	Cu	4.82E+00	6.98E+00	8.51E+00	8.24E-04	1.57E-03	1.57E-03	1.23E+00	1.23E+00	1.23E+00	3.04E-01	3.04E-01	3.04E-01	6.36E+00	8.51E+00	1.00E+01	5.68	1	2	2	10.9	<1	<1	<1
	Fe	6.01E+02	7.56E+02	8.20E+02	4.32E-02	4.71E-02	4.71E-02	1.85E+01	1.85E+01	1.85E+01	8.21E+00	8.21E+00	8.21E+00	6.28E+02	7.83E+02	8.47E+02	No TRV	-	-	-	No TRV	-	-	-
	Hg	2.02E+00	8.41E+00	8.41E+00	7.85E-07	7.85E-07	7.85E-07	1.05E-02	1.05E-02	1.05E-02	3.48E-03	3.48E-03	3.48E-03	2.03E+00	8.43E+00	8.43E+00	0.74	3	11	11	1.5	1	6	6
	MeHg	2.02E+00	8.41E+00	8.41E+00	7.85E-07	7.85E-07	7.85E-07	2.63E-03	2.63E-03	2.63E-03	1.15E-04	1.15E-04	1.15E-04	2.02E+00	8.42E+00	8.42E+00	0.032	63	263	263	0.5	4	17	17
	Mn	5.23E+01	5.76E+01	5.88E+01	8.63E-03	9.42E-03	9.42E-03	1.30E+01	1.30E+01	1.30E+01	2.36E+00	2.36E+00	2.36E+00	6.76E+01	7.30E+01	7.41E+01	26	3	3	3	30	2	3	3
	Ni	3.51E-01	3.52E-01	3.52E-01	not measured			2.15E-02	2.15E-02	2.15E-02	6.80E-03	6.80E-03	6.80E-03	3.79E-01	3.80E-01	3.81E-01	31	<1	<1	<1	135	<1	<1	<1
	Pb	4.20E+01	6.81E+01	8.90E+01	4.20E-03	9.42E-03	9.42E-03	2.19E+00	2.19E+00	2.19E+00	1.10E+00	1.10E+00	1.10E+00	4.53E+01	7.14E+01	9.23E+01	3.85	12	19	24	11	4	7	8
	Se	4.99E-02	7.18E-02	8.84E-02	not measured			2.39E-02	2.39E-02	2.39E-02	8.26E-03	8.26E-03	8.26E-03	8.20E-02	1.04E-01	1.21E-01	0.2	<1	<1	<1	0.4	<1	<1	<1
	Ag	3.11E-01	4.82E-01	6.13E-01	not measured			1.58E-02	1.58E-02	1.58E-02	3.89E-03	3.89E-03	3.89E-03	3.30E-01	5.02E-01	6.33E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	7.82E-02	1.00E-01	1.11E-01	not measured			2.06E-03	2.06E-03	2.06E-03	7.29E-04	7.29E-04	7.29E-04	8.10E-02	1.03E-01	1.13E-01	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	1.21E+00	1.63E+00	1.75E+00	not measured			4.87E-02	4.87E-02	4.87E-02	1.36E-02	1.36E-02	1.36E-02	1.27E+00	1.69E+00	1.81E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	3.35E+01	3.95E+01	4.09E+01	7.85E-03	1.57E-02	1.57E-02	4.39E+00	4.39E+00	4.39E+00	2.70E+00	2.70E+00	2.70E+00	4.06E+01	4.66E+01	4.80E+01	130	<1	<1	<1	No TRV	-	-	-
LL	Al	5.57E+02	7.52E+02	1.08E+03	1.05E-02	1.57E-02	1.57E-02	1.11E+01	2.11E+01	2.72E+01	5.21E+01	1.21E+02	1.21E+02	6.21E+02	8.94E+02	1.23E+03	124	5	7	10	No TRV	-	-	-
	As	9.23E+01	2.49E+02	2.53E+02	2.50E-02	3.53E-02	3.81E-02	7.62E-01	1.40E+00	1.75E+00	1.09E+01	2.08E+01	2.08E+01	1.04E+02	2.71E+02	2.75E+02	10	11	27	28	40	3	7	7
	Cd	5.69E+01	2.23E+02	2.23E+02	1.56E-03	2.07E-03	6.28E-03	6.20E-01	8.82E-01	9.49E-01	2.06E+00	3.13E+00	3.13E+00	5.95E+01	2.27E+02	2.27E+02	1.45	41	157	157	20	3	11	11
	Cr	1.06E+00	1.62E+00	1.84E+00	1.29E-04	1.57E-04	1.57E-04	2.62E-02	4.10E-02	4.74E-02	1.16E-01	2.51E-01	2.51E-01	1.20E+00	1.91E+00	2.14E+00	0.86	1	2	3	4.32	<1	<1	<1
	Cu	8.50E+01	1.24E+02	2.17E+02	4.59E-03	5.55E-03	1.10E-02	1.80E+00	2.82E+00	3.10E+00	1.04E+01	1.54E+01	1.54E+01	9.72E+01	1.42E+02	2.35E+02	5.68	17	25	42	10.9	9	13	22
	Hg	2.04E+00	3.16E+00	4.44E+00	5.88E-06	7.85E-06	7.85E-06	2.47E-02	7.52E-02	7.03E-02	7.32E-02	1.19E-01	1.19E-01	2.14E+00	3.36E+00	4.63E+00	0.74	3	5	6	1.5	2	2	3

Table E-21. Risk Assessment Results for Avian Benthivores (Sandpiper)

		Dose: Sediment Ingestion (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Dose: Benthic Inverts (mg/kg-d$_{ww}$)			Dose: Other Aq. Inverts (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max	LOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max
	MeHg	2.04E+00	3.16E+00	4.44E+00	5.88E-06	7.85E-06	7.85E-06	6.81E-03	8.06E-03	8.06E-03	2.08E-04	2.08E-04	2.08E-04	2.05E+00	3.17E+00	4.45E+00	0.032	64	99	139	0.5	4	6	9
	Mn	6.09E+01	8.32E+01	1.14E+02	3.75E-02	4.51E-02	7.85E-02	7.67E+00	1.30E+01	1.43E+01	4.73E+01	7.03E+01	7.03E+01	1.16E+02	1.67E+02	1.99E+02	26	5	7	8	30	4	6	7
	Pb	4.17E+02	7.17E+02	1.20E+03	1.09E-02	1.33E-02	2.79E-02	4.17E+00	7.16E+00	7.70E+00	2.31E+01	4.18E+01	4.18E+01	4.44E+02	7.66E+02	1.25E+03	3.85	116	199	325	11	41	70	114
	Se	1.07E+01	3.60E+01	3.60E+01	6.09E-03	7.33E-03	8.49E-03	3.56E-01	5.26E-01	5.75E-01	2.72E-01	3.25E-01	3.25E-01	1.13E+01	3.69E+01	3.69E+01	0.2	57	184	185	0.4	28	92	92
	Ag	4.13E+00	7.17E+00	1.18E+01	2.35E-04	3.30E-04	3.30E-04	4.49E-02	7.35E-02	8.89E-02	2.35E-01	4.03E-01	4.03E-01	4.41E+00	7.64E+00	1.22E+01	6.8	<1	1	2	21	<1	<1	<1
	Tl	3.90E+01	1.65E+02	1.65E+02	8.38E-03	1.10E-02	1.21E-02	9.25E-02	1.45E-01	1.41E-01	6.37E-01	9.73E-01	9.73E-01	3.97E+01	1.66E+02	1.66E+02	0.237	168	701	701	23.7	2	7	7
	V	2.79E+00	5.22E+00	5.34E+00	2.13E-03	3.92E-03	3.92E-03	4.66E-02	7.93E-02	9.13E-02	3.63E-01	7.93E-01	7.93E-01	3.21E+00	6.10E+00	6.23E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	2.56E+02	3.91E+02	5.78E+02	1.09E-02	1.41E-02	3.14E-02	6.95E+00	9.68E+00	1.09E+01	2.04E+01	3.84E+01	3.84E+01	2.83E+02	4.39E+02	6.27E+02	130	2	3	5	No TRV	-	-	-

Sandpiper Exposure Factors:

Body weight = 0.0516 kg
Food ingestion rate (wet weight) = 0.0330 kg/d
Water ingestion rate = 0.0081 L/d
Sediment ingestion rate (wet weight) = 0.0059 kg/d
Area use factor = 1

Diet Composition:

Benthic Invertebrates = 75%
Other Aquatic Invertebrates = 25%
Forage Fish = 0%
Piscivorous Fish = 0%
Amphibians = 0%
Sediment Ingestion (% of total diet) = 18%

Notes:

HQ> 1.0

Table E-22. Risk Assessment Results for Mammalian Piscivores (Mink)

		Dose: Sediment Ingestion (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Dose: Other Aq. Inverts (mg/kg-d_{ww})			Dose: Forage Fish (mg/kg-d_{ww})			Dose: Piscivorous Fish (mg/kg-d_{ww})			Dose: Amphibians (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max
PPC	Al	5.69E+01	8.03E+01	1.25E+02	1.46E-02	1.69E-02	3.15E-02	9.72E-01	1.40E+00	1.40E+00	1.40E-01	1.54E-01	1.54E-01	1.50E-01	2.43E-01	2.80E-01	4.66E-02	9.21E-02	9.21E-02	5.83E+01	8.22E+01	1.27E+02	1.93	30	43	66	19.3	3	4	7
	Sb	1.90E-02	2.78E-02	5.59E-02	6.92E-04	3.15E-03	3.15E-03	9.72E-04	1.52E-03	1.52E-03	4.94E-04	7.12E-04	7.12E-04	2.34E-03	2.34E-03	2.34E-03	7.23E-04	8.66E-04	8.66E-04	2.42E-02	3.63E-02	6.45E-02	0.07	<1	<1	<1	0.72	<1	<1	<1
	As	6.77E-01	1.27E+00	3.10E+00	6.92E-04	7.71E-04	4.20E-03	2.55E-02	3.69E-02	3.69E-02	5.23E-03	5.91E-03	5.91E-03	1.02E-02	1.32E-02	1.34E-02	2.58E-03	4.51E-03	4.51E-03	7.21E-01	1.33E+00	3.17E+00	0.75	<1	2	4	3	<1	<1	1
	Be	1.38E-02	1.74E-02	1.74E-02	4.82E-03	5.25E-03	5.25E-03	1.19E-04	2.02E-04	2.02E-04	1.88E-04	1.97E-04	1.97E-04	9.12E-03	9.12E-03	9.12E-03	1.87E-04	2.46E-04	2.46E-04	2.82E-02	3.24E-02	3.24E-02	0.66	<1	<1	<1	No TRV	-	-	-
	Cd	8.52E-02	1.86E-01	4.57E-01	2.34E-05	3.08E-05	3.78E-05	6.41E-03	1.25E-02	1.25E-02	7.24E-04	7.51E-04	7.51E-04	4.77E-03	6.87E-03	7.65E-03	9.46E-03	1.39E-02	1.39E-02	1.07E-01	2.20E-01	4.92E-01	1	<1	<1	<1	10	<1	<1	<1
	Cr	1.17E-01	1.50E-01	2.63E-01	1.77E-04	5.25E-04	5.25E-04	2.32E-03	4.55E-03	4.55E-03	1.25E-03	1.97E-03	1.97E-03	1.97E-03	2.44E-03	2.44E-03	1.37E-03	2.60E-03	2.60E-03	1.24E-01	1.62E-01	2.75E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	1.08E+00	3.22E+00	5.96E+00	3.24E-04	3.51E-04	7.36E-04	2.35E-01	4.57E-01	4.57E-01	6.85E-03	7.24E-03	7.24E-03	5.90E-02	8.04E-02	9.14E-02	3.31E-02	4.33E-02	4.33E-02	1.41E+00	3.80E+00	6.56E+00	11.7	<1	<1	<1	15.1	<1	<1	<1
	Hg	8.02E-03	3.13E-02	3.85E-02	1.55E-04	3.15E-04	3.15E-04	3.13E-04	4.76E-04	4.76E-04	2.36E-04	3.21E-04	3.21E-04	2.16E-03	7.07E-03	7.07E-03	2.96E-04	3.80E-04	3.80E-04	1.12E-02	3.98E-02	4.71E-02	1	<1	<1	<1	18.8	<1	<1	<1
	MeHg	8.02E-03	3.13E-02	3.85E-02	1.55E-04	3.15E-04	3.15E-04	3.06E-05	3.24E-05	3.24E-05	2.36E-04	3.21E-04	3.21E-04	2.16E-03	7.07E-03	7.07E-03	2.96E-04	3.80E-04	3.80E-04	1.09E-02	3.94E-02	4.66E-02	0.032	<1	1	2	0.16	<1	<1	<1
	Mn	1.74E+01	5.82E+01	1.12E+02	7.45E-03	7.82E-03	1.37E-02	6.03E-01	9.39E-01	9.39E-01	1.06E-01	1.25E-01	1.25E-01	1.54E-01	2.02E-01	2.19E-01	4.23E-01	5.24E-01	5.24E-01	1.87E+01	6.00E+01	1.14E+02	88	<1	<1	1	280	<1	<1	<1
	Pb	3.47E+00	6.33E+00	1.35E+01	5.19E-04	5.67E-04	2.10E-03	7.43E-02	1.29E-01	1.29E-01	8.29E-03	9.54E-03	9.54E-03	1.07E-02	1.32E-02	1.36E-02	1.34E-02	1.74E-02	1.74E-02	3.58E+00	6.50E+00	1.37E+01	11	<1	<1	1	90	<1	<1	<1
	Se	2.00E-02	2.89E-02	6.58E-02	1.46E-04	1.97E-04	4.20E-04	1.12E-03	2.07E-03	2.07E-03	3.67E-03	3.91E-03	3.91E-03	1.33E-02	1.71E-02	1.92E-02	2.38E-03	2.91E-03	2.91E-03	4.06E-02	5.52E-02	9.44E-02	0.2	<1	<1	<1	0.33	<1	<1	<1
	Ag	1.07E-02	1.51E-02	3.10E-02	2.47E-04	5.25E-04	5.25E-04	1.59E-03	2.63E-03	2.63E-03	9.16E-05	1.21E-04	1.21E-04	3.89E-04	5.18E-04	5.94E-04	2.56E-04	2.91E-04	2.91E-04	1.32E-02	1.92E-02	3.52E-02	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	4.04E-02	4.04E-02	4.04E-02	2.73E-04	1.31E-03	1.31E-03	1.47E-04	2.53E-04	2.53E-04	1.88E-04	1.97E-04	1.97E-04	4.67E-04	5.80E-04	5.80E-04	2.15E-04	4.26E-04	4.26E-04	4.16E-02	4.31E-02	4.31E-02	0.074	<1	<1	<1	0.74	<1	<1	<1
	V	3.55E-01	4.30E-01	6.85E-01	8.76E-04	2.63E-03	2.63E-03	6.26E-03	1.30E-02	1.30E-02	2.71E-03	2.91E-03	2.91E-03	3.17E-03	4.47E-03	5.48E-03	4.71E-04	1.23E-03	1.23E-03	3.69E-01	4.54E-01	7.11E-01	0.209	2	2	4	2.09	<1	<1	<1
	Zn	9.83E+00	2.12E+01	4.88E+01	5.23E-03	5.64E-03	9.95E-03	4.50E-01	7.53E-01	7.53E-01	2.53E-01	2.88E-01	2.88E-01	1.17E+00	1.74E+00	1.85E+00	2.18E-01	2.74E-01	2.74E-01	1.19E+01	2.43E+01	5.20E+01	160	<1	<1	<1	320	<1	<1	<1
UL&M	Al	9.34E+01	1.09E+02	1.83E+02	3.31E-02	5.51E-02	1.70E-01	3.71E-01	6.20E-01	7.60E-01	2.37E-01	3.34E-01	5.42E-01	3.06E-01	4.72E-01	8.76E-01	4.66E-02	9.21E-02	9.21E-02	9.44E+01	1.11E+02	1.85E+02	1.93	49	57	96	19.3	5	6	10
	Sb	1.95E-01	3.19E-01	1.02E+00	2.73E-03	3.15E-03	3.15E-03	1.95E-03	3.19E-03	4.12E-03	6.29E-04	8.11E-04	1.15E-03	1.65E-03	2.10E-03	2.38E-03	7.23E-04	8.66E-04	8.66E-04	2.02E-01	3.30E-01	1.04E+00	0.07	3	5	15	0.72	<1	<1	2
	As	1.75E+00	2.38E+00	5.31E+00	1.33E-03	1.71E-03	3.31E-03	2.11E-02	3.25E-02	4.51E-02	6.54E-03	8.84E-03	1.23E-02	6.47E-03	7.83E-03	7.83E-03	2.58E-03	4.51E-03	4.51E-03	1.79E+00	2.44E+00	5.38E+00	0.75	2	3	7	3	<1	<1	2
	Be	1.46E-02	1.64E-02	1.92E-02	2.33E-04	2.63E-04	2.63E-04	9.97E-05	1.35E-04	1.35E-04	9.35E-04	9.35E-04	9.35E-04	2.48E-02	2.48E-02	2.48E-02	1.87E-04	2.46E-04	2.46E-04	4.09E-02	4.28E-02	4.56E-02	0.66	<1	<1	<1	No TRV	-	-	-
	Cd	6.57E-01	1.04E+00	3.09E+00	3.73E-04	7.73E-04	3.15E-03	5.24E-03	9.01E-03	1.36E-02	6.27E-03	2.76E-02	5.03E-02	1.83E-03	2.27E-03	3.64E-03	9.46E-03	1.39E-02	1.39E-02	6.80E-01	1.09E+00	3.17E+00	1	<1	1	3	10	<1	<1	<1
	Cr	1.33E-01	1.54E-01	2.50E-01	2.14E-04	3.07E-04	6.31E-04	1.21E-03	4.01E-03	4.53E-03	1.67E-03	3.72E-03	5.05E-03	1.01E-02	5.24E-02	7.01E-02	1.37E-03	2.60E-03	2.60E-03	1.47E-01	2.17E-01	3.32E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	4.55E+00	6.56E+00	2.09E+01	1.22E-03	2.26E-03	2.91E-03	7.85E-02	1.26E-01	1.78E-01	5.02E-02	1.85E-01	3.27E-01	4.13E-02	5.06E-02	7.54E-02	3.31E-02	4.33E-02	4.33E-02	4.75E+00	6.97E+00	2.16E+01	11.7	<1	<1	2	15.1	<1	<1	2
	Hg	3.86E-01	8.74E-01	2.43E+00	4.10E-06	5.25E-05	5.25E-05	1.30E-03	2.46E-03	3.25E-03	8.06E-04	1.16E-03	2.34E-03	2.88E-03	3.67E-03	5.00E-03	2.96E-04	3.80E-04	3.80E-04	3.91E-01	8.82E-01	2.44E+00	1	<1	<1	3	18.8	<1	<1	<1
	MeHg	3.86E-01	8.74E-01	2.43E+00	4.10E-06	5.25E-05	5.25E-05	2.52E-05	4.13E-05	4.13E-05	8.06E-04	1.16E-03	2.34E-03	2.88E-03	3.67E-03	5.00E-03	2.96E-04	3.80E-04	3.80E-04	3.90E-01	8.79E-01	2.44E+00	0.032	12	28	76	0.16	3	6	15
	Mn	6.25E+00	7.59E+00	2.30E+01	3.77E-02	1.16E-01	2.29E-01	2.33E-01	3.37E-01	3.78E-01	1.56E-01	2.21E-01	3.39E-01	1.35E-01	1.55E-01	1.76E-01	4.23E-01	5.24E-01	5.24E-01	7.23E+00	8.94E+00	2.47E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	2.39E+01	3.64E+01	1.06E+02	9.85E-03	3.36E-02	8.41E-02	1.15E-01	1.96E-01	2.81E-01	1.11E-01	4.93E-01	8.99E-01	2.87E-02	4.02E-02	7.26E-02	1.34E-02	1.74E-02	1.74E-02	2.41E+01	3.72E+01	1.07E+02	11	2	3	10	90	<1	<1	1
	Se	5.20E-02	1.29E-01	2.13E-01	1.58E-03	1.84E-03	1.84E-03	1.89E-03	2.62E-03	2.81E-03	3.64E-03	4.35E-03	5.68E-03	7.96E-03	9.81E-03	1.11E-02	2.38E-03	2.91E-03	2.91E-03	6.95E-02	1.51E-01	2.38E-01	0.2	<1	<1	1	0.33	<1	<1	<1
	Ag	2.16E-01	4.81E-01	1.16E+00	8.85E-05	9.37E-05	9.88E-05	1.15E-03	1.88E-03	2.30E-03	3.79E-04	5.27E-04	9.41E-04	5.15E-04	5.93E-04	6.92E-04	2.56E-04	2.91E-04	2.91E-04	2.19E-01	4.84E-01	1.17E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	1.29E-02	1.79E-02	4.89E-02	1.13E-03	1.31E-03	1.31E-03	1.61E-04	2.30E-04	2.70E-04	8.99E-04	8.99E-04	8.99E-04	8.96E-04	1.03E-03	1.02E-03	2.15E-04	4.26E-04	4.26E-04	1.62E-02	2.18E-02	5.28E-02	0.074	<1	<1	<1	0.74	<1	<1	<1
	V	3.38E-01	3.76E-01	5.43E-01	4.05E-04	5.22E-04	5.89E-04	1.79E-03	3.21E-03	4.98E-03	1.85E-03	2.32E-03	3.15E-03	2.80E-03	3.54E-03	4.65E-03	4.71E-04	1.23E-03	1.23E-03	3.45E-01	3.87E-01	5.58E-01	0.209	2	2	3	2.09	<1	<1	<1
	Zn	1.83E+01	2.40E+01	5.99E+01	9.49E-03	1.34E-02	3.15E-02	3.80E-01	5.43E-01	7.14E-01	5.59E-01	1.45E+00	2.37E+00	5.44E-01	7.19E-01	1.09E+00	2.18E-01	2.74E-01	2.74E-01	2.01E+01	2.70E+01	6.43E+01	160	<1	<1	<1	320	<1	<1	<1
WD	Al	5.06E+01	6.56E+01	7.27E+01	not measured			2.39E-01	2.39E-01	2.39E-01	3.79E-01	3.79E-01	3.79E-01	not measured			not measured			5.12E+01	6.62E+01	7.34E+01	1.93	27	34	38	19.3	3	4	4
	Sb	2.34E-02	3.73E-02	4.78E-02	not measured			2.29E-03	2.29E-03	2.29E-03	1.01E-03	1.01E-03	1.01E-03	not measured			not measured			2.67E-02	4.06E-02	5.12E-02	0.07	<1	<1	<1	0.72	<1	<1	<1
	As	3.51E-01	5.38E-01	6.41E-01	5.78E-04	1.05E-03	1.05E-03	1.37E-02	1.37E-02	1.37E-02	4.95E-03	4.95E-03	4.95E-03	not measured			not measured			3.70E-01	5.58E-01	6.60E-01	0.75	<1	<1	<1	3	<1	<1	<1
	Ba	5.14E-01	5.14E-01	5.14E-01	not measured			9.29E-03	9.29E-03	9.29E-03	1.72E-02	1.72E-02	1.72E-02	not measured			not measured			5.41E-01	5.41E-01	5.41E-01	6.1	<1	<1	<1	12	<1	<1	<1
	Be	5.14E-02	5.14E-02	5.14E-02	not measured			9.56E-05	9.56E-05	9.56E-05	1.60E-04	1.60E-04	1.60E-04	not measured			not measured			5.17E-02	5.17E-02	5.17E-02	0.66	<1	<1	<1	No TRV	-	-	-
	Cd	1.63E-01	2.37E-01	2.85E-01	1.58E-04	3.15E-04	3.15E-04	2.62E-03	2.62E-03	2.62E-03	2.50E-03	2.50E-03	2.50E-03	not measured			not measured			1.68E-01	2.42E-01	2.90E-01	1	<1	<1	<1	10	<1	<1	<1
	Cr	5.00E-02	6.96E-02	7.20E-02	not measured			8.20E-04	8.20E-04	8.20E-04	5.85E-04	5.85E-04	5.85E-04	not measured			not measured			5.14E-02	7.10E-02	7.34E-02	0.596	<1	<1	<1	5.96	<1	<1	<1
	Co	4.21E-02	5.36E-02	6.17E-02	not measured			7.35E-04	7.35E-04	7.35E-04	3.94E-04	3.94E-04	3.94E-04	not measured			not measured			4.32E-02	5.47E-02	6.29E-02	0.5	<1	<1	<1	2	<1	<1	<1
	Cu	7.08E-01	1.02E+00	1.25E+00	5.52E-04	1.05E-03	1.05E-03	3.42E-02	3.42E-02	3.42E-02	1.43E-02	1.43E-02	1.43E-02	not measured			not measured			7.57E-01	1.07E+00	1.30E+00	11.7	<1	<1	<1	15.1	<1	<1	<1
	Fe	8.82E+01	1.11E+02	1.20E+02	2.89E-02	3.15E-02	3.15E-02	9.23E-01	9.23E-01	9.23E-01	8.78E-01	8.78E-01	8.78E-01	not measured			not measured			9.00E+01	1.13E+02	1.22E+02	No TRV	-	-	-	No TRV	-	-	-
	Hg	2.96E-01	1.23E+00	1.23E+00	5.25E-07	5.25E-07	5.25E-07	3.91E-04	3.91E-04	3.91E-04	4.59E-04	4.59E-04	4.59E-04	not measured			not measured			2.97E-01	1.24E+00	1.24E+00	1	<1	1	1	18.8	<1	<1	<1
	MeHg	2.96E-01	1.23E+00	1.23E+00	5.25E-07	5.25E-07	5.25E-07	1.29E-05	1.29E-05	1.29E-05	4.59E-04	4.59E-04	4.59E-04	not measured			not measured			2.96E-01	1.24E+00	1.24E+00	0.032	9	39	39	0.16	2	8	8
	Mn	7.68E+00	8.46E+00	8.63E+00	5.78E-03	6.31E-03	6.31E-03	2.66E-01	2.66E-01	2.66E-01	3.71E-01	3.71E-01	3.71E-01	not measured			not measured			8.32E+00	9.10E+00	9.28E+00	88	<1	<1	<1	280	<1	<1	<1
	Ni	5.15E-02	5.16E-02	5.17E-02	not measured			7.65E-04	7.65E-04	7.65E-04	4.79E-04	4.79E-04	4.79E-04	not measured			not measured			5.27E-02	5.29E-02	5.29E-02	40	<1	<1	<1	80	<1	<1	<1
	Pb	6.17E+00	9.99E+00	1.31E+01	2.81E-03	6.31E-03	6.31E-03	1.23E-01	1.23E-01	1.23E-01	1.06E-01	1.06E-01	1.06E-01	not measured			not measured			6.40E+00	1.02E+01	1.33E+01	11	<1	<1	1	90	<1	<1	<1
	Se	7.32E-03	1.05E-02	1.30E-02	not measured			9.29E-04	9.29E-04	9.29E-04	1.44E-03	1.44E-03	1.44E-03	not measured			not measured			9.68E-03	1.29E-02	1.53E-02	0.2	<1	<1	<1	0.33	<1	<1	<1
	Ag	4.56E-02	7.08E-02	9.00E-02	not measured			4.37E-04	4.37E-04	4.37E-04	4.52E-04	4.52E-04	4.52E-04	not measured			not measured			4.65E-02	7.17E-02	9.09E-02	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	1.15E-02	1.47E-02	1.62E-02	not measured			8.20E-05	8.20E-05	8.20E-05	1.06E-04	1.06E-04	1.06E-04	not measured			not measured			1.17E-02	1.49E-02	1.64E-02	0.074	<1	<1	<1	0.74	<1	<1	<1
	V	1.77E-01	2.39E-01	2.57E-01	not measured			1.53E-03	1.53E-03	1.53E-03	2.18E-03	2.18E-03	2.18E-03	not measured			not measured			1.81E-01	2.43E-01	2.61E-01	0.209	<1	1	1	2.09	<1	<1	<1
	Zn	4.91E+00	5.80E+00	6.00E+00	5.25E-03	1.05E-02	1.05E-02	3.03E-01	3.03E-01	3.03E-01	3.19E-01	3.19E-01	3.19E-01	not measured			not measured			5.54E+00	6.43E+00	6.63E+00	160	<1	<1	<1	320	<1	<1	<1
LL	Al	8.18E+01	1.10E+02	1.59E+02	7.03E-03	1.05E-02	1.05E-02	5.86E+00	1.36E+01	1.36E+01	9.35E-01	2.61E+00	2.61E+00	not measured			not measured			8.86E+01	1.27E+02	1.75E+02	1.93	46	66	91	19.3	5	7	9
	Sb	3.34E+00	9.78E+00	1.21E+01	2.89E-02	3.95E-02	4.59E-02	1.31E-01	1.74E-01	1.74E-01	1.17E-02	3.13E-02	3.13E-02	not measured			not measured			3.51E+00	1.00E+01	1.24E+01	0.07	50	143	177	0.72	5	14	17
	As	1.36E+01	3.65E+01	3.71E+01	1.67E-02	2.37E-02	2.55E-02	1.22E+00	2.33E+00	2.33E+00	5.07E-02	1.23E-01	1.23E-01	not measured			not measured			1.48E+01	3.90E+01	3.95E+01	0.75	20	52	53	3	5	13	13
	Cd	8.34E+00	3.28E+01	3.28E+01	1.05E-03	1.39E-03	4.20E-03	2.31E-01	3.51E-01	3.51E-01	3.88E-02	1.08E-01	1.08E-01	not measured			not measured			8.62E+00	3.32E+01	3.32E+01	1	9	33	33	10	<1	3	3
	Cr	1.55E-01	2.37E-01	2.70E-01	8.63E-05	1.05E-04	1.05E-04	1.30E-02	2.82E-02	2.82E-02	1.93E-03	3.33E-03	3.33E-03	not measured			not measured			1.71E-01	2.69E-01	3.02E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	1.25E+01	1.82E+01	3.18E+01	3.07E-03	3.72E-03	7.36E-03	1.17E+00	1.73E+00	1.73E+00	8.17E-02	1.88E-01	1.88E-01	not measured			not measured			1.37E+01	2.01E+01	3.37E+01	11.7	1	2	3	15.1	<1	1	2
	Hg	3.00E-01	4.64E-01	6.52E-01	3.94E-06	5.25E-06	5.25E-06	8.23E-03	1.33E-02	1.33E-02	1.16E-03	2.79E-03	2.79E-03	not measured			not measured			3.09E-01	4.80E-01	6.68E-01	1	<1	<1	<1	18.8	<1	<1	<1
	MeHg	3.00E-01	4.64E-01	6.52E-01	3.94E-06	5.25E-06	5.25E-06	2.34E-05	2.34E-05	2.34E-05	1.16E-03	2.79E-03	2.79E-03	not measured			not measured			3.01E-01	4.67E-01	6.55E-01	0.032	10	15	21	0.16	2	3	4
	Mn	8.94E+00	1.22E+01	1.68E+01	2.51E-02	3.02E-02	5.25E-02	5.32E+00	7.90E+00	7.90E+00	3.37E-01	6.98E-01	6.98E-01	not measured			not measured			1.46E+01	2.08E+01	2.54E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	6.12E+01	1.05E+02	1.76E+02	7.30E-03	8.93E-03	1.87E-02	2.60E+00	4.69E+00	4.69E+00	3.76E-01	1.09E+00	1.09E+00	not measured			not measured			6.42E+01	1.11E+02	1.82E+02	11	6	10	17	90	<1	1	2

Table E-22. Risk Assessment Results for Mammalian Piscivores (Mink)

		Dose: Sediment Ingestion (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Dose: Other Aq. Inverts (mg/kg-d_{ww})			Dose: Forage Fish (mg/kg-d_{ww})			Dose: Piscivorous Fish (mg/kg-d_{ww})			Dose: Amphibians (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max
	Se	1.57E+00	5.28E+00	5.28E+00	4.08E-03	4.91E-03	5.69E-03	3.06E-02	3.65E-02	3.65E-02	4.56E-02	6.24E-02	6.24E-02	not measured			not measured			1.65E+00	5.39E+00	5.39E+00	0.2	8	27	27	0.33	5	16	16
	Ag	6.06E-01	1.05E+00	1.72E+00	1.58E-04	2.21E-04	2.21E-04	2.64E-02	4.53E-02	4.53E-02	2.06E-03	5.59E-03	5.59E-03	not measured			not measured			6.35E-01	1.10E+00	1.78E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	5.72E+00	2.42E+01	2.42E+01	5.61E-03	7.35E-03	8.09E-03	7.16E-02	1.09E-01	1.09E-01	2.04E-02	2.45E-02	2.45E-02	not measured			not measured			5.82E+00	2.44E+01	2.44E+01	0.074	79	329	329	0.74	8	33	33
	V	4.10E-01	7.67E-01	7.83E-01	1.43E-03	2.63E-03	2.63E-03	4.08E-02	8.91E-02	8.91E-02	3.33E-03	7.98E-03	7.98E-03	not measured			not measured			4.56E-01	8.67E-01	8.83E-01	0.209	2	4	4	2.09	<1	<1	<1
	Zn	3.76E+01	5.74E+01	8.48E+01	7.30E-03	9.44E-03	2.10E-02	2.29E+00	4.32E+00	4.32E+00	5.81E-01	8.25E-01	8.25E-01	not measured			not measured			4.05E+01	6.25E+01	8.99E+01	160	<1	<1	<1	320	<1	<1	<1

Mink Exposure Factors:

Body weight = 0.55 kg
Food ingestion rate (wet weight) = 0.0989 kg/d
Water ingestion rate = 0.0578 L/d
Sediment ingestion rate (wet weight) = 0.0093 kg/d
Area use factor = 1

Diet Composition:

Benthic Invertebrates = 0%
Other Aquatic Invertebrates = 10%
Forage Fish = 20%
Piscivorous Fish = 50%
Amphibians = 20%
Sediment Ingestion (% of total diet) = 9.4%

Notes:

HQ> 1.0

Table E-23. Risk Assessment Results for Terrestrial Avian Omnivore (Robin)

		Dose: Soil Ingestion (mg/kg-d_{ww})			Dose: Terrestrial Plants (mg/kg-d_{ww})			Dose: Earthworms (mg/kg-d_{ww})			Dose: Soil Inverts. (mg/kg-d_{ww})			Dose: Aerial/Foliar Inverts. (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max
PPC (Riparian Zone)	Al	2.08E+02	2.63E+02	3.06E+02	1.31E+02	1.62E+02	1.63E+02	7.52E+00	1.23E+01	1.79E+01	7.11E+00	1.12E+01	1.12E+01	3.42E+00	3.42E+00	3.42E+00	1.91E-02	2.21E-02	4.13E-02	3.57E+02	4.51E+02	5.02E+02	124	3	4	4	No TRV	-	-	-
	As	3.26E+00	8.99E+00	9.67E+00	7.08E-02	1.51E-01	1.80E-01	3.34E-01	4.30E-01	5.46E-01	2.93E-01	4.28E-01	4.28E-01	1.33E-01	1.33E-01	1.33E-01	9.05E-04	1.01E-03	5.50E-03	4.09E+00	1.01E+01	1.10E+01	10	<1	1	1	40	<1	<1	<1
	Cd	7.00E-01	1.84E+00	2.40E+00	6.44E-02	1.01E-01	1.18E-01	2.20E-01	3.01E-01	3.55E-01	4.68E-01	5.47E-01	5.47E-01	1.42E-01	1.42E-01	1.42E-01	3.07E-05	4.03E-05	4.95E-05	1.60E+00	2.93E+00	3.57E+00	1.45	1	2	3	20	<1	<1	<1
	Cr	4.88E-01	6.59E-01	8.75E-01	1.22E-02	1.47E-02	1.78E-02	9.80E-03	1.51E-02	2.09E-02	2.26E-02	3.74E-02	3.74E-02	1.07E-02	1.07E-02	1.07E-02	2.32E-04	6.88E-04	6.88E-04	5.43E-01	7.37E-01	9.62E-01	0.86	<1	<1	1	4.32	<1	<1	<1
	Cu	1.25E+01	3.51E+01	4.29E+01	4.02E-01	5.74E-01	6.22E-01	1.55E-01	2.03E-01	2.37E-01	1.69E+00	1.75E+00	1.75E+00	3.78E+00	3.78E+00	3.78E+00	4.24E-04	4.60E-04	9.63E-04	1.85E+01	4.14E+01	4.93E+01	5.68	3	7	9	10.9	2	4	5
	Hg	1.03E-01	4.58E-01	4.58E-01	5.59E-02	2.28E-01	2.28E-01	1.88E-03	2.70E-03	3.89E-03	5.63E-03	9.72E-03	9.72E-03	5.43E-04	5.43E-04	5.43E-04	2.03E-04	4.13E-04	4.13E-04	1.67E-01	7.00E-01	7.01E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	1.03E-01	4.58E-01	4.58E-01	5.59E-02	2.28E-01	2.28E-01	3.22E-04	3.22E-04	3.22E-04	3.52E-04	3.52E-04	3.52E-04	7.61E-05	7.61E-05	7.61E-05	2.03E-04	4.13E-04	4.13E-04	1.60E-01	6.87E-01	6.87E-01	0.032	5	22	22	0.5	<1	1	1
	Mn	2.94E+01	4.16E+01	5.62E+01	1.43E+00	1.87E+00	2.21E+00	1.17E+00	1.75E+00	2.51E+00	1.57E+01	1.77E+01	1.77E+01	1.18E+00	1.18E+00	1.18E+00	9.75E-03	1.02E-02	1.79E-02	4.89E+01	6.41E+01	7.98E+01	26	2	3	3	30	2	2	3
	Pb	3.95E+01	1.18E+02	1.50E+02	2.72E-01	4.65E-01	5.42E-01	3.40E-01	4.49E-01	5.43E-01	3.44E+00	5.98E+00	5.98E+00	3.17E-01	3.17E-01	3.17E-01	6.78E-04	7.42E-04	2.75E-03	4.38E+01	1.26E+02	1.57E+02	3.85	11	33	41	11	4	12	14
	Se	2.53E-01	1.37E+00	1.37E+00	7.96E-02	5.00E-01	5.00E-01	2.05E-02	2.74E-02	3.51E-02	3.60E-02	4.69E-02	4.69E-02	3.81E-02	3.81E-02	3.81E-02	1.90E-04	2.57E-04	5.50E-04	4.27E-01	1.99E+00	2.00E+00	0.2	2	10	10	0.4	1	5	5
	Ag	5.36E-01	2.04E+00	2.25E+00	4.06E-04	1.37E-03	1.57E-03	4.11E-03	5.27E-03	6.26E-03	4.81E-02	7.81E-02	7.81E-02	2.74E-03	2.74E-03	2.74E-03	3.24E-04	6.88E-04	6.88E-04	5.91E-01	2.13E+00	2.34E+00	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	3.53E-02	1.01E-01	1.08E-01	2.02E-02	5.05E-02	5.39E-02	1.31E-03	2.61E-03	2.61E-03	4.67E-03	6.79E-03	6.79E-03	4.28E-04	4.28E-04	4.28E-04	3.57E-04	1.72E-03	1.72E-03	6.22E-02	1.63E-01	1.74E-01	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	1.30E+00	1.47E+00	1.63E+00	3.99E-03	4.44E-03	4.62E-03	4.65E-02	1.27E-01	1.61E-01	3.69E-02	6.01E-02	6.01E-02	1.92E-02	1.92E-02	1.92E-02	1.15E-03	3.44E-03	3.44E-03	1.41E+00	1.68E+00	1.87E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	4.28E+01	1.19E+02	1.25E+02	5.10E+00	7.25E+00	8.46E+00	2.65E+00	3.74E+00	4.25E+00	8.96E+00	1.12E+01	1.12E+01	3.83E+00	3.83E+00	3.83E+00	6.84E-03	7.38E-03	1.30E-02	6.34E+01	1.45E+02	1.53E+02	130	<1	1	1	No TRV	-	-	-
UL&M (Banks)	Al	3.43E+02	5.21E+02	5.21E+02	1.82E+02	2.78E+02	2.71E+02	1.82E+02	2.78E+02	2.71E+02	3.25E+01	3.25E+01	3.25E+01	1.95E+01	1.95E+01	1.95E+01	4.33E-02	7.21E-02	2.23E-01	7.58E+02	1.13E+03	1.12E+03	124	6	9	9	No TRV	-	-	-
	As	6.61E+00	1.31E+01	1.60E+01	1.27E-01	2.47E-01	3.05E-01	1.82E-01	2.92E-01	3.39E-01	4.60E-01	4.60E-01	4.60E-01	2.10E-01	2.10E-01	2.10E-01	1.74E-03	2.24E-03	4.33E-03	7.59E+00	1.43E+01	1.73E+01	10	<1	2	2	40	<1	<1	<1
	Cd	4.50E+00	1.07E+01	1.55E+01	1.68E-01	2.69E-01	3.30E-01	7.20E+00	1.43E+01	1.93E+01	4.30E-01	4.30E-01	4.30E-01	2.27E-01	2.27E-01	2.27E-01	4.88E-04	1.01E-03	4.13E-03	1.25E+01	2.59E+01	3.58E+01	1.45	9	18	25	20	<1	1	2
	Cr	5.11E-01	6.50E-01	6.90E-01	1.17E-02	1.35E-02	1.44E-02	8.75E-02	1.01E-01	1.08E-01	3.04E-02	3.04E-02	3.04E-02	3.82E-02	3.82E-02	3.82E-02	2.80E-04	4.01E-04	8.25E-04	6.79E-01	8.34E-01	8.82E-01	0.86	<1	<1	1	4.32	<1	<1	<1
	Cu	1.20E+01	2.60E+01	3.60E+01	3.81E-01	5.14E-01	5.85E-01	3.17E+00	6.78E+00	9.41E+00	1.24E+00	1.24E+00	1.24E+00	1.78E+00	1.78E+00	1.78E+00	1.60E-03	2.96E-03	3.81E-03	1.86E+01	3.63E+01	4.90E+01	5.68	3	6	9	10.9	2	3	5
	Hg	8.83E-01	1.96E+00	2.45E+00	4.40E-01	9.70E-01	1.20E+00	4.40E-01	9.70E-01	1.20E+00	2.21E-02	2.21E-02	2.21E-02	1.77E-02	1.77E-02	1.77E-02	5.36E-06	6.88E-05	6.88E-05	1.80E+00	3.94E+00	4.89E+00	0.74	3	5	7	1.5	1	3	3
	MeHg	8.83E-01	1.96E+00	2.45E+00	4.40E-01	9.70E-01	1.20E+00	3.42E-04	3.42E-04	3.42E-04	1.39E-03	1.39E-03	1.39E-03	2.47E-03	2.47E-03	2.47E-03	5.36E-06	6.88E-05	6.88E-05	1.33E+00	2.93E+00	3.65E+00	0.032	42	92	114	0.5	3	6	7
	Mn	1.53E+01	2.28E+01	2.64E+01	6.84E-01	1.11E+00	1.41E+00	5.66E-01	7.89E-01	9.26E-01	1.85E+00	1.85E+00	1.85E+00	9.54E-01	9.54E-01	9.54E-01	4.93E-02	1.52E-01	3.00E-01	1.94E+01	2.77E+01	3.19E+01	26	<1	1	1	30	<1	<1	1
	Pb	1.06E+02	2.45E+02	3.54E+02	4.52E-01	7.23E-01	8.90E-01	9.48E+00	1.87E+01	2.51E+01	4.07E+00	4.07E+00	4.07E+00	1.59E+00	1.59E+00	1.59E+00	1.29E-02	4.40E-02	1.10E-01	1.22E+02	2.70E+02	3.86E+02	3.85	32	70	100	11	11	25	35
	Se	8.42E-01	2.20E+00	2.20E+00	2.93E-01	8.61E-01	8.61E-01	1.75E-01	3.58E-01	3.58E-01	2.30E-01	2.30E-01	2.30E-01	1.40E-01	1.40E-01	1.40E-01	2.07E-03	2.41E-03	2.41E-03	1.68E+00	3.79E+00	3.79E+00	0.2	9	19	19	0.4	4	10	10
	Ag	7.66E-01	1.81E+00	2.49E+00	5.45E-04	1.28E-03	1.77E-03	7.96E-01	1.87E+00	2.58E+00	3.31E-02	3.31E-02	3.31E-02	2.48E-02	2.48E-02	2.48E-02	1.16E-04	1.23E-04	1.29E-04	1.62E+00	3.74E+00	5.13E+00	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	1.22E-01	2.40E-01	2.85E-01	6.13E-02	1.21E-01	1.45E-01	6.13E-02	1.21E-01	1.45E-01	7.98E-03	7.98E-03	7.98E-03	1.73E-02	1.73E-02	1.73E-02	1.48E-03	1.72E-03	1.72E-03	2.71E-01	5.09E-01	6.02E-01	0.237	1	2	3	23.7	<1	<1	<1
	V	1.26E+00	1.88E+00	1.95E+00	3.32E-03	4.92E-03	4.82E-03	2.87E-02	4.26E-02	4.18E-02	7.03E-02	7.03E-02	7.03E-02	7.53E-02	7.53E-02	7.53E-02	5.29E-04	6.84E-04	7.70E-04	1.43E+00	2.07E+00	2.14E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	3.32E+01	1.07E+02	1.07E+02	4.17E+00	6.39E+00	7.83E+00	1.61E+01	2.08E+01	2.34E+01	4.14E+00	4.14E+00	4.14E+00	3.17E+00	3.17E+00	3.17E+00	1.24E-02	1.76E-02	4.13E-02	6.08E+01	1.41E+02	1.45E+02	130	<1	1	1	No TRV	-	-	-
LL (Banks)	Al	3.48E+02	4.99E+02	4.99E+02	1.86E+02	2.57E+02	2.57E+02	1.86E+02	2.57E+02	2.57E+02	7.14E+01	9.95E+01	9.95E+01	1.95E+01	1.95E+01	1.95E+01	9.20E-03	1.38E-02	1.38E-02	8.11E+02	1.13E+03	1.13E+03	124	7	9	9	No TRV	-	-	-
	As	1.32E+01	4.87E+01	4.87E+01	2.52E-01	9.25E-01	9.25E-01	2.96E-01	7.42E-01	7.42E-01	1.10E+00	1.43E+00	1.43E+00	2.10E-01	2.10E-01	2.10E-01	2.19E-02	3.10E-02	3.34E-02	1.51E+01	5.20E+01	5.20E+01	10	2	5	5	40	<1	1	1
	Cd	4.18E+00	1.43E+01	1.43E+01	1.62E-01	3.16E-01	3.16E-01	6.86E+00	1.81E+01	1.81E+01	7.62E-01	9.13E-01	9.13E-01	2.27E-01	2.27E-01	2.27E-01	1.37E-03	1.81E-03	5.50E-03	1.22E+01	3.39E+01	3.39E+01	1.45	9	23	23	20	<1	2	2
	Cr	5.47E-01	6.84E-01	6.84E-01	1.19E-02	1.44E-02	1.44E-02	8.87E-02	1.08E-01	1.08E-01	1.09E-01	1.44E-01	1.44E-01	3.82E-02	3.82E-02	3.82E-02	1.13E-04	1.38E-04	1.38E-04	7.95E-01	9.89E-01	9.89E-01	0.86	<1	1	1	4.32	<1	<1	<1
	Cu	2.85E+01	9.86E+01	9.86E+01	5.35E-01	8.69E-01	8.69E-01	7.53E+00	2.57E+01	2.57E+01	4.80E+00	5.91E+00	5.91E+00	1.78E+00	1.78E+00	1.78E+00	4.02E-03	4.87E-03	9.63E-03	4.32E+01	1.33E+02	1.33E+02	5.68	8	24	24	10.9	4	12	12
	Hg	3.24E-01	1.15E+00	1.15E+00	1.66E-01	5.80E-01	5.80E-01	1.66E-01	5.80E-01	5.80E-01	4.26E-02	4.75E-02	4.75E-02	1.77E-02	1.77E-02	1.77E-02	5.16E-06	6.88E-06	6.88E-06	7.15E-01	2.37E+00	2.37E+00	0.74	<1	3	3	1.5	<1	2	2
	MeHg	3.24E-01	1.15E+00	1.15E+00	1.66E-01	5.80E-01	5.80E-01	1.66E-01	5.80E-01	5.80E-01	3.03E-03	4.39E-03	4.39E-03	2.47E-03	2.47E-03	2.47E-03	5.16E-06	6.88E-06	6.88E-06	6.60E-01	2.31E+00	2.31E+00	0.032	21	72	72	0.5	1	5	5
	Mn	1.93E+01	4.26E+01	4.26E+01	7.99E-01	1.70E+00	1.70E+00	6.29E-01	1.05E+00	1.05E+00	8.71E+00	9.49E+00	9.49E+00	9.54E-01	9.54E-01	9.54E-01	3.28E-02	3.96E-02	6.88E-02	3.04E+01	5.58E+01	5.58E+01	26	1	2	2	30	1	2	2
	Pb	9.25E+01	3.33E+02	3.33E+02	4.20E-01	8.57E-01	8.57E-01	8.55E+00	2.38E+01	2.38E+01	1.05E+01	1.32E+01	1.32E+01	1.59E+00	1.59E+00	1.59E+00	9.55E-03	1.17E-02	2.45E-02	1.14E+02	3.72E+02	3.72E+02	3.85	30	97	97	11	10	34	34
	Se	2.95E-01	9.41E-01	9.41E-01	9.50E-02	3.35E-01	3.35E-01	8.28E-02	1.91E-01	1.91E-01	4.86E-01	5.20E-01	5.20E-01	1.40E-01	1.40E-01	1.40E-01	5.34E-03	6.42E-03	7.44E-03	1.10E+00	2.14E+00	2.14E+00	0.2	6	11	11	0.4	3	5	5
	Ag	1.08E+00	3.68E+00	3.68E+00	7.83E-04	2.61E-03	2.61E-03	1.14E+00	3.81E+00	3.81E+00	2.04E-01	2.73E-01	2.73E-01	2.48E-02	2.48E-02	2.48E-02	2.06E-04	2.89E-04	2.89E-04	2.46E+00	7.80E+00	7.80E+00	6.8	<1	1	1	21	<1	<1	<1
	Tl	3.30E-01	1.19E+00	1.19E+00	1.68E-01	6.01E-01	6.01E-01	1.68E-01	6.01E-01	6.01E-01	5.92E-02	6.25E-02	6.25E-02	1.73E-02	1.73E-02	1.73E-02	7.34E-03	9.62E-03	1.06E-02	7.51E-01	2.48E+00	2.48E+00	0.237	3	11	11	23.7	<1	<1	<1
	V	1.56E+00	1.93E+00	1.93E+00	4.02E-03	4.82E-03	4.82E-03	3.48E-02	4.18E-02	4.18E-02	2.44E-01	3.33E-01	3.33E-01	7.53E-02	7.53E-02	7.53E-02	1.87E-03	3.44E-03	3.44E-03	1.92E+00	2.39E+00	2.39E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	6.02E+01	2.16E+02	2.16E+02	5.72E+00	1.15E+01	1.15E+01	1.94E+01	2.95E+01	2.95E+01	8.15E+00	9.04E+00	9.04E+00	3.17E+00	3.17E+00	3.17E+00	9.55E-03	1.24E-02	2.75E-02	9.67E+01	2.69E+02	2.69E+02	130	<1	2	2	No TRV	-	-	-

Table E-23. Risk Assessment Results for Terrestrial Avian Omnivore (Robin)

		Dose: Soil Ingestion (mg/kg-d_{ww})			Dose: Terrestrial Plants (mg/kg-d_{ww})			Dose: Earthworms (mg/kg-d_{ww})			Dose: Soil Inverts. (mg/kg-d_{ww})			Dose: Aerial/Foliar Inverts. (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max	(mg/kg-d_{ww})	Mean	95% UCL	Max
Tito Park LL (SW)	Al	4.50E+02	4.85E+02	5.15E+02	2.44E+02	2.62E+02	2.78E+02	2.44E+02	2.62E+02	2.78E+02	2.53E+01	2.53E+01	2.53E+01	1.95E+01	1.95E+01	1.95E+01	9.20E-03	1.38E-02	1.38E-02	9.84E+02	1.05E+03	1.11E+03	124	8	9	9	No TRV	-	-	-
	As	6.16E+01	1.11E+02	3.09E+02	1.25E+00	2.25E+00	6.29E+00	9.20E-01	1.39E+00	2.87E+00	4.83E-01	4.83E-01	4.83E-01	2.10E-01	2.10E-01	2.10E-01	2.19E-02	3.10E-02	3.34E-02	6.45E+01	1.15E+02	3.18E+02	10	7	12	32	40	2	3	8
	Cd	6.51E+01	2.16E+02	5.61E+02	7.49E-01	1.44E+00	2.43E+00	6.36E+01	1.65E+02	3.53E+02	6.89E-01	6.89E-01	6.89E-01	2.27E-01	2.27E-01	2.27E-01	1.37E-03	1.81E-03	5.50E-03	1.30E+02	3.84E+02	9.18E+02	1.45	90	265	633	20	7	19	46
	Cr	6.05E-01	6.88E-01	7.03E-01	1.34E-02	1.51E-02	1.53E-02	1.00E-01	1.12E-01	1.14E-01	4.39E-02	4.39E-02	4.39E-02	3.82E-02	3.82E-02	3.82E-02	1.13E-04	1.38E-04	1.38E-04	8.01E-01	8.97E-01	9.14E-01	0.86	<1	1	1	4.32	<1	<1	<1
	Cu	1.29E+02	2.40E+02	9.00E+02	9.93E-01	1.27E+00	2.13E+00	3.61E+01	6.72E+01	2.52E+02	1.58E+00	1.58E+00	1.58E+00	1.78E+00	1.78E+00	1.78E+00	4.02E-03	4.87E-03	9.63E-03	1.69E+02	3.12E+02	1.16E+03	5.68	30	55	204	10.9	16	29	106
	Hg	1.34E-01	3.90E-01	3.90E-01	7.13E-02	2.07E-01	2.07E-01	7.13E-02	2.07E-01	2.07E-01	1.02E-02	1.02E-02	1.02E-02	1.77E-02	1.77E-02	1.77E-02	5.16E-06	6.88E-06	6.88E-06	3.04E-01	8.33E-01	8.33E-01	0.74	<1	1	1	1.5	<1	<1	<1
	MeHg	1.34E-01	3.90E-01	3.90E-01	7.13E-02	2.07E-01	2.07E-01	7.13E-02	2.07E-01	2.07E-01	6.39E-04	6.39E-04	6.39E-04	2.38E-04	2.38E-04	2.38E-04	5.16E-06	6.88E-06	6.88E-06	2.77E-01	8.06E-01	8.06E-01	0.032	9	25	25	0.5	<1	2	2
	Mn	1.22E+01	1.63E+01	1.92E+01	5.22E-01	6.89E-01	8.07E-01	4.70E-01	5.69E-01	6.33E-01	1.89E+00	1.89E+00	1.89E+00	9.54E-01	9.54E-01	9.54E-01	3.28E-02	3.96E-02	6.88E-02	1.61E+01	2.05E+01	2.36E+01	26	<1	<1	<1	30	<1	<1	<1
	Pb	5.12E+02	1.13E+03	2.71E+03	1.14E+00	1.77E+00	2.90E+00	3.57E+01	6.76E+01	1.37E+02	1.90E+00	1.90E+00	1.90E+00	1.59E+00	1.59E+00	1.59E+00	9.55E-03	1.17E-02	2.45E-02	5.52E+02	1.20E+03	2.86E+03	3.85	143	312	743	11	50	109	260
	Se	1.72E-01	3.44E-01	5.06E-01	5.45E-02	1.17E-01	1.79E-01	5.72E-02	9.49E-02	1.26E-01	3.33E-01	3.33E-01	3.33E-01	1.40E-01	1.40E-01	1.40E-01	5.34E-03	6.42E-03	7.44E-03	7.62E-01	1.04E+00	1.29E+00	0.2	4	5	7	0.4	2	3	3
	Ag	6.27E-01	1.31E+00	1.64E+00	4.69E-04	9.72E-04	1.22E-03	6.85E-01	1.42E+00	1.78E+00	2.02E-02	2.02E-02	2.02E-02	2.48E-02	2.48E-02	2.48E-02	2.06E-04	2.89E-04	2.89E-04	1.36E+00	2.77E+00	3.46E+00	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	8.68E-02	3.12E-01	3.12E-01	4.68E-02	1.66E-01	1.66E-01	4.68E-02	1.66E-01	1.66E-01	1.27E-02	1.27E-02	1.27E-02	1.73E-02	1.73E-02	1.73E-02	7.34E-03	9.62E-03	1.06E-02	2.18E-01	6.83E-01	6.84E-01	0.237	<1	3	3	23.7	<1	<1	<1
	V	1.58E+00	1.66E+00	1.73E+00	4.17E-03	4.33E-03	4.52E-03	3.61E-02	3.75E-02	3.92E-02	1.27E-01	1.27E-01	1.27E-01	7.53E-02	7.53E-02	7.53E-02	1.87E-03	3.44E-03	3.44E-03	1.83E+00	1.90E+00	1.98E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	2.99E+02	4.64E+02	1.68E+03	1.44E+01	1.83E+01	3.74E+01	3.35E+01	3.88E+01	5.91E+01	6.68E+00	6.68E+00	6.68E+00	3.17E+00	3.17E+00	3.17E+00	9.55E-03	1.24E-02	2.75E-02	3.56E+02	5.31E+02	1.79E+03	130	3	4	14	No TRV	-	-	-
Site Perimeter (East) PPC (SW)	Al	2.62E+02	2.79E+02	2.79E+02	1.31E+02	1.41E+02	1.41E+02	1.31E+02	1.41E+02	1.41E+02	1.18E+02	1.18E+02	1.18E+02	3.42E+00	3.42E+00	3.42E+00	1.91E-02	2.21E-02	0.00E+00	6.45E+02	6.83E+02	6.83E+02	124	5	6	6	No TRV	-	-	-
	As	1.73E+01	9.46E+01	1.27E+02	3.29E-01	1.80E+00	2.43E+00	3.58E-01	1.19E+00	1.47E+00	4.78E+00	4.78E+00	4.78E+00	1.33E-01	1.33E-01	1.33E-01	9.05E-04	1.01E-03	0.00E+00	2.29E+01	1.03E+02	1.36E+02	10	2	10	14	40	<1	3	4
	Cd	1.65E+00	2.52E+00	3.75E+00	9.71E-02	1.22E-01	1.52E-01	3.25E+00	4.55E+00	6.25E+00	2.52E+00	2.52E+00	2.52E+00	1.42E-01	1.42E-01	1.42E-01	3.07E-05	4.03E-05	0.00E+00	7.66E+00	9.85E+00	1.28E+01	1.45	5	7	9	20	<1	<1	<1
	Cr	5.20E-01	6.30E-01	6.30E-01	1.06E-02	1.27E-02	1.27E-02	7.92E-02	9.51E-02	9.51E-02	2.10E-01	2.10E-01	2.10E-01	1.07E-02	1.07E-02	1.07E-02	2.32E-04	6.88E-04	0.00E+00	8.30E-01	9.59E-01	9.58E-01	0.86	<1	1	1	4.32	<1	<1	<1
	Cu	9.13E+01	5.01E+02	6.68E+02	8.43E-01	1.65E+00	1.85E+00	2.38E+01	1.31E+02	1.75E+02	1.28E+01	1.28E+01	1.28E+01	3.78E+00	3.78E+00	3.78E+00	4.24E-04	4.60E-04	0.00E+00	1.33E+02	6.51E+02	8.61E+02	5.68	23	115	152	10.9	12	60	79
	Hg	2.45E-01	4.51E-01	4.51E-01	1.24E-01	2.28E-01	2.28E-01	1.24E-01	2.28E-01	2.28E-01	1.26E-01	1.26E-01	1.26E-01	5.43E-04	5.43E-04	5.43E-04	2.03E-04	4.13E-04	0.00E+00	6.19E-01	1.03E+00	1.03E+00	0.74	<1	1	1	1.5	<1	<1	<1
	MeHg	2.45E-01	4.51E-01	4.51E-01	1.24E-01	2.28E-01	2.28E-01	1.24E-01	2.28E-01	2.28E-01	7.89E-03	7.89E-03	7.89E-03	1.24E-04	1.24E-04	1.24E-04	2.03E-04	4.13E-04	0.00E+00	5.01E-01	9.15E-01	9.14E-01	0.032	16	29	29	0.5	1	2	2
	Mn	3.30E+01	3.49E+01	3.49E+01	1.30E+00	1.36E+00	1.36E+00	8.78E-01	9.03E-01	9.03E-01	1.01E+01	1.01E+01	1.01E+01	1.18E+00	1.18E+00	1.18E+00	9.75E-03	1.02E-02	0.00E+00	4.66E+01	4.85E+01	4.84E+01	26	2	2	2	30	2	2	2
	Pb	5.48E+01	8.31E+01	1.56E+02	3.12E-01	3.94E-01	5.60E-01	5.56E+00	7.78E+00	1.29E+01	4.65E+01	4.65E+01	4.65E+01	3.17E-01	3.17E-01	3.17E-01	6.78E-04	7.42E-04	0.00E+00	1.07E+02	1.38E+02	2.16E+02	3.85	28	36	56	11	10	13	20
	Se	1.09E-01	1.68E-01	1.68E-01	3.09E-02	5.00E-02	5.00E-02	3.93E-02	5.41E-02	5.41E-02	2.45E-01	2.45E-01	2.45E-01	3.81E-02	3.81E-02	3.81E-02	1.90E-04	2.57E-04	0.00E+00	4.62E-01	5.55E-01	5.55E-01	0.2	2	3	3	0.4	1	1	1
	Ag	4.53E-01	7.38E-01	7.38E-01	3.19E-04	5.22E-04	5.22E-04	4.66E-01	7.63E-01	7.63E-01	5.34E-01	5.34E-01	5.34E-01	2.74E-03	2.74E-03	2.74E-03	3.24E-04	6.88E-04	0.00E+00	1.46E+00	2.04E+00	2.04E+00	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	8.63E-02	1.52E-01	1.52E-01	4.35E-02	7.66E-02	7.66E-02	4.35E-02	7.66E-02	7.66E-02	8.49E-02	8.49E-02	8.49E-02	4.28E-04	4.28E-04	4.28E-04	3.57E-04	1.72E-03	0.00E+00	2.59E-01	3.92E-01	3.90E-01	0.237	1	2	2	23.7	<1	<1	<1
	V	1.71E+00	2.10E+00	2.10E+00	4.12E-03	5.02E-03	5.02E-03	3.57E-02	4.35E-02	4.35E-02	4.50E-01	4.50E-01	4.50E-01	1.92E-02	1.92E-02	1.92E-02	1.15E-03	3.44E-03	0.00E+00	2.22E+00	2.62E+00	2.62E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	6.30E+01	8.80E+01	1.50E+02	5.82E+00	6.99E+00	9.29E+00	1.96E+01	2.19E+01	2.59E+01	2.66E+01	2.66E+01	2.66E+01	3.83E+00	3.83E+00	3.83E+00	6.84E-03	7.38E-03	0.00E+00	1.19E+02	1.47E+02	2.15E+02	130	<1	1	2	No TRV	-	-	-
Site Perimeter (West) Wilson Ditch (SW)	Al	3.33E+02	4.82E+02	4.82E+02	1.69E+02	2.49E+02	2.49E+02	1.69E+02	2.49E+02	2.49E+02	3.38E+01	3.38E+01	3.38E+01	2.96E+00	2.96E+00	2.96E+00	not measured			5.39E+02	1.02E+03	1.02E+03	124	4	8	8	No TRV	-	-	-
	As	7.03E+00	1.54E+01	3.36E+01	1.34E-01	2.94E-01	6.44E-01	1.90E-01	3.30E-01	5.75E-01	5.63E-01	5.63E-01	5.63E-01	2.65E-01	2.65E-01	2.65E-01	7.56E-04	1.38E-03	1.38E-03	8.18E+00	1.68E+01	3.57E+01	10	<1	2	4	40	<1	<1	<1
	Cd	4.76E+00	1.01E+01	2.17E+01	1.73E-01	2.61E-01	3.97E-01	7.54E+00	1.37E+01	2.52E+01	1.00E+00	1.00E+00	1.00E+00	1.67E-01	1.67E-01	1.67E-01	2.06E-04	4.13E-04	4.13E-04	1.36E+01	2.52E+01	4.85E+01	1.45	10	17	34	20	<1	1	3
	Cr	6.15E-01	1.05E+00	1.05E+00	1.28E-02	2.21E-02	2.21E-02	9.59E-02	1.65E-01	1.65E-01	5.37E-02	5.37E-02	5.37E-02	6.79E-03	6.79E-03	6.79E-03	not measured			7.72E-01	1.30E+00	1.30E+00	0.86	<1	2	2	4.32	<1	<1	<1
	Cu	5.64E+01	2.00E+02	3.98E+02	6.98E-01	1.15E+00	1.51E+00	1.47E+01	5.22E+01	1.04E+02	1.82E+00	1.82E+00	1.82E+00	9.60E-01	9.60E-01	9.60E-01	7.22E-04	1.38E-03	1.38E-03	7.46E+01	2.56E+02	5.06E+02	5.68	13	45	89	10.9	7	24	47
	Hg	1.50E-01	3.32E-01	3.32E-01	7.61E-02	1.70E-01	1.70E-01	7.61E-02	1.70E-01	1.70E-01	8.97E-03	8.97E-03	8.97E-03	2.72E-03	2.72E-03	2.72E-03	6.88E-07	6.88E-07	6.88E-07	3.14E-01	6.84E-01	6.84E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	1.50E-01	3.32E-01	3.32E-01	7.61E-02	1.70E-01	1.70E-01	7.61E-02	1.70E-01	1.70E-01	5.62E-04	5.62E-04	5.62E-04	2.28E-04	2.28E-04	2.28E-04	6.88E-07	6.88E-07	6.88E-07	3.03E-01	6.73E-01	6.73E-01	0.032	10	21	21	0.5	<1	1	1
	Mn	4.47E+01	1.33E+02	1.33E+02	1.80E+00	5.38E+00	5.38E+00	1.09E+00	2.31E+00	2.31E+00	3.59E+00	3.59E+00	3.59E+00	3.33E-01	3.33E-01	3.33E-01	7.56E-03	8.25E-03	8.25E-03	5.15E+01	1.45E+02	1.45E+02	26	2	6	6	30	2	5	5
	Pb	1.30E+02	2.03E+02	4.73E+02	5.08E-01	6.51E-01	1.05E+00	1.12E+01	1.60E+01	3.17E+01	4.14E+00	4.14E+00	4.14E+00	1.19E+00	1.19E+00	1.19E+00	3.68E-03	8.25E-03	8.25E-03	1.47E+02	2.25E+02	5.11E+02	3.85	38	59	133	11	14	21	47
	Se	3.51E-01	1.09E+00	1.09E+00	1.14E-01	4.00E-01	4.00E-01	9.32E-02	2.15E-01	2.15E-01	1.18E-01	1.18E-01	1.18E-01	5.14E-02	5.14E-02	5.14E-02	not measured			6.14E-01	1.88E+00	1.88E+00	0.2	3	10	10	0.4	2	5	5
	Ag	2.86E+00	9.45E+00	9.45E+00	2.04E-03	6.76E-03	6.76E-03	2.98E+00	9.87E+00	9.87E+00	4.68E-02	4.68E-02	4.68E-02	1.38E-02	1.38E-02	1.38E-02	not measured			5.89E+00	1.94E+01	1.94E+01	6.8	<1	3	3	21	<1	<1	<1
	Tl	1.22E-01	2.43E-01	2.43E-01	6.21E-02	1.24E-01	1.24E-01	6.21E-02	1.24E-01	1.24E-01	1.23E-02	1.23E-02	1.23E-02	4.20E-03	4.20E-03	4.20E-03	not measured			2.01E-01	5.08E-01	5.08E-01	0.237	<1	2	2	23.7	<1	<1	<1
	V	1.44E+00	2.18E+00	2.18E+00	3.54E-03	5.32E-03	5.32E-03	3.07E-02	4.61E-02	4.61E-02	1.30E-01	1.30E-01	1.30E-01	1.07E-02	1.07E-02	1.07E-02	not measured			1.61E+00	2.37E+00	2.37E+00	11	<1	<1	<1	No TRV	-	-	-
	Zn	1.03E+02	1.76E+02	5.72E+02	7.67E+00	1.03E+01	1.99E+01	2.31E+01	2.76E+01	4.07E+01	6.63E+00	6.63E+00	6.63E+00	2.70E+00	2.70E+00	2.70E+00	6.88E-03	1.38E-02	1.38E-02	1.43E+02	2.23E+02	6.42E+02	130	1	2	5	No TRV	-	-	-

Robin Exposure Factors:		
Body weight =	0.077	kg
Food ingestion rate (wet weight) =	0.0319	kg/d
Water ingestion rate =	0.0106	L/d
Soil ingestion rate (wet weight) =	0.0033	kg/d
Area use factor =	1	
Diet Composition:		
Terrestrial Plants =	25%	
Earthworms =	25%	
Soil Invertebrates =	25%	
Aerial/Foliar Invertebrates =	25%	
Sediment Ingestion (% of total diet) =	10.4%	

Notes:

HQ> 1.0

Table E-24. Risk Assessment Results for Terrestrial Avian Insectivore (Tree Swallow)

		Dose: Soil Ingestion (mg/kg-d_{ww})			Dose: Terrestrial Plants (mg/kg-d_{ww})			Dose: Benthic Invertebrates (mg/kg-d_{ww})			Dose: Soil Inverts. (mg/kg-d_{ww})			Dose: Aerial/Foliar Inverts. (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	LOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max
PPC (Riparian Zone)	Al	0.00E+00	0.00E+00	0.00E+00	1.66E+02	2.05E+02	2.07E+02	5.20E+00	6.18E+00	7.30E+00	9.00E+00	1.42E+01	1.42E+01	4.33E+00	4.33E+00	4.33E+00	2.56E-02	2.96E-02	5.53E-02	1.84E+02	2.30E+02	2.33E+02	124	2	2	2	No TRV	-	-	-
	As	0.00E+00	0.00E+00	0.00E+00	8.96E-02	1.91E-01	2.28E-01	1.22E-01	1.81E-01	2.19E-01	3.71E-01	5.42E-01	5.42E-01	1.68E-01	1.68E-01	1.68E-01	1.21E-03	1.35E-03	7.38E-03	7.52E-01	1.08E+00	1.16E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	0.00E+00	0.00E+00	0.00E+00	8.15E-02	1.28E-01	1.49E-01	2.07E-02	2.58E-02	2.90E-02	5.93E-01	6.93E-01	6.93E-01	1.80E-01	1.80E-01	1.80E-01	4.11E-05	5.40E-05	6.64E-05	8.75E-01	1.03E+00	1.05E+00	1.45	<1	<1	<1	20	<1	<1	<1
	Cr	0.00E+00	0.00E+00	0.00E+00	1.54E-02	1.87E-02	2.26E-02	1.04E-02	1.35E-02	1.69E-02	2.86E-02	4.73E-02	4.73E-02	1.35E-02	1.35E-02	1.35E-02	3.11E-04	9.22E-04	9.22E-04	6.82E-02	9.40E-02	1.01E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	0.00E+00	0.00E+00	0.00E+00	5.09E-01	7.27E-01	7.87E-01	2.52E-01	2.97E-01	3.17E-01	2.14E+00	2.22E+00	2.22E+00	4.78E+00	4.78E+00	4.78E+00	5.68E-04	6.16E-04	1.29E-03	7.68E+00	8.02E+00	8.10E+00	5.68	1	2	2	10.9	<1	<1	<1
	Hg	0.00E+00	0.00E+00	0.00E+00	7.08E-02	2.89E-01	2.89E-01	8.81E-04	1.21E-03	1.53E-03	7.13E-03	1.23E-02	1.23E-02	6.88E-04	6.88E-04	6.88E-04	2.73E-04	5.53E-04	5.53E-04	7.97E-02	3.03E-01	3.04E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	0.00E+00	0.00E+00	0.00E+00	7.08E-02	2.89E-01	2.89E-01	3.28E-04	4.98E-04	4.98E-04	4.46E-04	4.46E-04	4.46E-04	9.63E-05	9.63E-05	9.63E-05	2.73E-04	5.53E-04	5.53E-04	7.19E-02	2.90E-01	2.90E-01	0.032	2	9	9	0.5	<1	<1	<1
	Mn	0.00E+00	0.00E+00	0.00E+00	1.81E+00	2.37E+00	2.80E+00	4.56E+00	5.81E+00	6.63E+00	1.99E+01	2.24E+01	2.24E+01	1.49E+00	1.49E+00	1.49E+00	1.31E-02	1.37E-02	2.40E-02	2.78E+01	3.20E+01	3.33E+01	26	1	1	1	30	<1	1	1
	Pb	0.00E+00	0.00E+00	0.00E+00	3.45E-01	5.89E-01	6.86E-01	3.03E-01	3.81E-01	3.89E-01	4.36E+00	7.57E+00	7.57E+00	4.02E-01	4.02E-01	4.02E-01	9.10E-04	9.95E-04	3.69E-03	5.41E+00	8.94E+00	9.05E+00	3.85	2	2	2	11	<1	<1	<1
	Se	0.00E+00	0.00E+00	0.00E+00	1.01E-01	6.33E-01	6.33E-01	8.19E-03	9.60E-03	1.14E-02	4.55E-02	5.94E-02	5.94E-02	4.82E-02	4.82E-02	4.82E-02	2.55E-04	3.45E-04	7.38E-04	2.03E-01	7.50E-01	7.52E-01	0.2	1	4	4	0.4	<1	2	2
	Ag	0.00E+00	0.00E+00	0.00E+00	5.14E-04	1.73E-03	1.98E-03	2.69E-03	3.15E-03	3.23E-03	6.09E-02	9.89E-02	9.89E-02	3.47E-03	3.47E-03	3.47E-03	4.34E-04	9.22E-04	9.22E-04	6.80E-02	1.08E-01	1.09E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	0.00E+00	0.00E+00	0.00E+00	2.56E-02	6.40E-02	6.82E-02	5.27E-04	8.53E-04	7.99E-04	5.91E-03	8.60E-03	8.60E-03	5.42E-04	5.42E-04	5.42E-04	4.78E-04	2.31E-03	2.31E-03	3.30E-02	7.63E-02	8.04E-02	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	0.00E+00	0.00E+00	0.00E+00	5.05E-03	5.62E-03	5.85E-03	3.00E-02	3.71E-02	4.07E-02	4.67E-02	7.61E-02	7.61E-02	2.44E-02	2.44E-02	2.44E-02	1.54E-03	4.61E-03	4.61E-03	1.08E-01	1.48E-01	1.52E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	0.00E+00	0.00E+00	0.00E+00	6.46E+00	9.18E+00	1.07E+01	3.62E+00	4.49E+00	5.24E+00	1.13E+01	1.42E+01	1.42E+01	4.85E+00	4.85E+00	4.85E+00	9.17E-03	9.90E-03	1.75E-02	2.63E+01	3.27E+01	3.50E+01	130	<1	<1	<1	No TRV	-	-	-
UL&M (Banks)	Al	0.00E+00	0.00E+00	0.00E+00	2.30E+02	3.52E+02	3.44E+02	2.19E+00	2.79E+00	4.26E+00	4.11E+01	4.11E+01	4.11E+01	2.46E+01	2.46E+01	2.46E+01	5.81E-02	9.67E-02	2.99E-01	2.98E+02	4.21E+02	4.14E+02	124	3	3	3	No TRV	-	-	-
	As	0.00E+00	0.00E+00	0.00E+00	1.60E-01	3.12E-01	3.87E-01	5.28E-02	6.94E-02	1.05E-01	5.82E-01	5.82E-01	5.82E-01	2.66E-01	2.66E-01	2.66E-01	2.34E-03	3.00E-03	5.81E-03	1.06E+00	1.23E+00	1.35E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	0.00E+00	0.00E+00	0.00E+00	2.12E-01	3.40E-01	4.18E-01	1.39E-01	5.85E-01	1.26E+00	5.44E-01	5.44E-01	5.44E-01	2.88E-01	2.88E-01	2.88E-01	6.54E-04	1.36E-03	5.53E-03	1.18E+00	1.76E+00	2.51E+00	1.45	<1	1	2	20	<1	<1	<1
	Cr	0.00E+00	0.00E+00	0.00E+00	1.48E-02	1.71E-02	1.83E-02	3.60E-03	4.29E-03	5.45E-03	3.85E-02	3.85E-02	3.85E-02	4.83E-02	4.83E-02	4.83E-02	3.76E-04	5.38E-04	1.11E-03	1.06E-01	1.09E-01	1.12E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	0.00E+00	0.00E+00	0.00E+00	4.82E-01	6.51E-01	7.40E-01	1.44E+00	5.26E+00	1.04E+01	1.56E+00	1.56E+00	1.56E+00	2.26E+00	2.26E+00	2.26E+00	2.14E-03	3.97E-03	5.11E-03	5.74E+00	9.74E+00	1.50E+01	5.68	1	2	3	10.9	<1	<1	1
	Hg	0.00E+00	0.00E+00	0.00E+00	5.58E-01	1.23E+00	1.52E+00	2.81E-03	6.85E-03	8.23E-03	2.80E-02	2.80E-02	2.80E-02	2.24E-02	2.24E-02	2.24E-02	7.19E-06	9.22E-05	9.22E-05	6.11E-01	1.29E+00	1.58E+00	0.74	<1	2	2	1.5	<1	<1	1
	MeHg	0.00E+00	0.00E+00	0.00E+00	5.58E-01	1.23E+00	1.52E+00	7.61E-04	1.35E-03	1.35E-03	1.76E-03	1.76E-03	1.76E-03	3.13E-03	3.13E-03	3.13E-03	7.19E-06	9.22E-05	9.22E-05	5.63E-01	1.23E+00	1.53E+00	0.032	18	39	48	0.5	1	3	3
	Mn	0.00E+00	0.00E+00	0.00E+00	8.66E-01	1.41E+00	1.78E+00	1.52E+00	1.80E+00	2.04E+00	2.34E+00	2.34E+00	2.34E+00	1.21E+00	1.21E+00	1.21E+00	6.62E-02	2.04E-01	4.02E-01	6.01E+00	6.97E+00	7.78E+00	26	<1	<1	<1	30	<1	<1	<1
	Pb	0.00E+00	0.00E+00	0.00E+00	5.72E-01	9.15E-01	1.13E+00	1.84E+00	5.42E+00	1.38E+01	5.15E+00	5.15E+00	5.15E+00	2.01E+00	2.01E+00	2.01E+00	1.73E-02	5.90E-02	1.48E-01	9.59E+00	1.36E+01	2.22E+01	3.85	3	4	6	11	<1	1	2
	Se	0.00E+00	0.00E+00	0.00E+00	3.71E-01	1.09E+00	1.09E+00	7.66E-03	9.34E-03	1.33E-02	2.92E-01	2.92E-01	2.92E-01	1.77E-01	1.77E-01	1.77E-01	2.78E-03	3.23E-03	3.23E-03	8.51E-01	1.57E+00	1.58E+00	0.2	4	8	8	0.4	2	4	4
	Ag	0.00E+00	0.00E+00	0.00E+00	6.90E-04	1.62E-03	2.24E-03	5.65E-03	1.45E-02	1.74E-02	4.19E-02	4.19E-02	4.19E-02	3.15E-02	3.15E-02	3.15E-02	1.55E-04	1.64E-04	1.73E-04	7.98E-02	8.96E-02	9.31E-02	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	0.00E+00	0.00E+00	0.00E+00	7.76E-02	1.53E-01	1.84E-01	6.84E-04	1.65E-03	2.03E-03	1.01E-02	1.01E-02	1.01E-02	2.20E-02	2.20E-02	2.20E-02	1.98E-03	2.31E-03	2.31E-03	1.12E-01	1.89E-01	2.20E-01	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	0.00E+00	0.00E+00	0.00E+00	4.20E-03	6.23E-03	6.11E-03	8.44E-03	9.90E-03	1.32E-02	8.90E-02	8.90E-02	8.90E-02	9.53E-02	9.53E-02	9.53E-02	7.10E-04	9.17E-04	1.03E-03	1.98E-01	2.01E-01	2.05E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	0.00E+00	0.00E+00	0.00E+00	5.28E+00	8.09E+00	9.92E+00	2.02E+00	3.35E+00	8.79E+00	5.25E+00	5.25E+00	5.25E+00	4.02E+00	4.02E+00	4.02E+00	1.66E-02	2.36E-02	5.53E-02	1.66E+01	2.07E+01	2.80E+01	130	<1	<1	<1	No TRV	-	-	-
LL (Banks)	Al	0.00E+00	0.00E+00	0.00E+00	2.36E+02	3.25E+02	3.25E+02	3.03E+00	5.76E+00	7.43E+00	9.05E+01	1.26E+02	1.26E+02	2.46E+01	2.46E+01	2.46E+01	1.23E-02	1.84E-02	1.84E-02	3.54E+02	4.82E+02	4.83E+02	124	3	4	4	No TRV	-	-	-
	As	0.00E+00	0.00E+00	0.00E+00	3.19E-01	1.17E+00	1.17E+00	2.08E-01	3.82E-01	4.78E-01	1.39E+00	1.81E+00	1.81E+00	2.66E-01	2.66E-01	2.66E-01	2.93E-02	4.15E-02	4.48E-02	2.22E+00	3.67E+00	3.77E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	0.00E+00	0.00E+00	0.00E+00	2.05E-01	4.00E-01	4.00E-01	1.70E-01	2.41E-01	2.59E-01	9.65E-01	1.16E+00	1.16E+00	2.88E-01	2.88E-01	2.88E-01	1.83E-03	2.43E-03	7.38E-03	1.63E+00	2.09E+00	2.11E+00	1.45	1	2	2	20	<1	<1	<1
	Cr	0.00E+00	0.00E+00	0.00E+00	1.51E-02	1.83E-02	1.83E-02	7.16E-03	1.12E-02	1.30E-02	1.38E-01	1.83E-01	1.83E-01	4.83E-02	4.83E-02	4.83E-02	1.51E-04	1.84E-04	1.84E-04	2.08E-01	2.61E-01	2.62E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	0.00E+00	0.00E+00	0.00E+00	6.78E-01	1.10E+00	1.10E+00	4.92E-01	7.71E-01	8.47E-01	6.07E+00	7.48E+00	7.48E+00	2.26E+00	2.26E+00	2.26E+00	5.39E-03	6.53E-03	1.29E-02	9.51E+00	1.16E+01	1.17E+01	5.68	2	2	2	10.9	<1	1	1
	Hg	0.00E+00	0.00E+00	0.00E+00	2.10E-01	7.34E-01	7.34E-01	6.75E-03	2.06E-02	1.92E-02	5.39E-02	6.02E-02	6.02E-02	2.24E-02	2.24E-02	2.24E-02	6.92E-06	9.22E-06	9.22E-06	2.93E-01	8.38E-01	8.36E-01	0.74	<1	1	1	1.5	<1	<1	<1
	MeHg	0.00E+00	0.00E+00	0.00E+00	2.10E-01	7.34E-01	7.34E-01	1.86E-03	2.20E-03	2.20E-03	3.84E-03	5.56E-03	5.56E-03	3.13E-03	3.13E-03	3.13E-03	6.92E-06	9.22E-06	9.22E-06	2.19E-01	7.45E-01	7.45E-01	0.032	7	23	23	0.5	<1	2	2
	Mn	0.00E+00	0.00E+00	0.00E+00	1.01E+00	2.15E+00	2.15E+00	2.10E+00	3.57E+00	3.92E+00	1.10E+01	1.20E+01	1.20E+01	1.21E+00	1.21E+00	1.21E+00	4.41E-02	5.31E-02	9.22E-02	1.54E+01	1.90E+01	1.94E+01	26	<1	<1	<1	30	<1	<1	<1
	Pb	0.00E+00	0.00E+00	0.00E+00	5.32E-01	1.09E+00	1.09E+00	1.14E+00	1.96E+00	2.10E+00	1.32E+01	1.67E+01	1.67E+01	2.01E+00	2.01E+00	2.01E+00	1.28E-02	1.57E-02	3.28E-02	1.69E+01	2.18E+01	2.20E+01	3.85	5	6	6	11	2	2	2
	Se	0.00E+00	0.00E+00	0.00E+00	1.20E-01	4.25E-01	4.25E-01	9.73E-02	1.44E-01	1.57E-01	6.15E-01	6.59E-01	6.59E-01	1.77E-01	1.77E-01	1.77E-01	7.16E-03	8.61E-03	9.98E-03	1.02E+00	1.41E+00	1.43E+00	0.2	5	7	7	0.4	3	4	4
	Ag	0.00E+00	0.00E+00	0.00E+00	9.91E-04	3.30E-03	3.30E-03	1.23E-02	2.01E-02	2.43E-02	2.58E-01	3.46E-01	3.46E-01	3.15E-02	3.15E-02	3.15E-02	2.77E-04	3.87E-04	3.87E-04	3.04E-01	4.01E-01	4.06E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	0.00E+00	0.00E+00	0.00E+00	2.13E-01	7.61E-01	7.61E-01	2.53E-02	3.96E-02	3.85E-02	7.49E-02	7.91E-02	7.91E-02	2.20E-02	2.20E-02	2.20E-02	9.85E-03	1.29E-02	1.42E-02	3.45E-01	9.14E-01	9.14E-01	0.237	2	4	4	23.7	<1	<1	<1
	V	0.00E+00	0.00E+00	0.00E+00	5.09E-03	6.11E-03	6.11E-03	1.27E-02	2.17E-02	2.50E-02	3.08E-01	4.22E-01	4.22E-01	9.53E-02	9.53E-02	9.53E-02	2.50E-03	4.61E-03	4.61E-03	4.24E-01	5.49E-01	5.53E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	0.00E+00	0.00E+00	0.00E+00	7.24E+00	1.46E+01	1.46E+01	1.90E+00	2.65E+00	2.99E+00	1.03E+01	1.14E+01	1.14E+01	4.02E+00	4.02E+00	4.02E+00	1.28E-02	1.66E-02	3.69E-02	2.35E+01	3.27E+01	3.31E+01	130	<1	<1	<1	No TRV	-	-	-
Tito Park LL (SW&BI)	Al	0.00E+00	0.00E+00	0.00E+00	3.09E+02	3.32E+02	3.51E+02	3.03E+00	5.76E+00	7.43E+00	3.20E+01	3.20E+01	3.20E+01	2.46E+01	2.46E+01	2.46E+01	1.23E-02	1.84E-02	1.84E-02	3.69E+02	3.94E+02	4.16E+02	124	3	3	3	No TRV	-	-	-
	As	0.00E+00	0.00E+00	0.00E+00	1.59E+00	2.85E+00	7.96E+00	2.08E-01	3.82E-01	4.78E-01	6.12E-01	6.12E-01	6.12E-01	2.66E-01	2.66E-01	2.66E-01	2.93E-02	4.15E-02	4.48E-02	2.70E+00	4.16E+00	9.36E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	0.00E+00	0.00E+00	0.00E+00	9.49E-01	1.83E+00	3.08E+00	1.70E-01	2.41E-01	2.59E-01	8.73E-01	8.73E-01	8.73E-01	2.88E-01	2.88E-01	2.88E-01	1.83E-03	2.43E-03	7.38E-03	2.28E+00	3.23E+00	4.51E+00	1.45	2	2	3	20	<1	<1	<1
	Cr	0.00E+00	0.00E+00	0.00E+00	1.70E-02	1.91E-02	1.94E-02	7.16E-03	1.12E-02	1.30E-02	5.56E-02	5.56E-02	5.56E-02	4.83E-02	4.83E-02	4.83E-02	1.51E-04	1.84E-04	1.84E-04	1.28E-01	1.34E-01	1.36E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	0.00E+00	0.00E+00	0.00E+00	1.26E+00	1.61E+00	2.70E+00	4.92E-01	7.71E-01	8.47E-01	2.00E+00	2.00E+00	2.00E+00	2.26E+00	2.26E+00	2.26E+00	5.39E-03	6.53E-03	1.29E-02	6.01E+00	6.64E+00	7.82E+00	5.68	1	1	1	10.9	<1	<1	<1
	Hg	0.00E+00	0.00E+00	0.00E+00	9.02E-02	2.62E-01	2.62E-01	6.75E-03	2.06E-02	1.92E-02	1.29E-02	1.29E-02	1.29E-02	2.24E-02	2.24E-02	2.24E-02	6.92E-06	9.22E-06	9.22E-06	1.32E-01	3.18E-01	3.17E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	0.00E+00	0.00E+00	0.00E+00	9.02E-02	2.62E-01	2.62E-01	1.86E-03	2.20E-03	2.20E-03	8.09E-04	8.09E-04	8.09E-04	3.02E-04	3.02E-04	3.02E-04	6.92E-06	9.22E-06	9.22E-06	9.32E-02	2.66E-01	2.66E-01	0.032	3	8	8	0.5	<1	<1	<1
	Mn	0.00E+00	0.00E+00	0.00E+00	6.61E-01	8.73E-01	1.02E+00	2.10E+00	3.57E+00	3.92E+00	2.39E+00	2.39E+00	2.39E+00	1.21E+00	1.21E+00	1.21E+00	4.41E-02	5.31E-02	9.22E-02	6.40E+00	8.09E+00	8.63E+00	26	<1	<1	<1	30	<1	<1	<1
	Pb	0.00E+00	0.00E+00	0.00E+00	1.44E+00	2.24E+00	3.67E+00	1.14E+00	1.96E+00	2.10E+00	2.40E+00	2.40E+00	2.40E+00	2.01E+00	2.01E+00	2.01E+00	1.28E-02	1.57E-02	3.28E-02	7.00E+00	8.63E+00	1.02E+01	3.85	2	2	3	11	<1	<1	<1
	Se	0.00E+00	0.00E+00	0.00E+00	6.90E-02	1.48E-01	2.26E-01	9.73E-02	1.44E-01	1.57E-01	4.21E-01	4.21E-01	4.21E-01	1.77E-01	1.77E-01	1.77E-01	7.16E-03	8.61E-03	9.98E-03	7.72E-01	8.99E-01	9.92E-01	0.2	4	5	5	0.4	2	2	3
	Ag	0.00E+00	0.00E+00	0.00E+00	5.94E-04	1.23E-03	1.54E-03	1.23E-02	2.01E-02	2.43E-02	2.56E-02	2.56E-02	2.56E-02	3.15E-02	3.15E-02	3.15E-02	2.77E-04	3.87E-04	3.87E-04	7.02E-02	7.87E-02	8.33E-02	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	0.00E+00	0.00E+00	0.00E+00	5.93E-02	2.10E-01	2.10E-01	2.53E-02	3.96E-02	3.85E-02	1.61E-02	1.61E-02	1.61E-02	2.20E-02	2.20E-02	2.20E-02	9.85E-03	1.29E-02	1.42E-02	1.33E-01	3.00E-01	3.01E-01	0.237	<1	1	1	23.7	<1	<1	<1
	V	0.00E+00	0.00E+00	0.00E+00	5.28E-03	5.49E-03	5.72E-03	1.27E-02	2.17E-02	2.50E-02	1.61E-01	1.61E-01	1.61E-01	9.53E-02	9.53E-02	9.53E-02	2.50E-03	4.61E-03	4.61E-03	2.77E-01	2.88E-01	2.92E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	0.00E+00	0.00E+00	0.00E+00	1.82E+01	2.32E+01	4.74E+01	1.90E+00	2.65E+00	2.99E+00	8.45E+00	8.45E+00	8.45E+00	4.02E+00	4.02E+00	4.02E+00	1.28E-02	1.66E-02	3.69E-02	3.26E+01	3.84E+01	6.29E+01	130	<1	<1	<1	No TRV	-	-	-

Table E-24. Risk Assessment Results for Terrestrial Avian Insectivore (Tree Swallow)

		Dose: Soil Ingestion (mg/kg-d$_{ww}$)			Dose: Terrestrial Plants (mg/kg-d$_{ww}$)			Dose: Benthic Invertebrates (mg/kg-d$_{ww}$)			Dose: Soil Inverts. (mg/kg-d$_{ww}$)			Dose: Aerial/Foliar Inverts. (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	**Metal**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**NOAEL (mg/kg-d$_{ww}$)**	**Mean**	**95% UCL**	**Max**	**LOAEL (mg/kg-d$_{ww}$)**	**Mean**	**95% UCL**	**Max**
Site Perimeter (East) PPC (SW&BI)	Al	0.00E+00	0.00E+00	0.00E+00	1.66E+02	1.79E+02	1.79E+02	5.20E+00	6.18E+00	7.30E+00	1.49E+02	1.49E+02	1.49E+02	4.33E+00	4.33E+00	4.33E+00	2.56E-02	2.96E-02	0.00E+00	3.25E+02	3.39E+02	3.40E+02	124	3	3	3	No TRV	-	-	-
	As	0.00E+00	0.00E+00	0.00E+00	4.17E-01	2.28E+00	3.07E+00	1.22E-01	1.81E-01	2.19E-01	6.05E+00	6.05E+00	6.05E+00	1.68E-01	1.68E-01	1.68E-01	1.21E-03	1.35E-03	0.00E+00	6.76E+00	8.68E+00	9.51E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	0.00E+00	0.00E+00	0.00E+00	1.23E-01	1.55E-01	1.93E-01	2.07E-02	2.58E-02	2.90E-02	3.19E+00	3.19E+00	3.19E+00	1.80E-01	1.80E-01	1.80E-01	4.11E-05	5.40E-05	0.00E+00	3.52E+00	3.55E+00	3.59E+00	1.45	3	3	3	20	<1	<1	<1
	Cr	0.00E+00	0.00E+00	0.00E+00	1.34E-02	1.61E-02	1.61E-02	1.04E-02	1.35E-02	1.69E-02	2.65E-01	2.65E-01	2.65E-01	1.35E-02	1.35E-02	1.35E-02	3.11E-04	9.22E-04	0.00E+00	3.03E-01	3.10E-01	3.12E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	0.00E+00	0.00E+00	0.00E+00	1.07E+00	2.09E+00	2.34E+00	2.52E-01	2.97E-01	3.17E-01	1.62E+01	1.62E+01	1.62E+01	4.78E+00	4.78E+00	4.78E+00	5.68E-04	6.16E-04	0.00E+00	2.23E+01	2.34E+01	2.36E+01	5.68	4	4	4	10.9	2	2	2
	Hg	0.00E+00	0.00E+00	0.00E+00	1.57E-01	2.89E-01	2.89E-01	8.81E-04	1.21E-03	1.53E-03	1.59E-01	1.59E-01	1.59E-01	6.88E-04	6.88E-04	6.88E-04	2.73E-04	5.53E-04	0.00E+00	3.18E-01	4.50E-01	4.50E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	0.00E+00	0.00E+00	0.00E+00	1.57E-01	2.89E-01	2.89E-01	3.28E-04	4.98E-04	4.98E-04	9.99E-03	9.99E-03	9.99E-03	1.57E-04	1.57E-04	1.57E-04	2.73E-04	5.53E-04	0.00E+00	1.67E-01	3.00E-01	2.99E-01	0.032	5	9	9	0.5	<1	<1	<1
	Mn	0.00E+00	0.00E+00	0.00E+00	1.65E+00	1.72E+00	1.72E+00	4.56E+00	5.81E+00	6.63E+00	1.28E+01	1.28E+01	1.28E+01	1.49E+00	1.49E+00	1.49E+00	1.31E-02	1.37E-02	0.00E+00	2.06E+01	2.19E+01	2.27E+01	26	<1	<1	<1	30	<1	<1	<1
	Pb	0.00E+00	0.00E+00	0.00E+00	3.95E-01	4.99E-01	7.10E-01	3.03E-01	3.81E-01	3.89E-01	5.88E+01	5.88E+01	5.88E+01	4.02E-01	4.02E-01	4.02E-01	9.10E-04	9.95E-04	0.00E+00	5.99E+01	6.01E+01	6.03E+01	3.85	16	16	16	11	6	6	6
	Se	0.00E+00	0.00E+00	0.00E+00	3.91E-02	6.33E-02	6.33E-02	8.19E-03	9.60E-03	1.14E-02	3.10E-01	3.10E-01	3.10E-01	4.82E-02	4.82E-02	4.82E-02	2.55E-04	3.45E-04	0.00E+00	4.05E-01	4.31E-01	4.33E-01	0.2	2	2	2	0.4	1	1	1
	Ag	0.00E+00	0.00E+00	0.00E+00	4.04E-04	6.61E-04	6.61E-04	2.69E-03	3.15E-03	3.23E-03	6.76E-01	6.76E-01	6.76E-01	3.47E-03	3.47E-03	3.47E-03	4.34E-04	9.22E-04	0.00E+00	6.83E-01	6.85E-01	6.84E-01	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	0.00E+00	0.00E+00	0.00E+00	5.51E-02	9.70E-02	9.70E-02	5.27E-04	8.53E-04	7.99E-04	1.07E-01	1.07E-01	1.07E-01	5.42E-04	5.42E-04	5.42E-04	4.78E-04	2.31E-03	0.00E+00	1.64E-01	2.08E-01	2.06E-01	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	0.00E+00	0.00E+00	0.00E+00	5.22E-03	6.36E-03	6.36E-03	3.00E-02	3.71E-02	4.07E-02	5.70E-01	5.70E-01	5.70E-01	2.44E-02	2.44E-02	2.44E-02	1.54E-03	4.61E-03	0.00E+00	6.31E-01	6.43E-01	6.42E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	0.00E+00	0.00E+00	0.00E+00	7.37E+00	8.85E+00	1.18E+01	3.62E+00	4.49E+00	5.24E+00	3.37E+01	3.37E+01	3.37E+01	4.85E+00	4.85E+00	4.85E+00	9.17E-03	9.90E-03	0.00E+00	4.95E+01	5.19E+01	5.55E+01	130	<1	<1	<1	No TRV	-	-	-
Site Perimeter (West) Wilson Ditch (SW&BI)	Al	0.00E+00	0.00E+00	0.00E+00	2.14E+02	3.15E+02	3.15E+02	3.11E+00	3.11E+00	3.11E+00	4.28E+01	4.28E+01	4.28E+01	3.75E+00	3.75E+00	3.75E+00	not measured			2.64E+02	3.64E+02	3.64E+02	124	2	3	3	No TRV	-	-	-
	As	0.00E+00	0.00E+00	0.00E+00	1.70E-01	3.72E-01	8.16E-01	4.53E-02	4.53E-02	4.53E-02	7.13E-01	7.13E-01	7.13E-01	3.36E-01	3.36E-01	3.36E-01	1.01E-03	1.84E-03	1.84E-03	1.27E+00	1.47E+00	1.91E+00	10	<1	<1	<1	40	<1	<1	<1
	Cd	0.00E+00	0.00E+00	0.00E+00	2.19E-01	3.30E-01	5.02E-01	4.22E-02	4.22E-02	4.22E-02	1.27E+00	1.27E+00	1.27E+00	2.11E-01	2.11E-01	2.11E-01	2.77E-04	5.53E-04	5.53E-04	1.74E+00	1.85E+00	2.02E+00	1.45	1	1	1	20	<1	<1	<1
	Cr	0.00E+00	0.00E+00	0.00E+00	1.63E-02	2.80E-02	2.80E-02	9.47E-03	9.47E-03	9.47E-03	6.79E-02	6.79E-02	6.79E-02	8.59E-03	8.59E-03	8.59E-03	not measured			1.02E-01	1.14E-01	1.14E-01	0.86	<1	<1	<1	4.32	<1	<1	<1
	Cu	0.00E+00	0.00E+00	0.00E+00	8.84E-01	1.45E+00	1.91E+00	3.36E-01	3.36E-01	3.36E-01	2.30E+00	2.30E+00	2.30E+00	1.22E+00	1.22E+00	1.22E+00	9.68E-04	1.84E-03	1.84E-03	4.74E+00	5.31E+00	5.77E+00	5.68	<1	<1	1	10.9	<1	<1	<1
	Hg	0.00E+00	0.00E+00	0.00E+00	9.64E-02	2.15E-01	2.15E-01	2.86E-03	2.86E-03	2.86E-03	1.14E-02	1.14E-02	1.14E-02	3.45E-03	3.45E-03	3.45E-03	9.22E-07	9.22E-07	9.22E-07	1.14E-01	2.33E-01	2.33E-01	0.74	<1	<1	<1	1.5	<1	<1	<1
	MeHg	0.00E+00	0.00E+00	0.00E+00	9.64E-02	2.15E-01	2.15E-01	7.19E-04	7.19E-04	7.19E-04	7.12E-04	7.12E-04	7.12E-04	2.89E-04	2.89E-04	2.89E-04	9.22E-07	9.22E-07	9.22E-07	9.81E-02	2.17E-01	2.17E-01	0.032	3	7	7	0.5	<1	<1	<1
	Mn	0.00E+00	0.00E+00	0.00E+00	2.28E+00	6.82E+00	6.82E+00	3.54E+00	3.54E+00	3.54E+00	4.55E+00	4.55E+00	4.55E+00	4.21E-01	4.21E-01	4.21E-01	1.01E-02	1.11E-02	1.11E-02	1.08E+01	1.53E+01	1.53E+01	26	<1	<1	<1	30	<1	<1	<1
	Pb	0.00E+00	0.00E+00	0.00E+00	6.43E-01	8.25E-01	1.32E+00	6.00E-01	6.00E-01	6.00E-01	5.24E+00	5.24E+00	5.24E+00	1.51E+00	1.51E+00	1.51E+00	4.93E-03	1.11E-02	1.11E-02	7.99E+00	8.18E+00	8.68E+00	3.85	2	2	2	11	<1	<1	<1
	Se	0.00E+00	0.00E+00	0.00E+00	1.44E-01	5.07E-01	5.07E-01	6.54E-03	6.54E-03	6.54E-03	1.50E-01	1.50E-01	1.50E-01	6.51E-02	6.51E-02	6.51E-02	not measured			3.65E-01	7.28E-01	7.28E-01	0.2	2	4	4	0.4	<1	2	2
	Ag	0.00E+00	0.00E+00	0.00E+00	2.58E-03	8.56E-03	8.56E-03	4.33E-03	4.33E-03	4.33E-03	5.92E-02	5.92E-02	5.92E-02	1.75E-02	1.75E-02	1.75E-02	not measured			8.36E-02	8.96E-02	8.96E-02	6.8	<1	<1	<1	21	<1	<1	<1
	Tl	0.00E+00	0.00E+00	0.00E+00	7.87E-02	1.57E-01	1.57E-01	5.64E-04	5.64E-04	5.64E-04	1.55E-02	1.55E-02	1.55E-02	5.32E-03	5.32E-03	5.32E-03	not measured			1.00E-01	1.79E-01	1.79E-01	0.237	<1	<1	<1	23.7	<1	<1	<1
	V	0.00E+00	0.00E+00	0.00E+00	4.48E-03	6.74E-03	6.74E-03	1.33E-02	1.33E-02	1.33E-02	1.65E-01	1.65E-01	1.65E-01	1.35E-02	1.35E-02	1.35E-02	not measured			1.96E-01	1.99E-01	1.99E-01	11	<1	<1	<1	No TRV	-	-	-
	Zn	0.00E+00	0.00E+00	0.00E+00	9.72E+00	1.31E+01	2.52E+01	1.20E+00	1.20E+00	1.20E+00	8.39E+00	8.39E+00	8.39E+00	3.42E+00	3.42E+00	3.42E+00	9.22E-03	1.84E-02	1.84E-02	2.27E+01	2.61E+01	3.82E+01	130	<1	<1	<1	No TRV	-	-	-

Tree Swallow Exposure Factors:

Body weight =	0.021	kg
Food ingestion rate (wet weight) =	0.0110	kg/d
Water ingestion rate =	0.0039	L/d
Soil ingestion rate (wet weight) =	0.0000	kg/d
Area use factor =	1	

Diet Composition:

Terrestrial Plants =	25%
Benthic Invertebrates =	25%
Soil Invertebrates =	25%
Aerial/Foliar Invertebrates =	25%
Sediment Ingestion (% of total diet) =	0.0%

Notes:

HQ> 1.0

Table E-25. Risk Assessment Results for Terrestrial Mammalian Insectivores (Short-Tailed Shrew)

		Dose: Soil Ingestion (mg/kg-d_{ww})			Dose: Terrestrial Plants (mg/kg-d_{ww})			Dose: Earthworms (mg/kg-d_{ww})			Dose: Soil Inverts. (mg/kg-d_{ww})			Dose: Aerial/Foliar Inverts. (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	LOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max
PPC (Riparian Zone)	Al	2.00E+02	2.53E+02	2.95E+02	2.79E+01	3.45E+01	3.49E+01	1.28E+01	2.10E+01	3.06E+01	1.21E+01	1.91E+01	1.91E+01	2.19E+00	2.19E+00	2.19E+00	3.12E-02	3.61E-02	6.75E-02	2.55E+02	3.30E+02	3.82E+02	1.93	132	171	198	19.3	13	17	20
	Sb	5.42E-01	2.04E+00	2.25E+00	2.17E-03	6.66E-03	7.60E-03	1.48E-02	2.19E-02	3.12E-02	1.93E-01	2.96E-01	2.96E-01	1.29E-02	1.29E-02	1.29E-02	1.48E-03	6.75E-03	6.75E-03	7.66E-01	2.38E+00	2.60E+00	0.07	11	34	37	0.72	1	3	4
	As	3.14E+00	8.67E+00	9.32E+00	1.51E-02	3.21E-02	3.85E-02	5.70E-01	7.33E-01	9.31E-01	5.00E-01	7.30E-01	7.30E-01	8.48E-02	8.48E-02	8.48E-02	1.48E-03	1.65E-03	9.00E-03	4.31E+00	1.02E+01	1.11E+01	0.75	6	14	15	3	2	4	4
	Cd	6.75E-01	1.78E+00	2.32E+00	1.37E-02	2.15E-02	2.51E-02	3.76E-01	5.14E-01	6.05E-01	7.99E-01	9.33E-01	9.33E-01	9.09E-02	9.09E-02	9.09E-02	5.02E-05	6.59E-05	8.10E-05	1.95E+00	3.33E+00	3.97E+00	1	2	3	4	10	<1	<1	<1
	Cr	4.70E-01	6.35E-01	8.43E-01	2.60E-03	3.14E-03	3.80E-03	1.67E-02	2.57E-02	3.56E-02	3.86E-02	6.37E-02	6.37E-02	6.84E-03	6.84E-03	6.84E-03	3.80E-04	1.13E-03	1.13E-03	5.35E-01	7.35E-01	9.54E-01	0.596	<1	1	2	5.96	<1	<1	<1
	Cu	1.20E+01	3.38E+01	4.14E+01	8.57E-02	1.22E-01	1.33E-01	2.64E-01	3.47E-01	4.04E-01	2.88E+00	2.98E+00	2.98E+00	2.42E+00	2.42E+00	2.42E+00	6.93E-04	7.52E-04	1.58E-03	1.77E+01	3.97E+01	4.73E+01	11.7	2	3	4	15.1	1	3	3
	Fe	7.39E+02	1.63E+03	1.76E+03	9.76E+01	1.37E+02	1.93E+02	2.34E+01	3.80E+01	5.55E+01	3.98E+01	6.84E+01	6.84E+01	5.69E+00	5.69E+00	5.69E+00	7.23E-02	7.71E-02	1.58E-01	9.06E+02	1.88E+03	2.08E+03	No TRV	-	-	-	No TRV	-	-	-
	Hg	9.95E-02	4.42E-01	4.42E-01	1.19E-02	4.86E-02	4.86E-02	3.20E-03	4.61E-03	6.63E-03	9.61E-03	1.66E-02	1.66E-02	3.48E-04	3.48E-04	3.48E-04	3.33E-04	6.75E-04	6.75E-04	1.25E-01	5.12E-01	5.14E-01	1	<1	<1	<1	18.8	<1	<1	<1
	MeHg	9.95E-02	4.42E-01	4.42E-01	1.19E-02	4.86E-02	4.86E-02	5.50E-04	5.50E-04	5.50E-04	6.01E-04	6.01E-04	6.01E-04	4.87E-05	4.87E-05	4.87E-05	3.33E-04	6.75E-04	6.75E-04	1.13E-01	4.92E-01	4.92E-01	0.032	4	15	15	0.16	<1	3	3
	Mn	2.84E+01	4.01E+01	5.42E+01	3.04E-01	3.99E-01	4.71E-01	2.00E+00	2.99E+00	4.27E+00	2.68E+01	3.01E+01	3.01E+01	7.55E-01	7.55E-01	7.55E-01	1.60E-02	1.67E-02	2.93E-02	5.82E+01	7.44E+01	8.99E+01	88	<1	<1	1	280	<1	<1	<1
	Pb	3.80E+01	1.14E+02	1.44E+02	5.81E-02	9.93E-02	1.16E-01	5.79E-01	7.67E-01	9.26E-01	5.88E+00	1.02E+01	1.02E+01	2.03E-01	2.03E-01	2.03E-01	1.11E-03	1.21E-03	4.50E-03	4.47E+01	1.25E+02	1.56E+02	11	4	11	14	90	<1	1	2
	Se	2.44E-01	1.33E+00	1.33E+00	1.70E-02	1.07E-01	1.07E-01	3.50E-02	4.68E-02	5.99E-02	6.14E-02	8.00E-02	8.00E-02	2.44E-02	2.44E-02	2.44E-02	3.12E-04	4.21E-04	9.00E-04	3.82E-01	1.58E+00	1.60E+00	0.2	2	8	8	0.33	1	5	5
	Ag	5.16E-01	1.97E+00	2.17E+00	8.66E-05	2.92E-04	3.34E-04	7.02E-03	9.00E-03	1.07E-02	8.20E-02	1.33E-01	1.33E-01	1.75E-03	1.75E-03	1.75E-03	5.30E-04	1.13E-03	1.13E-03	6.08E-01	2.12E+00	2.32E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	3.40E-02	9.74E-02	1.04E-01	4.31E-03	1.08E-02	1.15E-02	2.23E-03	4.45E-03	4.45E-03	7.97E-03	1.16E-02	1.16E-02	2.74E-04	2.74E-04	2.74E-04	5.84E-04	2.81E-03	2.81E-03	4.93E-02	1.27E-01	1.35E-01	0.074	<1	2	2	0.74	<1	<1	<1
	V	1.25E+00	1.42E+00	1.57E+00	8.50E-04	9.46E-04	9.85E-04	7.93E-02	2.17E-01	2.75E-01	6.30E-02	1.03E-01	1.03E-01	1.23E-02	1.23E-02	1.23E-02	1.87E-03	5.63E-03	5.63E-03	1.41E+00	1.75E+00	1.96E+00	0.209	7	8	9	2.09	<1	<1	<1
	Zn	4.13E+01	1.15E+02	1.21E+02	1.09E+00	1.55E+00	1.80E+00	4.52E+00	6.39E+00	7.24E+00	1.53E+01	1.91E+01	1.91E+01	2.45E+00	2.45E+00	2.45E+00	1.12E-02	1.21E-02	2.13E-02	6.46E+01	1.45E+02	1.51E+02	160	<1	<1	<1	320	<1	<1	<1
UL&M (Banks)	Al	3.30E+02	5.02E+02	5.02E+02	3.88E+01	5.93E+01	5.79E+01	3.10E+02	4.74E+02	4.63E+02	5.54E+01	5.54E+01	5.54E+01	1.25E+01	1.25E+01	1.25E+01	7.09E-02	1.18E-01	3.65E-01	7.47E+02	1.10E+03	1.09E+03	1.93	387	572	565	19.3	39	57	57
	Sb	9.83E-01	2.40E+00	2.40E+00	3.54E-03	7.22E-03	8.24E-03	8.77E-01	1.87E+00	2.16E+00	1.17E-01	1.17E-01	1.17E-01	6.90E-02	6.90E-02	6.90E-02	5.83E-03	6.75E-03	6.75E-03	2.05E+00	4.47E+00	4.75E+00	0.07	29	64	68	0.72	3	6	7
	As	6.37E+00	1.26E+01	1.54E+01	2.70E-02	5.26E-02	6.51E-02	3.11E-01	4.98E-01	5.79E-01	7.85E-01	7.85E-01	7.85E-01	1.35E-01	1.35E-01	1.35E-01	2.86E-03	3.67E-03	7.09E-03	7.63E+00	1.41E+01	1.70E+01	0.75	10	19	23	3	3	5	6
	Cd	4.34E+00	1.03E+01	1.49E+01	3.58E-02	5.73E-02	7.04E-02	1.23E+01	2.44E+01	3.29E+01	7.33E-01	7.33E-01	7.33E-01	1.45E-01	1.45E-01	1.45E-01	7.99E-04	1.66E-03	6.75E-03	1.75E+01	3.56E+01	4.88E+01	1	18	36	49	10	2	4	5
	Cr	4.92E-01	6.27E-01	6.65E-01	2.50E-03	2.89E-03	3.08E-03	1.49E-01	1.72E-01	1.84E-01	5.19E-02	5.19E-02	5.19E-02	2.44E-02	2.44E-02	2.44E-02	4.59E-04	6.56E-04	1.35E-03	7.20E-01	8.79E-01	9.29E-01	0.596	1	2	2	5.96	<1	<1	<1
	Co	2.33E-01	3.91E-01	5.11E-01	2.05E-04	3.34E-04	4.31E-04	2.67E-02	4.35E-02	5.60E-02	2.66E-02	2.66E-02	2.66E-02	8.66E-03	8.66E-03	8.66E-03	3.67E-04	6.08E-04	6.08E-04	2.96E-01	4.70E-01	6.03E-01	0.5	<1	<1	1	2	<1	<1	<1
	Cu	1.16E+01	2.51E+01	3.46E+01	8.12E-02	1.10E-01	1.25E-01	5.40E+00	1.16E+01	1.61E+01	2.11E+00	2.11E+00	2.11E+00	1.14E+00	1.14E+00	1.14E+00	2.61E-03	4.84E-03	6.23E-03	2.03E+01	4.00E+01	5.41E+01	11.7	2	4	5	15.1	1	3	4
	Hg	8.51E-01	1.88E+00	2.36E+00	9.39E-02	2.07E-01	2.56E-01	7.51E-01	1.66E+00	2.05E+00	3.77E-02	3.77E-02	3.77E-02	1.13E-02	1.13E-02	1.13E-02	8.78E-06	1.13E-04	1.13E-04	1.75E+00	3.80E+00	4.72E+00	1	2	4	5	18.8	<1	<1	<1
	MeHg	8.51E-01	1.88E+00	2.36E+00	9.39E-02	2.07E-01	2.56E-01	5.83E-04	5.83E-04	5.83E-04	2.37E-03	2.37E-03	2.37E-03	1.58E-03	1.58E-03	1.58E-03	8.78E-06	1.13E-04	1.13E-04	9.49E-01	2.10E+00	2.62E+00	0.032	30	66	82	0.16	6	13	16
	Mn	1.47E+01	2.20E+01	2.55E+01	1.46E-01	2.38E-01	3.00E-01	9.65E-01	1.35E+00	1.58E+00	3.16E+00	3.16E+00	3.16E+00	6.10E-01	6.10E-01	6.10E-01	8.08E-02	2.48E-01	4.91E-01	1.97E+01	2.76E+01	3.16E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	1.02E+02	2.36E+02	3.41E+02	9.64E-02	1.54E-01	1.90E-01	1.62E+01	3.18E+01	4.29E+01	6.94E+00	6.94E+00	6.94E+00	1.02E+00	1.02E+00	1.02E+00	2.11E-02	7.20E-02	1.80E-01	1.26E+02	2.76E+02	3.93E+02	11	12	25	36	90	2	3	4
	Se	8.11E-01	2.12E+00	2.12E+00	6.25E-02	1.84E-01	1.84E-01	2.99E-01	6.10E-01	6.10E-01	3.93E-01	3.93E-01	3.93E-01	8.97E-02	8.97E-02	8.97E-02	3.39E-03	3.94E-03	3.94E-03	1.66E+00	3.40E+00	3.40E+00	0.2	8	17	17	0.33	5	10	10
	Ag	7.38E-01	1.74E+00	2.40E+00	1.16E-04	2.73E-04	3.77E-04	1.36E+00	3.19E+00	4.41E+00	5.64E-02	5.64E-02	5.64E-02	1.59E-02	1.59E-02	1.59E-02	1.89E-04	2.01E-04	2.12E-04	2.17E+00	5.00E+00	6.88E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	1.17E-01	2.32E-01	2.75E-01	1.31E-02	2.57E-02	3.09E-02	1.05E-01	2.06E-01	2.47E-01	1.36E-02	1.36E-02	1.36E-02	1.11E-02	1.11E-02	1.11E-02	2.42E-03	2.81E-03	2.81E-03	2.62E-01	4.91E-01	5.81E-01	0.074	4	7	8	0.74	<1	<1	<1
	V	1.21E+00	1.81E+00	1.88E+00	7.07E-04	1.05E-03	1.03E-03	4.90E-02	7.27E-02	7.12E-02	1.20E-01	1.20E-01	1.20E-01	4.82E-02	4.82E-02	4.82E-02	8.66E-04	1.12E-03	1.26E-03	1.43E+00	2.05E+00	2.12E+00	0.209	7	10	10	2.09	<1	<1	1
	Zn	3.20E+01	1.03E+02	1.03E+02	8.89E-01	1.36E+00	1.67E+00	2.75E+01	3.54E+01	4.00E+01	7.07E+00	7.07E+00	7.07E+00	2.03E+00	2.03E+00	2.03E+00	2.03E-02	2.88E-02	6.75E-02	6.95E+01	1.49E+02	1.54E+02	160	<1	<1	<1	320	<1	<1	<1
LL (Banks)	Al	3.35E+02	4.81E+02	4.81E+02	3.97E+01	5.48E+01	5.48E+01	3.17E+02	4.38E+02	4.38E+02	1.22E+02	1.70E+02	1.70E+02	1.25E+01	1.25E+01	1.25E+01	1.50E-02	2.25E-02	2.25E-02	8.26E+02	1.16E+03	1.16E+03	1.93	428	599	599	19.3	43	60	60
	Sb	1.26E+00	4.54E+00	4.54E+00	4.52E-03	1.49E-02	1.49E-02	1.14E+00	4.06E+00	4.06E+00	4.64E-01	5.41E-01	5.41E-01	6.90E-02	6.90E-02	6.90E-02	6.19E-02	8.47E-02	9.83E-02	3.00E+00	9.31E+00	9.32E+00	0.07	43	133	133	0.72	4	13	13
	As	1.27E+01	4.69E+01	4.69E+01	5.37E-02	1.97E-01	1.97E-01	5.05E-01	1.27E+00	1.27E+00	1.88E+00	2.43E+00	2.43E+00	1.35E-01	1.35E-01	1.35E-01	3.58E-02	5.06E-02	5.47E-02	1.53E+01	5.10E+01	5.10E+01	0.75	21	68	68	3	5	17	17
	Cd	4.03E+00	1.38E+01	1.38E+01	3.46E-02	6.73E-02	6.73E-02	1.17E+01	3.08E+01	3.08E+01	1.30E+00	1.56E+00	1.56E+00	1.45E-01	1.45E-01	1.45E-01	2.24E-03	2.97E-03	9.00E-03	1.72E+01	4.64E+01	4.64E+01	1	17	47	47	10	2	5	5
	Cr	5.27E-01	6.59E-01	6.59E-01	2.54E-03	3.08E-03	3.08E-03	1.51E-01	1.84E-01	1.84E-01	1.85E-01	2.46E-01	2.46E-01	2.44E-02	2.44E-02	2.44E-02	1.85E-04	2.25E-04	2.25E-04	8.91E-01	1.12E+00	1.12E+00	0.596	2	2	2	5.96	<1	<1	<1
	Cu	2.75E+01	9.51E+01	9.51E+01	1.14E-01	1.85E-01	1.85E-01	1.28E+01	4.39E+01	4.39E+01	8.18E+00	1.01E+01	1.01E+01	1.14E+00	1.14E+00	1.14E+00	6.58E-03	7.96E-03	1.58E-02	4.98E+01	1.50E+02	1.50E+02	11.7	4	13	13	15.1	3	10	10
	Hg	3.12E-01	1.10E+00	1.10E+00	3.53E-02	1.24E-01	1.24E-01	2.83E-01	9.89E-01	9.89E-01	7.27E-02	8.11E-02	8.11E-02	1.13E-02	1.13E-02	1.13E-02	8.44E-06	1.13E-05	1.13E-05	7.14E-01	2.31E+00	2.31E+00	1	<1	2	2	18.8	<1	<1	<1
	MeHg	3.12E-01	1.10E+00	1.10E+00	3.53E-02	1.24E-01	1.24E-01	2.83E-01	9.89E-01	9.89E-01	5.18E-03	7.49E-03	7.49E-03	1.58E-03	1.58E-03	1.58E-03	8.44E-06	1.13E-05	1.13E-05	6.37E-01	2.23E+00	2.23E+00	0.032	20	70	70	0.16	4	14	14
	Mn	1.86E+01	4.10E+01	4.10E+01	1.70E-01	3.63E-01	3.63E-01	1.07E+00	1.80E+00	1.80E+00	1.49E+01	1.62E+01	1.62E+01	6.10E-01	6.10E-01	6.10E-01	5.38E-02	6.47E-02	1.13E-01	3.54E+01	6.00E+01	6.01E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	8.91E+01	3.21E+02	3.21E+02	8.96E-02	1.83E-01	1.83E-01	1.46E+01	4.06E+01	4.06E+01	1.78E+01	2.25E+01	2.25E+01	1.02E+00	1.02E+00	1.02E+00	1.56E-02	1.91E-02	4.01E-02	1.23E+02	3.85E+02	3.85E+02	11	11	35	35	90	1	4	4
	Se	2.84E-01	9.07E-01	9.07E-01	2.03E-02	7.15E-02	7.15E-02	1.41E-01	3.26E-01	3.26E-01	8.29E-01	8.87E-01	8.87E-01	8.97E-02	8.97E-02	8.97E-02	8.74E-03	1.05E-02	1.22E-02	1.37E+00	2.29E+00	2.29E+00	0.2	7	12	12	0.33	4	7	7
	Ag	1.05E+00	3.55E+00	3.55E+00	1.67E-04	5.57E-04	5.57E-04	1.95E+00	6.50E+00	6.50E+00	3.48E-01	4.66E-01	4.66E-01	1.59E-02	1.59E-02	1.59E-02	3.38E-04	4.73E-04	4.73E-04	3.36E+00	1.05E+01	1.05E+01	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	3.18E-01	1.14E+00	1.14E+00	3.59E-02	1.28E-01	1.28E-01	2.87E-01	1.02E+00	1.02E+00	1.01E-01	1.07E-01	1.07E-01	1.11E-02	1.11E-02	1.11E-02	1.20E-02	1.57E-02	1.73E-02	7.65E-01	2.43E+00	2.43E+00	0.074	10	33	33	0.74	1	3	3
	V	1.50E+00	1.86E+00	1.86E+00	8.57E-04	1.03E-03	1.03E-03	5.94E-02	7.12E-02	7.12E-02	4.16E-01	5.68E-01	5.68E-01	4.82E-02	4.82E-02	4.82E-02	3.05E-03	5.63E-03	5.63E-03	2.03E+00	2.56E+00	2.56E+00	0.209	10	12	12	2.09	<1	1	1
	Zn	5.80E+01	2.08E+02	2.08E+02	1.22E+00	2.46E+00	2.46E+00	3.32E+01	5.03E+01	5.03E+01	1.39E+01	1.54E+01	1.54E+01	2.03E+00	2.03E+00	2.03E+00	1.56E-02	2.02E-02	4.50E-02	1.08E+02	2.78E+02	2.78E+02	160	<1	2	2	320	<1	<1	<1

Table E-25. Risk Assessment Results for Terrestrial Mammalian Insectivores (Short-Tailed Shrew)

		Dose: Soil Ingestion (mg/kg-d_{ww})			Dose: Terrestrial Plants (mg/kg-d_{ww})			Dose: Earthworms (mg/kg-d_{ww})			Dose: Soil Inverts. (mg/kg-d_{ww})			Dose: Aerial/Foliar Inverts. (mg/kg-d_{ww})			Dose: Surface Water (mg/kg-d_{ww})			Total Dietary Dose (mg/kg-d_{ww})			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max	LOAEL (mg/kg-d_{ww})	Mean	95% UCL	Max
Tito Park LL (SW)	Al	4.34E+02	4.68E+02	4.96E+02	5.21E+01	5.59E+01	5.92E+01	4.17E+02	4.47E+02	4.74E+02	4.32E+01	4.32E+01	4.32E+01	1.25E+01	1.25E+01	1.25E+01	1.50E-02	2.25E-02	2.25E-02	9.59E+02	1.03E+03	1.08E+03	1.93	497	532	562	19.3	50	53	56
	Sb	7.50E-01	2.51E+00	2.51E+00	2.90E-03	8.99E-03	8.99E-03	7.07E-01	2.37E+00	2.37E+00	2.17E-01	2.17E-01	2.17E-01	6.90E-02	6.90E-02	6.90E-02	6.19E-02	8.47E-02	9.83E-02	1.81E+00	5.26E+00	5.28E+00	0.07	26	75	75	0.72	3	7	7
	As	5.93E+01	1.07E+02	2.97E+02	2.68E-01	4.81E-01	1.34E+00	1.57E+00	2.37E+00	4.90E+00	8.24E-01	8.24E-01	8.24E-01	1.35E-01	1.35E-01	1.35E-01	3.58E-02	5.06E-02	5.47E-02	6.22E+01	1.10E+02	3.05E+02	0.75	83	147	406	3	21	37	102
	Cd	6.27E+01	2.08E+02	5.41E+02	1.60E-01	3.08E-01	5.18E-01	1.09E+02	2.82E+02	6.02E+02	1.18E+00	1.18E+00	1.18E+00	1.45E-01	1.45E-01	1.45E-01	2.24E-03	2.97E-03	9.00E-03	1.73E+02	4.92E+02	1.15E+03	1	173	492	1146	10	17	49	115
	Cr	5.83E-01	6.63E-01	6.77E-01	2.87E-03	3.21E-03	3.26E-03	1.71E-01	1.92E-01	1.95E-01	7.49E-02	7.49E-02	7.49E-02	2.44E-02	2.44E-02	2.44E-02	1.85E-04	2.25E-04	2.25E-04	8.57E-01	9.57E-01	9.75E-01	0.596	2	2	2	5.96	<1	<1	<1
	Cu	1.24E+02	2.31E+02	8.67E+02	2.12E-01	2.70E-01	4.55E-01	6.15E+01	1.15E+02	4.29E+02	2.69E+00	2.69E+00	2.69E+00	1.14E+00	1.14E+00	1.14E+00	6.58E-03	7.96E-03	1.58E-02	1.90E+02	3.50E+02	1.30E+03	11.7	16	30	111	15.1	13	23	86
	Hg	1.29E-01	3.76E-01	3.76E-01	1.52E-02	4.42E-02	4.42E-02	1.22E-01	3.53E-01	3.53E-01	1.74E-02	1.74E-02	1.74E-02	1.13E-02	1.13E-02	1.13E-02	8.44E-06	1.13E-05	1.13E-05	2.94E-01	8.02E-01	8.02E-01	1	<1	<1	<1	18.8	<1	<1	<1
	MeHg	1.29E-01	3.76E-01	3.76E-01	1.52E-02	4.42E-02	4.42E-02	1.22E-01	3.53E-01	3.53E-01	1.09E-03	1.09E-03	1.09E-03	1.52E-04	1.52E-04	1.52E-04	8.44E-06	1.13E-05	1.13E-05	2.67E-01	7.75E-01	7.75E-01	0.032	8	24	24	0.16	2	5	5
	Mn	1.18E+01	1.57E+01	1.85E+01	1.11E-01	1.47E-01	1.72E-01	8.03E-01	9.70E-01	1.08E+00	3.22E+00	3.22E+00	3.22E+00	6.10E-01	6.10E-01	6.10E-01	5.38E-02	6.47E-02	1.13E-01	1.66E+01	2.07E+01	2.37E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	4.93E+02	1.09E+03	2.62E+03	2.42E-01	3.77E-01	6.17E-01	6.09E+01	1.15E+02	2.34E+02	3.24E+00	3.24E+00	3.24E+00	1.02E+00	1.02E+00	1.02E+00	1.56E-02	1.91E-02	4.01E-02	5.58E+02	1.21E+03	2.86E+03	11	51	110	260	90	6	14	32
	Se	1.65E-01	3.32E-01	4.88E-01	1.16E-02	2.49E-02	3.81E-02	9.77E-02	1.62E-01	2.15E-01	5.68E-01	5.68E-01	5.68E-01	8.97E-02	8.97E-02	8.97E-02	8.74E-03	1.05E-02	1.22E-02	9.41E-01	1.19E+00	1.41E+00	0.2	5	6	7	0.33	3	4	4
	Ag	6.04E-01	1.26E+00	1.58E+00	1.00E-04	2.07E-04	2.60E-04	1.17E+00	2.42E+00	3.04E+00	3.45E-02	3.45E-02	3.45E-02	1.59E-02	1.59E-02	1.59E-02	3.38E-04	4.73E-04	4.73E-04	1.82E+00	3.73E+00	4.66E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	8.37E-02	3.00E-01	3.00E-01	9.98E-03	3.53E-02	3.53E-02	7.99E-02	2.83E-01	2.83E-01	2.17E-02	2.17E-02	2.17E-02	1.11E-02	1.11E-02	1.11E-02	1.20E-02	1.57E-02	1.73E-02	2.18E-01	6.67E-01	6.68E-01	0.074	3	9	9	0.74	<1	<1	<1
	V	1.53E+00	1.60E+00	1.67E+00	8.89E-04	9.24E-04	9.64E-04	6.16E-02	6.40E-02	6.68E-02	2.17E-01	2.17E-01	2.17E-01	4.82E-02	4.82E-02	4.82E-02	3.05E-03	5.63E-03	5.63E-03	1.86E+00	1.93E+00	2.01E+00	0.209	9	9	10	2.09	<1	<1	<1
	Zn	2.88E+02	4.47E+02	1.62E+03	3.06E+00	3.91E+00	7.98E+00	5.72E+01	6.61E+01	1.01E+02	1.14E+01	1.14E+01	1.14E+01	2.03E+00	2.03E+00	2.03E+00	1.56E-02	2.02E-02	4.50E-02	3.61E+02	5.30E+02	1.74E+03	160	2	3	11	320	1	2	6
Site Perimeter (East) PPC (SW)	Al	2.53E+02	2.69E+02	2.69E+02	2.79E+01	3.01E+01	3.01E+01	2.24E+02	2.41E+02	2.41E+02	2.01E+02	2.01E+02	2.01E+02	2.19E+00	2.19E+00	2.19E+00	3.12E-02	3.61E-02	0.00E+00	7.07E+02	7.44E+02	7.44E+02	1.93	367	385	385	19.3	37	39	39
	Sb	6.64E-01	1.11E+00	1.11E+00	2.45E-03	3.97E-03	3.97E-03	5.92E-01	9.89E-01	9.89E-01	2.04E+00	2.04E+00	2.04E+00	1.29E-02	1.29E-02	1.29E-02	1.48E-03	6.75E-03	0.00E+00	3.32E+00	4.16E+00	4.16E+00	0.07	47	60	59	0.72	5	6	6
	As	1.67E+01	9.12E+01	1.23E+02	7.02E-02	3.84E-01	5.17E-01	6.10E-01	2.03E+00	2.50E+00	8.15E+00	8.15E+00	8.15E+00	8.48E-02	8.48E-02	8.48E-02	1.48E-03	1.65E-03	0.00E+00	2.56E+01	1.02E+02	1.34E+02	0.75	34	136	179	3	9	34	45
	Cd	1.59E+00	2.43E+00	3.62E+00	2.07E-02	2.61E-02	3.24E-02	5.54E+00	7.75E+00	1.07E+01	4.30E+00	4.30E+00	4.30E+00	9.09E-02	9.09E-02	9.09E-02	5.02E-05	6.59E-05	0.00E+00	1.15E+01	1.46E+01	1.87E+01	1	12	15	19	10	1	2	2
	Cr	5.01E-01	6.07E-01	6.07E-01	2.26E-03	2.72E-03	2.72E-03	1.35E-01	1.62E-01	1.62E-01	3.58E-01	3.58E-01	3.58E-01	6.84E-03	6.84E-03	6.84E-03	3.80E-04	1.13E-03	0.00E+00	1.00E+00	1.14E+00	1.14E+00	0.596	2	2	2	5.96	<1	<1	<1
	Cu	8.79E+01	4.83E+02	6.44E+02	1.80E-01	3.52E-01	3.94E-01	4.07E+01	2.24E+02	2.98E+02	2.18E+01	2.18E+01	2.18E+01	2.42E+00	2.42E+00	2.42E+00	6.93E-04	7.52E-04	0.00E+00	1.53E+02	7.31E+02	9.67E+02	11.7	13	63	83	15.1	10	49	64
	Hg	2.36E-01	4.34E-01	4.34E-01	2.64E-02	4.86E-02	4.86E-02	2.11E-01	3.89E-01	3.89E-01	2.15E-01	2.15E-01	2.15E-01	3.48E-04	3.48E-04	3.48E-04	3.33E-04	6.75E-04	0.00E+00	6.89E-01	1.09E+00	1.09E+00	1	<1	1	1	18.8	<1	<1	<1
	MeHg	2.36E-01	4.34E-01	4.34E-01	2.64E-02	4.86E-02	4.86E-02	2.11E-01	3.89E-01	3.89E-01	1.35E-02	1.35E-02	1.35E-02	7.95E-05	7.95E-05	7.95E-05	3.33E-04	6.75E-04	0.00E+00	4.88E-01	8.86E-01	8.85E-01	0.032	15	28	28	0.16	3	6	6
	Mn	3.18E+01	3.36E+01	3.36E+01	2.78E-01	2.90E-01	2.90E-01	1.50E+00	1.54E+00	1.54E+00	1.73E+01	1.73E+01	1.73E+01	7.55E-01	7.55E-01	7.55E-01	1.60E-02	1.67E-02	0.00E+00	5.17E+01	5.35E+01	5.35E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	5.28E+01	8.00E+01	1.50E+02	6.65E-02	8.40E-02	1.19E-01	9.49E+00	1.33E+01	2.21E+01	7.93E+01	7.93E+01	7.93E+01	2.03E-01	2.03E-01	2.03E-01	1.11E-03	1.21E-03	0.00E+00	1.42E+02	1.73E+02	2.52E+02	11	13	16	23	90	2	2	3
	Se	1.05E-01	1.62E-01	1.62E-01	6.58E-03	1.07E-02	1.07E-02	6.70E-02	9.22E-02	9.22E-02	4.17E-01	4.17E-01	4.17E-01	2.44E-02	2.44E-02	2.44E-02	3.12E-04	4.21E-04	0.00E+00	6.21E-01	7.07E-01	7.06E-01	0.2	3	4	4	0.33	2	2	2
	Ag	4.36E-01	7.11E-01	7.11E-01	6.80E-05	1.11E-04	1.11E-04	7.95E-01	1.30E+00	1.30E+00	9.11E-01	9.11E-01	9.11E-01	1.75E-03	1.75E-03	1.75E-03	5.30E-04	1.13E-03	0.00E+00	2.14E+00	2.93E+00	2.92E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	8.32E-02	1.46E-01	1.46E-01	9.28E-03	1.63E-02	1.63E-02	7.42E-02	1.31E-01	1.31E-01	1.45E-01	1.45E-01	1.45E-01	2.74E-04	2.74E-04	2.74E-04	5.84E-04	2.81E-03	0.00E+00	3.12E-01	4.41E-01	4.38E-01	0.074	4	6	6	0.74	<1	<1	<1
	V	1.64E+00	2.02E+00	2.02E+00	8.78E-04	1.07E-03	1.07E-03	6.09E-02	7.42E-02	7.42E-02	7.68E-01	7.68E-01	7.68E-01	1.23E-02	1.23E-02	1.23E-02	1.87E-03	5.63E-03	0.00E+00	2.49E+00	2.89E+00	2.88E+00	0.209	12	14	14	2.09	1	1	1
	Zn	6.07E+01	8.48E+01	1.44E+02	1.24E+00	1.49E+00	1.98E+00	3.35E+01	3.73E+01	4.42E+01	4.54E+01	4.54E+01	4.54E+01	2.45E+00	2.45E+00	2.45E+00	1.12E-02	1.21E-02	0.00E+00	1.43E+02	1.71E+02	2.38E+02	160	<1	1	2	320	<1	<1	<1
Site Perimeter (West) Wilson Ditch (SW)	Al	3.21E+02	4.65E+02	4.65E+02	3.61E+01	5.30E+01	5.30E+01	2.89E+02	4.24E+02	4.24E+02	5.77E+01	5.77E+01	5.77E+01	1.90E+00	1.90E+00	1.90E+00	not measured			7.05E+02	1.00E+03	1.00E+03	1.93	366	519	519	19.3	37	52	52
	Sb	1.39E+00	3.59E+00	3.59E+00	4.94E-03	1.21E-02	1.21E-02	1.25E+00	3.25E+00	3.25E+00	3.27E-01	3.27E-01	3.27E-01	4.13E-02	4.13E-02	4.13E-02	not measured			3.01E+00	7.23E+00	7.23E+00	0.07	43	103	103	0.72	4	10	10
	As	6.77E+00	1.48E+01	3.24E+01	2.86E-02	6.26E-02	1.37E-01	3.24E-01	5.63E-01	9.81E-01	9.61E-01	9.61E-01	9.61E-01	1.70E-01	1.70E-01	1.70E-01	1.24E-03	2.25E-03	2.25E-03	8.26E+00	1.66E+01	3.46E+01	0.75	11	22	46	3	3	6	12
	Cd	4.59E+00	9.69E+00	2.09E+01	3.69E-02	5.56E-02	8.46E-02	1.29E+01	2.33E+01	4.30E+01	1.71E+00	1.71E+00	1.71E+00	1.07E-01	1.07E-01	1.07E-01	3.38E-04	6.75E-04	6.75E-04	1.93E+01	3.49E+01	6.58E+01	1	19	35	66	10	2	4	7
	Cr	5.93E-01	1.02E+00	1.02E+00	2.74E-03	4.71E-03	4.71E-03	1.64E-01	2.81E-01	2.81E-01	9.15E-02	9.15E-02	9.15E-02	4.34E-03	4.34E-03	4.34E-03	not measured			8.55E-01	1.40E+00	1.40E+00	0.596	2	2	2	5.96	<1	<1	<1
	Cu	5.44E+01	1.93E+02	3.83E+02	1.49E-01	2.45E-01	3.21E-01	2.51E+01	8.91E+01	1.77E+02	3.11E+00	3.11E+00	3.11E+00	6.14E-01	6.14E-01	6.14E-01	1.18E-03	2.25E-03	2.25E-03	8.34E+01	2.86E+02	5.65E+02	11.7	7	25	48	15.1	6	19	38
	Hg	1.45E-01	3.20E-01	3.20E-01	1.62E-02	3.62E-02	3.62E-02	1.30E-01	2.90E-01	2.90E-01	1.53E-02	1.53E-02	1.53E-02	1.74E-03	1.74E-03	1.74E-03	1.13E-06	1.13E-06	1.13E-06	3.08E-01	6.63E-01	6.63E-01	1	<1	<1	<1	18.8	<1	<1	<1
	MeHg	1.45E-01	3.20E-01	3.20E-01	1.62E-02	3.62E-02	3.62E-02	1.30E-01	2.90E-01	2.90E-01	9.59E-04	9.59E-04	9.59E-04	1.46E-04	1.46E-04	1.46E-04	1.13E-06	1.13E-06	1.13E-06	2.92E-01	6.47E-01	6.47E-01	0.032	9	20	20	0.16	2	4	4
	Mn	4.30E+01	1.29E+02	1.29E+02	3.83E-01	1.15E+00	1.15E+00	1.87E+00	3.94E+00	3.94E+00	6.13E+00	6.13E+00	6.13E+00	2.13E-01	2.13E-01	2.13E-01	1.24E-02	1.35E-02	1.35E-02	5.16E+01	1.40E+02	1.40E+02	88	<1	2	2	280	<1	<1	<1
	Pb	1.26E+02	1.96E+02	4.56E+02	1.08E-01	1.39E-01	2.23E-01	1.91E+01	2.74E+01	5.41E+01	7.06E+00	7.06E+00	7.06E+00	7.61E-01	7.61E-01	7.61E-01	6.02E-03	1.35E-02	1.35E-02	1.53E+02	2.31E+02	5.18E+02	11	14	21	47	90	2	3	6
	Se	3.38E-01	1.05E+00	1.05E+00	2.42E-02	8.54E-02	8.54E-02	1.59E-01	3.67E-01	3.67E-01	2.02E-01	2.02E-01	2.02E-01	3.29E-02	3.29E-02	3.29E-02	not measured			7.56E-01	1.74E+00	1.74E+00	0.2	4	9	9	0.33	2	5	5
	Ag	2.75E+00	9.10E+00	9.10E+00	4.34E-04	1.44E-03	1.44E-03	5.08E+00	1.68E+01	1.68E+01	7.98E-02	7.98E-02	7.98E-02	8.83E-03	8.83E-03	8.83E-03	not measured			7.92E+00	2.60E+01	2.60E+01	18.8	<1	1	1	188	<1	<1	<1
	Tl	1.18E-01	2.34E-01	2.34E-01	1.33E-02	2.65E-02	2.65E-02	1.06E-01	2.12E-01	2.12E-01	2.09E-02	2.09E-02	2.09E-02	2.69E-03	2.69E-03	2.69E-03	not measured			2.61E-01	4.97E-01	4.97E-01	0.074	4	7	7	0.74	<1	<1	<1
	V	1.38E+00	2.10E+00	2.10E+00	7.55E-04	1.14E-03	1.14E-03	5.23E-02	7.87E-02	7.87E-02	2.22E-01	2.22E-01	2.22E-01	6.82E-03	6.82E-03	6.82E-03	not measured			1.67E+00	2.41E+00	2.41E+00	0.209	8	12	12	2.09	<1	1	1
	Zn	9.91E+01	1.70E+02	5.51E+02	1.64E+00	2.21E+00	4.24E+00	3.95E+01	4.71E+01	6.94E+01	1.13E+01	1.13E+01	1.13E+01	1.73E+00	1.73E+00	1.73E+00	1.13E-02	2.25E-02	2.25E-02	1.53E+02	2.32E+02	6.38E+02	160	<1	2	4	320	<1	<1	2

Short-Tailed Shrew Exposure Factors:

Body weight =	0.012	kg
Food ingestion rate (wet weight) =	0.0053	kg/d
Water ingestion rate =	0.0027	L/d
Soil ingestion rate (wet weight) =	0.0005	kg/d
Area use factor =	1	

Diet Composition:

Terrestrial Plants =	5%
Earthworms =	40%
Soil Invertebrates =	40%
Aerial/Foliar Invertebrates =	15%
Sediment Ingestion (% of total diet) =	9.4%

Notes:

HQ> 1.0

Table E-26. Risk Assessment Results for Terrestrial Mammalian Herbivores (Meadow Vole)

		Dose: Soil Ingestion (mg/kg-d$_{ww}$)			Dose: Terrestrial Plants (mg/kg-d$_{ww}$)			Dose: Soil Inverts. (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	Metal	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	Mean	95% UCL	Max	NOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max	LOAEL (mg/kg-d$_{ww}$)	Mean	95% UCL	Max
PPC (Riparian Zone)	Al	7.87E+01	9.95E+01	1.16E+02	8.18E+02	1.01E+03	1.02E+03	2.33E+00	3.67E+00	3.67E+00	1.91E-02	2.21E-02	4.13E-02	8.99E+02	1.11E+03	1.14E+03	1.93	466	577	590	19.3	47	58	59
	Sb	2.13E-01	8.01E-01	8.84E-01	6.34E-02	1.95E-01	2.22E-01	3.71E-02	5.69E-02	5.69E-02	9.06E-04	4.13E-03	4.13E-03	3.14E-01	1.06E+00	1.17E+00	0.07	5	15	17	0.72	<1	2	2
	As	1.24E+00	3.41E+00	3.66E+00	4.41E-01	9.40E-01	1.12E+00	9.63E-02	1.41E-01	1.41E-01	9.06E-04	1.01E-03	5.51E-03	1.77E+00	4.49E+00	4.93E+00	0.75	2	6	7	3	<1	2	2
	Cd	2.65E-01	6.98E-01	9.11E-01	4.01E-01	6.28E-01	7.36E-01	1.54E-01	1.80E-01	1.80E-01	3.07E-05	4.03E-05	4.96E-05	8.21E-01	1.51E+00	1.83E+00	1	<1	2	2	10	<1	<1	<1
	Cr	1.85E-01	2.50E-01	3.31E-01	7.59E-02	9.19E-02	1.11E-01	7.42E-03	1.23E-02	1.23E-02	2.32E-04	6.88E-04	6.88E-04	2.68E-01	3.54E-01	4.56E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	4.72E+00	1.33E+01	1.63E+01	2.51E+00	3.58E+00	3.88E+00	5.55E-01	5.74E-01	5.74E-01	4.24E-04	4.60E-04	9.64E-04	7.78E+00	1.74E+01	2.07E+01	11.7	<1	2	2	15.1	<1	1	1
	Hg	3.91E-02	1.74E-01	1.74E-01	3.49E-01	1.42E+00	1.42E+00	1.85E-03	3.19E-03	3.19E-03	2.04E-04	4.13E-04	4.13E-04	3.90E-01	1.60E+00	1.60E+00	1	<1	2	2	18.8	<1	<1	<1
	MeHg	3.91E-02	1.74E-01	1.74E-01	3.49E-01	1.42E+00	1.42E+00	1.16E-04	1.16E-04	1.16E-04	2.04E-04	4.13E-04	4.13E-04	3.88E-01	1.60E+00	1.60E+00	0.032	12	50	50	0.16	3	10	10
	Mn	1.11E+01	1.58E+01	2.13E+01	8.90E+00	1.17E+01	1.38E+01	5.16E+00	5.80E+00	5.80E+00	9.76E-03	1.02E-02	1.79E-02	2.52E+01	3.32E+01	4.09E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	1.49E+01	4.48E+01	5.67E+01	1.70E+00	2.90E+00	3.38E+00	1.13E+00	1.96E+00	1.96E+00	6.79E-04	7.43E-04	2.75E-03	1.78E+01	4.97E+01	6.20E+01	11	2	5	6	90	<1	<1	<1
	Se	9.57E-02	5.21E-01	5.21E-01	4.97E-01	3.12E+00	3.12E+00	1.18E-02	1.54E-02	1.54E-02	1.91E-04	2.57E-04	5.51E-04	6.04E-01	3.65E+00	3.65E+00	0.2	3	18	18	0.33	2	11	11
	Ag	2.03E-01	7.75E-01	8.52E-01	2.53E-03	8.54E-03	9.77E-03	1.58E-02	2.57E-02	2.57E-02	3.24E-04	6.88E-04	6.88E-04	2.22E-01	8.10E-01	8.88E-01	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	1.34E-02	3.83E-02	4.10E-02	1.26E-01	3.15E-01	3.36E-01	1.53E-03	2.23E-03	2.23E-03	3.57E-04	1.72E-03	1.72E-03	1.41E-01	3.57E-01	3.81E-01	0.074	2	5	5	0.74	<1	<1	<1
	V	4.93E-01	5.56E-01	6.16E-01	2.49E-02	2.77E-02	2.88E-02	1.21E-02	1.97E-02	1.97E-02	1.15E-03	3.44E-03	3.44E-03	5.31E-01	6.07E-01	6.68E-01	0.209	3	3	3	2.09	<1	<1	<1
	Zn	1.62E+01	4.52E+01	4.75E+01	3.18E+01	4.52E+01	5.28E+01	2.94E+00	3.68E+00	3.68E+00	6.84E-03	7.39E-03	1.30E-02	5.10E+01	9.41E+01	1.04E+02	160	<1	<1	<1	320	<1	<1	<1
UL&M (Banks)	Al	1.30E+02	1.97E+02	1.97E+02	1.13E+03	1.73E+03	1.69E+03	1.07E+01	1.07E+01	1.07E+01	4.34E-02	7.22E-02	2.23E-01	1.28E+03	1.94E+03	1.90E+03	1.93	661	1006	985	19.3	66	101	99
	Sb	3.86E-01	9.42E-01	9.42E-01	1.04E-01	2.11E-01	2.41E-01	2.25E-02	2.25E-02	2.25E-02	3.57E-03	4.13E-03	4.13E-03	5.16E-01	1.18E+00	1.21E+00	0.07	7	17	17	0.72	<1	2	2
	As	2.50E+00	4.95E+00	6.07E+00	7.90E-01	1.54E+00	1.91E+00	1.51E-01	1.51E-01	1.51E-01	1.75E-03	2.24E-03	4.34E-03	3.45E+00	6.64E+00	8.13E+00	0.75	5	9	11	3	1	2	3
	Cd	1.70E+00	4.04E+00	5.87E+00	1.05E+00	1.68E+00	2.06E+00	1.41E-01	1.41E-01	1.41E-01	4.89E-04	1.01E-03	4.13E-03	2.89E+00	5.86E+00	8.07E+00	1	3	6	8	10	<1	<1	<1
	Cr	1.93E-01	2.46E-01	2.61E-01	7.31E-02	8.44E-02	9.01E-02	9.98E-03	9.98E-03	9.98E-03	2.81E-04	4.02E-04	8.26E-04	2.77E-01	3.41E-01	3.62E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	4.55E+00	9.85E+00	1.36E+01	2.37E+00	3.21E+00	3.65E+00	4.06E-01	4.06E-01	4.06E-01	1.60E-03	2.96E-03	3.81E-03	7.33E+00	1.35E+01	1.77E+01	11.7	<1	1	2	15.1	<1	<1	1
	Hg	3.35E-01	7.41E-01	9.28E-01	2.75E+00	6.05E+00	7.50E+00	7.26E-03	7.26E-03	7.26E-03	5.37E-06	6.88E-05	6.88E-05	3.09E+00	6.80E+00	8.43E+00	1	3	7	9	18.8	<1	<1	<1
	MeHg	3.35E-01	7.41E-01	9.28E-01	2.75E+00	6.05E+00	7.50E+00	4.55E-04	4.55E-04	4.55E-04	5.37E-06	6.88E-05	6.88E-05	3.08E+00	6.79E+00	8.42E+00	0.032	96	212	263	0.16	19	43	53
	Mn	5.79E+00	8.65E+00	1.00E+01	4.27E+00	6.95E+00	8.79E+00	6.08E-01	6.08E-01	6.08E-01	4.94E-02	1.52E-01	3.00E-01	1.07E+01	1.64E+01	1.97E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	4.01E+01	9.30E+01	1.34E+02	2.82E+00	4.51E+00	5.55E+00	1.34E+00	1.34E+00	1.34E+00	1.29E-02	4.41E-02	1.10E-01	4.43E+01	9.89E+01	1.41E+02	11	4	9	13	90	<1	1	2
	Se	3.19E-01	8.34E-01	8.34E-01	1.83E+00	5.37E+00	5.37E+00	7.56E-02	7.56E-02	7.56E-02	2.07E-03	2.41E-03	2.41E-03	2.23E+00	6.28E+00	6.28E+00	0.2	11	32	32	0.33	7	19	19
	Ag	2.90E-01	6.85E-01	9.42E-01	3.40E-03	7.98E-03	1.10E-02	1.09E-02	1.09E-02	1.09E-02	1.16E-04	1.23E-04	1.29E-04	3.04E-01	7.04E-01	9.64E-01	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	4.62E-02	9.10E-02	1.08E-01	3.83E-01	7.53E-01	9.05E-01	2.62E-03	2.62E-03	2.62E-03	1.48E-03	1.72E-03	1.72E-03	4.33E-01	8.49E-01	1.02E+00	0.074	6	12	14	0.74	<1	1	1
	V	4.76E-01	7.12E-01	7.38E-01	2.07E-02	3.07E-02	3.01E-02	2.31E-02	2.31E-02	2.31E-02	5.30E-04	6.84E-04	7.71E-04	5.20E-01	7.67E-01	7.92E-01	0.209	3	4	4	2.09	<1	<1	<1
	Zn	1.26E+01	4.05E+01	4.05E+01	2.60E+01	3.99E+01	4.89E+01	1.36E+00	1.36E+00	1.36E+00	1.24E-02	1.76E-02	4.13E-02	4.00E+01	8.17E+01	9.07E+01	160	<1	<1	<1	320	<1	<1	<1
LL (Banks)	Al	1.32E+02	1.89E+02	1.89E+02	1.16E+03	1.60E+03	1.60E+03	2.35E+01	3.27E+01	3.27E+01	9.21E-03	1.38E-02	1.38E-02	1.32E+03	1.82E+03	1.82E+03	1.93	682	945	945	19.3	68	95	95
	Sb	4.95E-01	1.78E+00	1.78E+00	1.32E-01	4.37E-01	4.37E-01	8.92E-02	1.04E-01	1.04E-01	3.78E-02	5.18E-02	6.02E-02	7.55E-01	2.38E+00	2.38E+00	0.07	11	34	34	0.72	1	3	3
	As	4.99E+00	1.85E+01	1.85E+01	1.57E+00	5.77E+00	5.77E+00	3.62E-01	4.69E-01	4.69E-01	2.19E-02	3.10E-02	3.35E-02	6.95E+00	2.47E+01	2.47E+01	0.75	9	33	33	3	2	8	8
	Cd	1.58E+00	5.43E+00	5.43E+00	1.01E+00	1.97E+00	1.97E+00	2.50E-01	3.00E-01	3.00E-01	1.37E-03	1.82E-03	5.51E-03	2.85E+00	7.70E+00	7.70E+00	1	3	8	8	10	<1	<1	<1
	Cr	2.07E-01	2.59E-01	2.59E-01	7.42E-02	9.01E-02	9.01E-02	3.57E-02	4.73E-02	4.73E-02	1.13E-04	1.38E-04	1.38E-04	3.17E-01	3.97E-01	3.97E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	1.08E+01	3.74E+01	3.74E+01	3.34E+00	5.42E+00	5.42E+00	1.58E+00	1.94E+00	1.94E+00	4.03E-03	4.87E-03	9.64E-03	1.57E+01	4.47E+01	4.47E+01	11.7	1	4	4	15.1	1	3	3
	Hg	1.23E-01	4.34E-01	4.34E-01	1.03E+00	3.62E+00	3.62E+00	1.40E-02	1.56E-02	1.56E-02	5.16E-06	6.88E-06	6.88E-06	1.17E+00	4.07E+00	4.07E+00	1	1	4	4	18.8	<1	<1	<1
	MeHg	1.23E-01	4.34E-01	4.34E-01	1.03E+00	3.62E+00	3.62E+00	9.96E-04	1.44E-03	1.44E-03	5.16E-06	6.88E-06	6.88E-06	1.16E+00	4.05E+00	4.05E+00	0.032	36	127	127	0.16	7	25	25
	Mn	7.32E+00	1.61E+01	1.61E+01	4.98E+00	1.06E+01	1.06E+01	2.86E+00	3.12E+00	3.12E+00	3.29E-02	3.96E-02	6.88E-02	1.52E+01	2.99E+01	2.99E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	3.50E+01	1.26E+02	1.26E+02	2.62E+00	5.35E+00	5.35E+00	3.43E+00	4.34E+00	4.34E+00	9.56E-03	1.17E-02	2.45E-02	4.11E+01	1.36E+02	1.36E+02	11	4	12	12	90	<1	2	2
	Se	1.12E-01	3.57E-01	3.57E-01	5.93E-01	2.09E+00	2.09E+00	1.60E-01	1.71E-01	1.71E-01	5.35E-03	6.43E-03	7.45E-03	8.69E-01	2.63E+00	2.63E+00	0.2	4	13	13	0.33	3	8	8
	Ag	4.11E-01	1.40E+00	1.40E+00	4.88E-03	1.63E-02	1.63E-02	6.70E-02	8.98E-02	8.98E-02	2.06E-04	2.89E-04	2.89E-04	4.83E-01	1.50E+00	1.50E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	1.25E-01	4.50E-01	4.50E-01	1.05E+00	3.75E+00	3.75E+00	1.94E-02	2.05E-02	2.05E-02	7.35E-03	9.63E-03	1.06E-02	1.20E+00	4.23E+00	4.23E+00	0.074	16	57	57	0.74	2	6	6
	V	5.90E-01	7.32E-01	7.32E-01	2.51E-02	3.01E-02	3.01E-02	8.00E-02	1.09E-01	1.09E-01	1.87E-03	3.44E-03	3.44E-03	6.97E-01	8.75E-01	8.75E-01	0.209	3	4	4	2.09	<1	<1	<1
	Zn	2.28E+01	8.17E+01	8.17E+01	3.57E+01	7.20E+01	7.20E+01	2.68E+00	2.97E+00	2.97E+00	9.56E-03	1.24E-02	2.75E-02	6.12E+01	1.57E+02	1.57E+02	160	<1	<1	<1	320	<1	<1	<1

Table E-26. Risk Assessment Results for Terrestrial Mammalian Herbivores (Meadow Vole)

		Dose: Soil Ingestion (mg/kg-d$_{ww}$)			Dose: Terrestrial Plants (mg/kg-d$_{ww}$)			Dose: Soil Inverts. (mg/kg-d$_{ww}$)			Dose: Surface Water (mg/kg-d$_{ww}$)			Total Dietary Dose (mg/kg-d$_{ww}$)			NOAEL HQ				LOAEL HQ			
CSM Unit	**Metal**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**Mean**	**95% UCL**	**Max**	**NOAEL (mg/kg-d$_{ww}$)**	**Mean**	**95% UCL**	**Max**	**LOAEL (mg/kg-d$_{ww}$)**	**Mean**	**95% UCL**	**Max**
Tito Park	Al	1.71E+02	1.84E+02	1.95E+02	1.52E+03	1.63E+03	1.73E+03	8.31E+00	8.31E+00	8.31E+00	9.21E-03	1.38E-02	1.38E-02	1.70E+03	1.83E+03	1.94E+03	1.93	883	946	1003	19.3	88	95	100
	Sb	2.95E-01	9.89E-01	9.89E-01	8.47E-02	2.63E-01	2.63E-01	4.18E-02	4.18E-02	4.18E-02	3.78E-02	5.18E-02	6.02E-02	4.59E-01	1.35E+00	1.35E+00	0.07	7	19	19	0.72	<1	2	2
LL (SW)	As	2.33E+01	4.19E+01	1.17E+02	7.83E+00	1.41E+01	3.92E+01	1.59E-01	1.59E-01	1.59E-01	2.19E-02	3.10E-02	3.35E-02	3.13E+01	5.62E+01	1.56E+02	0.75	42	75	209	3	11	19	52
	Cd	2.46E+01	8.19E+01	2.13E+02	4.67E+00	9.00E+00	1.52E+01	2.26E-01	2.26E-01	2.26E-01	1.37E-03	1.82E-03	5.51E-03	2.95E+01	9.11E+01	2.28E+02	1	30	91	228	10	3	9	23
	Cr	2.29E-01	2.60E-01	2.66E-01	8.39E-02	9.40E-02	9.54E-02	1.44E-02	1.44E-02	1.44E-02	1.13E-04	1.38E-04	1.38E-04	3.28E-01	3.69E-01	3.76E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	4.88E+01	9.10E+01	3.41E+02	6.19E+00	7.91E+00	1.33E+01	5.18E-01	5.18E-01	5.18E-01	4.03E-03	4.87E-03	9.64E-03	5.55E+01	9.94E+01	3.55E+02	11.7	5	9	30	15.1	4	7	24
	Hg	5.07E-02	1.48E-01	1.48E-01	4.45E-01	1.29E+00	1.29E+00	3.35E-03	3.35E-03	3.35E-03	5.16E-06	6.88E-06	6.88E-06	4.99E-01	1.44E+00	1.44E+00	1	<1	2	2	18.8	<1	<1	<1
	MeHg	5.07E-02	1.48E-01	1.48E-01	4.45E-01	1.29E+00	1.29E+00	2.10E-04	2.10E-04	2.10E-04	5.16E-06	6.88E-06	6.88E-06	4.95E-01	1.44E+00	1.44E+00	0.032	16	45	45	0.16	3	9	9
	Mn	4.63E+00	6.19E+00	7.29E+00	3.26E+00	4.30E+00	5.03E+00	6.20E-01	6.20E-01	6.20E-01	3.29E-02	3.96E-02	6.88E-02	8.54E+00	1.11E+01	1.30E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	1.94E+02	4.28E+02	1.03E+03	7.08E+00	1.10E+01	1.81E+01	6.23E-01	6.23E-01	6.23E-01	9.56E-03	1.17E-02	2.45E-02	2.02E+02	4.39E+02	1.05E+03	11	18	40	95	90	2	5	12
	Se	6.50E-02	1.30E-01	1.92E-01	3.40E-01	7.28E-01	1.11E+00	1.09E-01	1.09E-01	1.09E-01	5.35E-03	6.43E-03	7.45E-03	5.20E-01	9.74E-01	1.42E+00	0.2	3	5	7	0.33	2	3	4
	Ag	2.37E-01	4.95E-01	6.20E-01	2.92E-03	6.07E-03	7.60E-03	6.63E-03	6.63E-03	6.63E-03	2.06E-04	2.89E-04	2.89E-04	2.47E-01	5.08E-01	6.34E-01	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	3.29E-02	1.18E-01	1.18E-01	2.92E-01	1.03E+00	1.03E+00	4.18E-03	4.18E-03	4.18E-03	7.35E-03	9.63E-03	1.06E-02	3.36E-01	1.17E+00	1.17E+00	0.074	5	16	16	0.74	<1	2	2
	V	6.00E-01	6.28E-01	6.55E-01	2.60E-02	2.70E-02	2.82E-02	4.18E-02	4.18E-02	4.18E-02	1.87E-03	3.44E-03	3.44E-03	6.70E-01	7.00E-01	7.29E-01	0.209	3	3	4	2.09	<1	<1	<1
	Zn	1.13E+02	1.76E+02	6.36E+02	8.96E+01	1.14E+02	2.33E+02	2.19E+00	2.19E+00	2.19E+00	9.56E-03	1.24E-02	2.75E-02	2.05E+02	2.92E+02	8.72E+02	160	1	2	6	320	<1	<1	3
Site Perimeter (East)	Al	9.93E+01	1.06E+02	1.06E+02	8.17E+02	8.81E+02	8.81E+02	3.87E+01	3.87E+01	3.87E+01	1.91E-02	2.21E-02	0.00E+00	9.55E+02	1.03E+03	1.03E+03	1.93	495	532	532	19.3	50	53	53
	Sb	2.61E-01	4.35E-01	4.35E-01	7.17E-02	1.16E-01	1.16E-01	3.93E-01	3.93E-01	3.93E-01	9.06E-04	4.13E-03	0.00E+00	7.27E-01	9.48E-01	9.44E-01	0.07	10	14	14	0.72	1	1	1
PPC (SW)	As	6.55E+00	3.58E+01	4.82E+01	2.05E+00	1.12E+01	1.51E+01	1.57E+00	1.57E+00	1.57E+00	9.06E-04	1.01E-03	0.00E+00	1.02E+01	4.87E+01	6.49E+01	0.75	14	65	87	3	3	16	22
	Cd	6.26E-01	9.55E-01	1.42E+00	6.06E-01	7.63E-01	9.49E-01	8.28E-01	8.28E-01	8.28E-01	3.07E-05	4.03E-05	0.00E+00	2.06E+00	2.55E+00	3.20E+00	1	2	3	3	10	<1	<1	<1
	Cr	1.97E-01	2.39E-01	2.39E-01	6.62E-02	7.95E-02	7.95E-02	6.88E-02	6.88E-02	6.88E-02	2.32E-04	6.88E-04	0.00E+00	3.32E-01	3.88E-01	3.87E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	3.46E+01	1.90E+02	2.53E+02	5.26E+00	1.03E+01	1.15E+01	4.20E+00	4.20E+00	4.20E+00	4.24E-04	4.60E-04	0.00E+00	4.40E+01	2.04E+02	2.69E+02	11.7	4	18	23	15.1	3	14	18
	Hg	9.29E-02	1.71E-01	1.71E-01	7.72E-01	1.42E+00	1.42E+00	4.13E-02	4.13E-02	4.13E-02	2.04E-04	4.13E-04	0.00E+00	9.07E-01	1.63E+00	1.63E+00	1	<1	2	2	18.8	<1	<1	<1
	MeHg	9.29E-02	1.71E-01	1.71E-01	7.72E-01	1.42E+00	1.42E+00	2.59E-03	2.59E-03	2.59E-03	2.04E-04	4.13E-04	0.00E+00	8.68E-01	1.60E+00	1.59E+00	0.032	27	50	50	0.16	6	10	10
	Mn	1.25E+01	1.32E+01	1.32E+01	8.13E+00	8.47E+00	8.47E+00	3.33E+00	3.33E+00	3.33E+00	9.76E-03	1.02E-02	0.00E+00	2.40E+01	2.50E+01	2.50E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	2.08E+01	3.15E+01	5.89E+01	1.94E+00	2.46E+00	3.50E+00	1.53E+01	1.53E+01	1.53E+01	6.79E-04	7.43E-04	0.00E+00	3.80E+01	4.92E+01	7.77E+01	11	4	5	7	90	<1	<1	<1
	Se	4.14E-02	6.36E-02	6.36E-02	1.93E-01	3.12E-01	3.12E-01	8.03E-02	8.03E-02	8.03E-02	1.91E-04	2.57E-04	0.00E+00	3.14E-01	4.56E-01	4.56E-01	0.2	2	2	2	0.33	<1	1	1
	Ag	1.72E-01	2.79E-01	2.79E-01	1.99E-03	3.26E-03	3.26E-03	1.75E-01	1.75E-01	1.75E-01	3.24E-04	6.88E-04	0.00E+00	3.49E-01	4.59E-01	4.58E-01	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	3.27E-02	5.74E-02	5.74E-02	2.71E-01	4.78E-01	4.78E-01	2.79E-02	2.79E-02	2.79E-02	3.57E-04	1.72E-03	0.00E+00	3.32E-01	5.65E-01	5.63E-01	0.074	5	8	8	0.74	<1	<1	<1
	V	6.46E-01	7.96E-01	7.96E-01	2.57E-02	3.13E-02	3.13E-02	1.48E-01	1.48E-01	1.48E-01	1.15E-03	3.44E-03	0.00E+00	8.21E-01	9.78E-01	9.75E-01	0.209	4	5	5	2.09	<1	<1	<1
	Zn	2.39E+01	3.33E+01	5.67E+01	3.63E+01	4.36E+01	5.79E+01	8.74E+00	8.74E+00	8.74E+00	6.84E-03	7.39E-03	0.00E+00	6.89E+01	8.57E+01	1.23E+02	160	<1	<1	<1	320	<1	<1	<1
Site Perimeter (West)	Al	1.26E+02	1.83E+02	1.83E+02	1.06E+03	1.55E+03	1.55E+03	1.11E+01	1.11E+01	1.11E+01	not measured			1.19E+03	1.74E+03	1.74E+03	1.93	619	904	904	19.3	62	90	90
	Sb	5.47E-01	1.41E+00	1.41E+00	1.45E-01	3.54E-01	3.54E-01	6.29E-02	6.29E-02	6.29E-02	not measured			7.54E-01	1.83E+00	1.83E+00	0.07	11	26	26	0.72	1	3	3
Wilson Ditch (SW)	As	2.66E+00	5.82E+00	1.27E+01	8.36E-01	1.83E+00	4.02E+00	1.85E-01	1.85E-01	1.85E-01	7.57E-04	1.38E-03	1.38E-03	3.68E+00	7.84E+00	1.69E+01	0.75	5	11	23	3	1	3	6
	Cd	1.80E+00	3.81E+00	8.22E+00	1.08E+00	1.63E+00	2.47E+00	3.28E-01	3.28E-01	3.28E-01	2.06E-04	4.13E-04	4.13E-04	3.21E+00	5.77E+00	1.10E+01	1	3	6	11	10	<1	<1	1
	Cr	2.33E-01	3.99E-01	3.99E-01	8.01E-02	1.38E-01	1.38E-01	1.76E-02	1.76E-02	1.76E-02	not measured			3.31E-01	5.55E-01	5.55E-01	0.596	<1	<1	<1	5.96	<1	<1	<1
	Cu	2.14E+01	7.57E+01	1.51E+02	4.35E+00	7.16E+00	9.40E+00	5.98E-01	5.98E-01	5.98E-01	7.23E-04	1.38E-03	1.38E-03	2.63E+01	8.35E+01	1.61E+02	11.7	2	7	14	15.1	2	6	11
	Hg	5.68E-02	1.26E-01	1.26E-01	4.75E-01	1.06E+00	1.06E+00	2.94E-03	2.94E-03	2.94E-03	6.88E-07	6.88E-07	6.88E-07	5.35E-01	1.19E+00	1.19E+00	1	<1	1	1	18.8	<1	<1	<1
	MeHg	5.68E-02	1.26E-01	1.26E-01	4.75E-01	1.06E+00	1.06E+00	1.85E-04	1.85E-04	1.85E-04	6.88E-07	6.88E-07	6.88E-07	5.32E-01	1.19E+00	1.19E+00	0.032	17	37	37	0.16	3	8	8
	Mn	1.69E+01	5.05E+01	5.05E+01	1.12E+01	3.36E+01	3.36E+01	1.18E+00	1.18E+00	1.18E+00	7.57E-03	8.26E-03	8.26E-03	2.93E+01	8.53E+01	8.53E+01	88	<1	<1	<1	280	<1	<1	<1
	Pb	4.94E+01	7.69E+01	1.79E+02	3.17E+00	4.06E+00	6.53E+00	1.36E+00	1.36E+00	1.36E+00	3.68E-03	8.26E-03	8.26E-03	5.39E+01	8.24E+01	1.87E+02	11	5	8	17	90	<1	<1	2
	Se	1.33E-01	4.15E-01	4.15E-01	7.09E-01	2.50E+00	2.50E+00	3.89E-02	3.89E-02	3.89E-02	not measured			8.80E-01	2.95E+00	2.95E+00	0.2	5	15	15	0.33	3	9	9
	Ag	1.08E+00	3.58E+00	3.58E+00	1.27E-02	4.22E-02	4.22E-02	1.54E-02	1.54E-02	1.54E-02	not measured			1.11E+00	3.64E+00	3.64E+00	18.8	<1	<1	<1	188	<1	<1	<1
	Tl	4.64E-02	9.22E-02	9.22E-02	3.88E-01	7.75E-01	7.75E-01	4.03E-03	4.03E-03	4.03E-03	not measured			4.38E-01	8.72E-01	8.72E-01	0.074	6	12	12	0.74	<1	1	1
	V	5.44E-01	8.24E-01	8.24E-01	2.21E-02	3.32E-02	3.32E-02	4.28E-02	4.28E-02	4.28E-02	not measured			6.09E-01	9.00E-01	9.00E-01	0.209	3	4	4	2.09	<1	<1	<1
	Zn	3.89E+01	6.67E+01	2.17E+02	4.79E+01	6.45E+01	1.24E+02	2.18E+00	2.18E+00	2.18E+00	6.88E-03	1.38E-02	1.38E-02	8.90E+01	1.33E+02	3.43E+02	160	<1	<1	2	320	<1	<1	1

Meadow Vole Exposure Factors:

Body weight =	0.037	kg
Food ingestion rate (wet weight) =	0.0252	kg/d
Water ingestion rate =	0.0051	L/d
Soil ingestion rate (wet weight) =	0.0006	kg/d
Area use factor =	1.0	

Diet Composition:

Terrestrial Plants =	95%
Soil Invertebrates =	5%
Sediment Ingestion (% of total diet) =	2.4%

Notes:

HQ> 1.0

Table E-27. Contribution of environmental media to overall dietary dose for wildlife receptors

		Mallard					Belted Kingfisher							Sandpiper				Mink						Robin						Tree Swallow						Short-Tailed Shrew						Meadow Vole			
CSM Unit	Metal	SD	SW	BI	OA	AP	SD	SW	BI	OA	FF	PF	AM	SD	SW	BI	OA	SD	SW	OA	FF	PF	AM	SO	TP	EW	SI	AI	SW	SO	TP	BI	SI	AI	SW	SO	TP	EW	SI	AI	SW	SO	TP	SI	SW
Mean from all CSM Units and Metals =		**33%**	**0.6%**	**5%**	**10%**	**52%**	**60%**	**1.2%**	**7%**	**16%**	**6%**	**9%**	**1%**	**90%**	**0.2%**	**5%**	**4%**	**91%**	**0.9%**	**3%**	**1%**	**3%**	**1%**	**66%**	**10%**	**15%**	**7%**	**2%**	**0.2%**	**0%**	**42%**	**8%**	**38%**	**11%**	**1.2%**	**63%**	**2%**	**22%**	**11%**	**1%**	**0.3%**	**48%**	**47%**	**4%**	**0.3%**
PPC	Al	45%	0.0%	4%	7%	43%	76%	0.0%	8%	12%	1%	2%	0%	94%	0.0%	4%	2%	98%	0.0%	2%	0.2%	0.3%	0.1%	58%	36%	3%	2.5%	0.8%	0.0%	0%	89%	3%	6.2%	1.9%	0.0%	77%	10%	6%	5.8%	0.7%	0.0%	9%	91%	0%	0.0%
	Sb	24%	4.9%	8%	12%	51%	30%	10.5%	9%	15%	7%	24%	4%	81%	2.0%	11%	6%	76%	8.7%	4%	2.0%	6.4%	2.4%	90%	1%	1%	7.4%	0.9%	0.2%	0%	13%	2%	73.9%	8.6%	1.9%	86%	0%	1%	12.4%	0.5%	0.3%	76%	18%	5%	0.4%
	As	36%	0.0%	7%	10%	47%	62%	0.1%	11%	17%	3%	6%	1%	90%	0.0%	7%	3%	95%	0.1%	3%	0.4%	1.0%	0.3%	89%	1%	4%	4.2%	1.3%	0.0%	0%	18%	17%	50.1%	15.5%	0.1%	85%	0%	7%	7.1%	0.8%	0.0%	76%	21%	3%	0.0%
	Ba	36%	0.1%	6%	8%	49%	64%	0.4%	11%	15%	4%	4%	2%	91%	0.0%	7%	3%	96%	0.2%	2%	0.6%	0.7%	0.5%	85%	11%	1%	2.2%	0.5%	0.0%	0%	76%	6%	14.9%	3.2%	0.1%	92%	3%	1%	4.2%	0.3%	0.0%	31%	68%	1%	0.0%
	Be	26%	14.1%	1%	3%	56%	14%	13.1%	0%	2%	1%	69%	1%	91%	6.0%	1%	1%	54%	16.2%	1%	0.6%	28.1%	0.8%	79%	15%	1%	2.6%	0.4%	2.6%	0%	72%	1%	12.3%	1.9%	13.2%	85%	4%	2%	4.9%	0.3%	4.7%	24%	74%	1%	2.1%
	Cd	28%	0.0%	5%	18%	49%	39%	0.0%	7%	25%	1%	14%	14%	86%	0.0%	6%	8%	84%	0.0%	6%	0.3%	3.1%	6.3%	63%	3%	10%	18.6%	4.8%	0.0%	0%	12%	3%	67.5%	17.5%	0.0%	53%	1%	15%	28.0%	2.7%	0.0%	46%	42%	12%	0.0%
	Cr	31%	0.2%	4%	9%	56%	57%	0.6%	7%	16%	7%	9%	5%	92%	0.1%	4%	4%	93%	0.3%	3%	1.2%	1.5%	1.6%	89%	2%	2%	5.1%	1.5%	0.1%	0%	20%	14%	50.4%	14.4%	1.0%	86%	0%	3%	8.7%	0.9%	0.2%	70%	26%	3%	0.2%
	Co	31%	1.1%	3%	8%	56%	64%	3.9%	7%	16%	2%	7%	1%	92%	0.4%	4%	3%	94%	1.8%	3%	0.3%	1.1%	0.2%	93%	0%	2%	3.5%	0.8%	0.6%	0%	5%	24%	50.3%	10.9%	9.6%	90%	0%	3%	5.9%	0.5%	1.0%	90%	5%	3%	1.6%
	Cu	27%	0.0%	3%	36%	35%	36%	0.0%	4%	48%	1%	8%	2%	81%	0.0%	4%	15%	85%	0.0%	12%	0.2%	2.1%	1.1%	85%	1%	0%	4.2%	9.1%	0.0%	0%	9%	4%	27.6%	59.6%	0.0%	85%	0%	1%	7.5%	6.1%	0.0%	76%	21%	3%	0.0%
	Fe	48%	0.0%	4%	7%	41%	78%	0.0%	7%	11%	1%	4%	0%	95%	0.0%	3%	2%	98%	0.0%	1%	0.2%	0.5%	0.1%	70%	27%	1%	1.7%	0.4%	0.0%	0%	91%	2%	5.7%	1.3%	0.0%	87%	7%	2%	3.6%	0.3%	0.0%	14%	86%	0%	0.0%
	Hg	31%	0.6%	2%	4%	63%	29%	0.9%	1%	4%	3%	61%	2%	96%	0.2%	2%	2%	79%	0.8%	1%	0.8%	17.7%	1.0%	66%	33%	0%	1.4%	0.1%	0.1%	0%	95%	0%	4.1%	0.2%	0.2%	86%	9%	1%	3.2%	0.1%	0.1%	11%	89%	0%	0.0%
	MeHg	32%	0.6%	1%	0%	66%	30%	0.9%	1%	0%	3%	64%	2%	99%	0.2%	1%	0%	79%	0.8%	0%	0.8%	17.9%	1.0%	67%	33%	0%	0.1%	0.0%	0.1%	0%	99%	0%	0.2%	0.0%	0.2%	90%	10%	0%	0.1%	0.0%	0.1%	11%	89%	0%	0.0%
	Mn	44%	0.0%	6%	7%	43%	73%	0.0%	9%	11%	1%	2%	3%	93%	0.0%	5%	2%	97%	0.0%	2%	0.2%	0.3%	0.9%	65%	3%	3%	27.6%	1.8%	0.0%	0%	7%	18%	69.8%	4.7%	0.0%	54%	1%	4%	40.5%	1.0%	0.0%	47%	35%	17%	0.0%
	Ni	30%	1.0%	5%	10%	54%	49%	2.8%	8%	16%	5%	14%	6%	90%	0.4%	6%	4%	89%	1.6%	3%	0.9%	2.7%	2.4%	60%	34%	2%	3.1%	1.1%	0.4%	0%	84%	4%	7.8%	2.7%	1.2%	78%	10%	4%	7.2%	0.9%	1.0%	10%	90%	0%	0.2%
	Pb	40%	0.0%	3%	8%	49%	76%	0.0%	6%	15%	1%	1%	1%	94%	0.0%	3%	3%	97%	0.0%	2%	0.1%	0.2%	0.3%	94%	0%	0%	4.8%	0.3%	0.0%	0%	7%	4%	84.6%	4.5%	0.0%	91%	0%	1%	8.1%	0.2%	0.0%	90%	6%	4%	0.0%
	Se	24%	0.3%	10%	16%	50%	11%	0.2%	5%	7%	13%	59%	5%	79%	0.1%	14%	7%	52%	0.4%	4%	7.1%	31.1%	5.3%	69%	25%	1%	2.4%	1.9%	0.0%	0%	84%	1%	7.9%	6.4%	0.0%	84%	7%	3%	5.1%	1.5%	0.0%	14%	85%	0%	0.0%
	Ag	19%	1.2%	5%	31%	43%	29%	3.1%	8%	47%	2%	9%	3%	74%	0.6%	8%	17%	79%	2.7%	14%	0.6%	2.7%	1.5%	96%	0%	0%	3.7%	0.1%	0.0%	0%	2%	3%	91.4%	3.2%	0.9%	93%	0%	0%	6.3%	0.1%	0.1%	96%	1%	3%	0.1%
	Tl	33%	2.0%	1%	2%	62%	71%	7.2%	2%	4%	3%	10%	3%	97%	0.7%	1%	1%	94%	3.0%	1%	0.5%	1.3%	1.0%	62%	31%	2%	4.2%	0.3%	1.1%	0%	84%	1%	11.3%	0.7%	3.0%	77%	8%	3%	9.1%	0.2%	2.2%	11%	88%	1%	0.5%
	V	33%	0.4%	4%	9%	53%	63%	1.2%	7%	18%	4%	6%	1%	92%	0.1%	4%	4%	95%	0.6%	3%	0.6%	1.0%	0.3%	87%	0%	8%	3.6%	1.1%	0.2%	0%	4%	25%	51.5%	16.5%	3.1%	81%	0%	12%	5.8%	0.7%	0.3%	92%	5%	3%	0.6%
	Zn	37%	0.0%	10%	12%	41%	39%	0.0%	11%	13%	5%	30%	2%	86%	0.0%	10%	4%	87%	0.0%	3%	1.2%	7.2%	1.1%	82%	5%	3%	7.7%	2.6%	0.0%	0%	28%	14%	43.4%	14.8%	0.0%	80%	1%	4%	13.2%	1.7%	0.0%	48%	48%	4%	0.0%
UL&M	Al	44%	0.0%	1%	2%	52%	86%	0.1%	3%	5%	2%	3%	0%	98%	0.0%	1%	1%	99%	0.0%	1%	0.3%	0.4%	0.1%	46%	25%	25%	2.9%	1.7%	0.0%	0%	84%	1%	9.8%	5.9%	0.0%	45%	5%	43%	5.0%	1.1%	0.0%	10%	89%	1%	0.0%
	Sb	30%	0.5%	4%	3%	62%	74%	2.3%	10%	7%	2%	5%	1%	93%	0.2%	5%	1%	97%	1.0%	1%	0.2%	0.6%	0.3%	65%	1%	29%	1.8%	2.8%	0.1%	0%	14%	11%	28.4%	44.8%	1.8%	54%	0%	42%	2.6%	1.5%	0.2%	80%	18%	2%	0.4%
	As	49%	0.1%	2%	6%	43%	80%	0.2%	3%	10%	3%	2%	1%	97%	0.0%	2%	2%	98%	0.1%	1%	0.4%	0.3%	0.2%	92%	2%	2%	3.2%	1.5%	0.0%	0%	25%	6%	47.2%	21.6%	0.2%	90%	0%	4%	5.6%	1.0%	0.0%	75%	23%	2%	0.0%
	Ba	30%	0.2%	12%	4%	54%	48%	0.5%	19%	7%	12%	12%	2%	84%	0.1%	14%	2%	93%	0.3%	1%	2.4%	2.4%	0.7%	80%	6%	4%	6.2%	3.8%	0.1%	0%	29%	24%	28.5%	17.5%	0.4%	79%	1%	6%	10.8%	2.5%	0.1%	42%	55%	3%	0.1%
	Be	24%	0.7%	2%	2%	71%	6%	0.3%	0%	0%	3%	89%	0%	96%	0.3%	3%	1%	38%	0.6%	0%	2.2%	58.0%	0.6%	81%	15%	2%	1.6%	0.5%	0.1%	0%	86%	2%	9.0%	3.0%	0.8%	89%	4%	3%	3.1%	0.4%	0.2%	24%	75%	0%	0.1%
	Cd	45%	0.1%	33%	4%	19%	47%	0.1%	34%	4%	12%	1%	3%	76%	0.0%	23%	1%	95%	0.1%	1%	2.5%	0.2%	1.3%	41%	1%	55%	1.7%	0.9%	0.0%	0%	19%	33%	30.9%	16.4%	0.1%	29%	0%	69%	2.1%	0.4%	0.0%	69%	29%	2%	0.0%
	Cr	28%	0.1%	1%	7%	64%	21%	0.1%	1%	5%	5%	67%	2%	95%	0.0%	1%	3%	71%	0.1%	2%	1.7%	24.2%	1.2%	78%	2%	12%	3.6%	4.6%	0.0%	0%	16%	4%	35.4%	44.4%	0.5%	71%	0%	20%	5.9%	2.8%	0.1%	72%	25%	3%	0.1%
	Co	28%	0.1%	1%	3%	67%	77%	0.6%	4%	9%	3%	6%	1%	96%	0.1%	2%	2%	97%	0.2%	1%	0.4%	0.7%	0.2%	88%	0%	6%	3.4%	2.9%	0.1%	0%	5%	10%	44.9%	39.0%	1.1%	83%	0%	9%	5.7%	1.8%	0.1%	91%	6%	3%	0.2%
	Cu	39%	0.0%	41%	7%	13%	39%	0.0%	40%	7%	10%	3%	1%	69%	0.0%	30%	2%	94%	0.0%	2%	2.6%	0.7%	0.6%	72%	1%	19%	3.4%	4.9%	0.0%	0%	7%	54%	16.1%	23.2%	0.0%	63%	0%	29%	5.3%	2.9%	0.0%	73%	24%	3%	0.0%
	Fe	45%	0.2%	2%	3%	50%	82%	0.5%	3%	5%	4%	5%	0%	98%	0.0%	1%	1%	98%	0.2%	1%	0.5%	0.6%	0.1%	47%	25%	25%	2.0%	1.6%	0.0%	0%	87%	1%	7.0%	5.5%	0.1%	46%	5%	43%	3.5%	1.0%	0.1%	10%	89%	0%	0.0%
	Hg	34%	0.0%	0%	1%	65%	92%	0.0%	1%	2%	1%	4%	0%	99%	0.0%	0%	0%	99%	0.0%	0%	0.1%	0.4%	0.0%	50%	25%	25%	0.6%	0.4%	0.0%	0%	96%	1%	2.2%	1.7%	0.0%	50%	5%	44%	1.0%	0.3%	0.0%	11%	89%	0%	0.0%
	MeHg	34%	0.0%	0%	0%	65%	95%	0.0%	0%	0%	1%	4%	0%	100%	0.0%	0%	0%	99%	0.0%	0%	0.1%	0.4%	0.0%	67%	33%	0%	0.0%	0.1%	0.0%	0%	99%	0%	0.1%	0.3%	0.0%	90%	10%	0%	0.1%	0.1%	0.0%	11%	89%	0%	0.0%
	Mn	30%	0.8%	9%	13%	47%	39%	1.9%	12%	16%	11%	8%	13%	84%	0.3%	11%	5%	85%	1.3%	4%	2.5%	1.7%	5.9%	82%	4%	3%	6.7%	3.4%	0.5%	0%	20%	26%	33.6%	17.3%	2.9%	80%	1%	5%	11.4%	2.2%	0.9%	53%	42%	4%	0.9%
	Ni	28%	0.8%	1%	3%	67%	58%	2.9%	2%	7%	5%	19%	6%	96%	0.3%	2%	2%	91%	1.5%	1%	0.8%	3.1%	2.2%	46%	24%	24%	3.3%	2.7%	0.2%	0%	78%	1%	11.0%	9.0%	0.8%	46%	5%	41%	5.8%	1.8%	0.4%	11%	89%	1%	0.1%
	Pb	71%	0.1%	14%	4%	12%	72%	0.2%	14%	4%	9%	1%	0%	92%	0.0%	7%	1%	98%	0.1%	1%	1.3%	0.1%	0.0%	91%	0%	7%	1.5%	0.6%	0.0%	0%	7%	40%	38.0%	14.8%	0.4%	86%	0%	12%	2.5%	0.4%	0.0%	94%	5%	1%	0.0%
	Se	22%	0.6%	2%	4%	71%	41%	1.8%	4%	8%	13%	29%	4%	94%	0.3%	4%	2%	86%	1.2%	2%	2.9%	6.5%	1.9%	58%	23%	9%	6.1%	3.7%	0.1%	0%	69%	1%	18.6%	11.3%	0.2%	62%	5%	18%	11.6%	2.6%	0.1%	13%	85%	1%	0.0%
	Ag	32%	0.0%	1%	1%	65%	91%	0.1%	4%	3%	1%	1%	0%	98%	0.0%	2%	0%	99%	0.0%	0%	0.1%	0.1%	0.1%	48%	0%	50%	0.9%	0.7%	0.0%	0%	2%	16%	46.7%	35.1%	0.2%	35%	0%	64%	1.1%	0.3%	0.0%	97%	1%	2%	0.0%
	Tl	22%	2.8%	3%	3%	71%	39%	8.8%	5%	5%	18%	21%	4%	92%	1.5%	5%	2%	82%	6.0%	1%	4.1%	4.7%	1.9%	47%	24%	24%	1.6%	3.4%	0.3%	0%	81%	1%	5.4%	11.6%	1.2%	47%	5%	42%	2.8%	2.3%	0.6%	11%	89%	0%	0.2%
	V	31%	0.1%	1%	2%	66%	78%	0.3%	3%	6%	5%	7%	1%	98%	0.0%	1%	1%	97%	0.1%	1%	0.6%	0.9%	0.3%	91%	0%	2%	3.4%	3.6%	0.0%	0%	3%	5%	44.2%	47.3%	0.5%	88%	0%	4%	5.8%	2.3%	0.1%	93%	4%	3%	0.1%
	Zn	53%	0.1%	10%	11%	26%	43%	0.1%	8%	9%	25%	12%	2%	91%	0.0%	7%	3%	89%	0.0%	2%	5.4%	2.7%	1.0%	76%	5%	15%	2.9%	2.2%	0.0%	0%	39%	16%	25.3%	19.4%	0.1%	69%	1%	24%	4.7%	1.4%	0.0%	50%	49%	2%	0.0%
LL	Al	43%	0.0%	3%	1%	53%	87%	0.0%	5%	3%	5%	0%	0%	97%	0.0%	2%	0%	99%	0.0%	0%	0.6%	0.0%	0.0%	44%	23%	23%	8.8%	1.7%	0.0%	0%	68%	1%	26.2%	5.1%	0.0%	42%	5%	38%	14.7%	1.1%	0.0%	10%	88%	2%	0.0%
	Sb	21%	0.0%	6%	12%	61%	47%	0.0%	14%	27%	12%	0%	0%	83%	0.0%	10%	7%	92%	0.0%	6%	2.5%	0.0%	0.0%	62%	1%	31%	4.2%	1.4%	0.7%	0%	11%	14%	49.6%	16.9%	8.6%	49%	0%	44%	5.8%	0.7%	0.9%	75%	18%	4%	2.2%
	As	28%	0.1%	3%	7%	62%	69%	0.4%	8%	17%	6%	0%	0%	93%	0.0%	4%	3%	96%	0.2%	2%	0.9%	0.0%	0.0%	94%	2%	1%	2.7%	0.4%	0.1%	0%	32%	10%	49.3%	7.3%	1.1%	92%	0%	2%	4.8%	0.3%	0.1%	75%	23%	2%	0.1%
	Ba	23%	0.0%	31%	4%	42%	35%	0.0%	48%	6%	11%	0%	0%	63%	0.0%	36%	1%	95%	0.0%	2%	3.2%	0.0%	0.0%	80%	6%	4%	8.7%	1.5%	0.0%	0%	37%	4%	50.4%	8.7%	0.2%	77%	1%	6%	14.8%	1.0%	0.1%	42%	54%	4%	0.0%
	Be	30%	0.0%	0%	1%	69%	94%	0.0%	1%	2%	3%	0%	0%	99%	0.0%	1%	0%	100%	0.0%	0%	0.3%	0.0%	0.0%	76%	15%	2%	4.5%	0.5%	2.6%	0%	65%	1%	19.8%	2.3%	12.0%	80%	3%	3%	8.3%	0.4%	4.6%	23%	74%	1%	2.1%
	Cd	29%	0.1%	7%	3%	62%	70%	0.3%	16%	7%	7%	0%	0%	90%	0.0%	9%	1%	98%	0.1%	1%	1.0%	0.0%	0.0%	42%	1%	53%	2.7%	0.7%	0.0%	0%	19%	12%	55.4%	13.8%	0.1%	30%	0%	66%	3.4%	0.3%	0.0%	71%	26%	4%	0.0%
	Cr	26%	0.0%	5%	3%	66%	73%	0.0%	13%	8%	6%	0%	0%	92%	0.0%	7%	1%	98%	0.0%	1%	0.8%	0.0%	0.0%	69%	1%	11%	14.6%	3.9%	0.0%	0%	7%	4%	70.1%	18.5%	0.1%	59%	0%	16%	22.0%	2.2%	0.0%	65%	23%	12%	0.0%
	Co	27%	0.0%	3%	3%	67%	77%	0.0%	7%	10%	5%	0%	0%	95%	0.0%	4%	2%	98%	0.0%	1%	0.7%	0.0%	0.0%	86%	0%	5%	6.8%	1.4%	0.3%	0%	3%	7%	71.8%	14.2%	3.8%	79%	0%	9%	11.1%	0.8%	0.5%	88%	5%	6%	0.9%
	Cu	26%	0.0%	11%	8%	55%	53%	0.2%	23%	17%	7%	0%	0%	82%	0.0%	14%	4%	95%	0.1%	3%	1.3%	0.0%	0.0%	74%	1%	19%	4.4%	1.3%	0.0%	0%	9%	7%	64.4%	19.4%	0.1%	63%	0%	29%	6.7%	0.8%	0.0%	84%	12%	4%	0.0%
	Fe	43%	0.0%	3%	3%	51%	83%	0.1%	5%	6%	6%	0%	0%	97%	0.0%	2%	1%	98%	0.0%	1%	0.8%	0.0%	0.0%	47%	24%	24%	5.3%	1.1%	0.0%	0%	78%	1%	17.5%	3.7%	0.0%	45%	5%	40%	9.1%	0.7%	0.0%	11%	88%	1%	0.0%
	Hg	37%	0.0%	0%	0%	63%	99%	0.0%	0%	0%	0%	0%	0%	100%	0.0%	0%	0%	100%	0.0%	0%	0.0%	0.0%	0.0%	48%	24%	24%	2.0%	0.7%	0.0%	0%	88%	2%	7.2%	2.7%	0.0%	48%	5%	43%	3.5%	0.5%	0.0%	11%	89%	0%	0.0%
	MeHg	37%	0.0%	0%	0%	63%	100%	0.0%	0%	0%	0%	0%	0%	100%	0.0%	0%	0%	100%	0.0%	0%	0.0%	0.0%	0.0%	50%	25%	25%	0.2%	0.1%	0.0%	0%	99%	0%	0.7%	0.4%	0.0%	50%	6%	44%	0.3%	0.1%	0.0%	11%	89%	0%	0.0%
	Mn	28%	0.0%	15%	8%	49%	44%	0.1%	24%	13%	18%	0%	0%	79%	0.0%	18%	3%	93%	0.1%	3%	4.1%	0.0%	0.0%	76%	3%	2%	17.0%	1.7%	0.1%	0%	11%	19%	63.2%	6.4%	0.3%	68%	1%	3%	27.0%	1.0%	0.1%	54%	36%	10%	0.1%
	Ni	26%	0.0%	4%	4%	67%	73%	0.0%	11%	10%	6%	0%	0%	93%	0.0%	6%	2%	98%	0.0%	1%	0.9%	0.0%	0.0%	46%	23%	23%	6.3%	1.0%	0.0%	0%	75%	1%	20.4%	3.2%	0.1%	44%	5%	40%	10.7%	0.6%	0.0%	11%	88%	1%	0.0%
	Pb	35%	0.0%	3%	4%	59%	77%	0.2%	6%	9%	8%	0%	0%	95%	0.0%	3%	2%	98%	0.1%	1%	1.0%	0.0%	0.0%	89%	0%	6%	3.6%	0.4%	0.0%	0%	5%	9%	76.7%	9.2%	0.1%	83%	0%	11%	5.9%	0.3%	0.0%	93%	4%	3%	0.0%
	Se	17%	0.0%	13%	14%	57%	26%	0.0%	20%	21%	33%	0%	0%	69%	0.0%	23%	8%	82%	0.0%	7%	11.1%	0.0%	0.0%	44%	16%	9%	24.4%	6.6%	0.3%	0%	30%	10%	46.6%	12.6%	0.6%	40%	3%	14%	38.7%	3.9%	0.5%	14%	80%	7%	0.2%
	Ag	25%	0.0%	2%	1%	72%	84%	0.0%	7%	5%	5%	0%	0%	96%	0.0%	3%	1%	99%	0.0%	1%	0.6%	0.0%	0.0%	47%	0%	49%	3.5%	0.3%	0.0%	0%	1%	5%	86.2%	7.8%	0.1%	34%	0%	62%	4.4%	0.2%	0.0%	93%	1%	6%	0.0%
	Tl	24%	0.0%	1%	1%	74%	85%	0.0%	4%	4%	6%	0%	0%	97%	0.0%	2%	1%	99%	0.0%	1%	0.7%	0.0%	0.0%	48%	24%	24%	2.5%	0.7%	0.4%	0%	83%	4%	8.7%	2.4%	1.4%	47%	5%	42%	4.4%	0.5%	0.6%	11%	89%	0%	0.2%
	V	30%	0.0%	2%	2%	66%	82%	0.0%	6%	5%	7%	0%	0%	96%	0.0%	3%	1%	98%	0.0%	1%	0.9%	0.0%	0.0%	81%	0%	2%	13.9%	3.2%	0.1%	0%	1%	4%	76.8%	17.4%	0.8%	73%	0%	3%	22.2%	1.9%	0.2%	84%	3%	13%	0.4%
	Zn	28%	0.1%	8%	14%	50%	44%	0.2%	12%	22%	23%	0%	0%	85%	0.0%	9%	6%	90%	0.2%	5%	5.0%	0.0%	0.0%	80%	4%	11%	3.4%	1.2%	0.0%	0%	45%	8%	34.9%	12.3%	0.1%	75%	1%	18%	5.5%	0.7%	0.0%	52%	46%	2%	0.0%
Tito Park	Al	32%	0.0%	2%	37%	29%	41%	0.0%	3%	47%	9%	0%	0%	84%	0.0%	2%	14%	87%	0.0%	11%	2.1%	0.0%	0.0%	46%	25%	25%	2.4%	1.8%	0.0%	0%	84%	1%	8.1%	6.3%	0.0%	46%	5%	44%	4.2%	1.2%	0.0%	10%	89%	0%	0.0%
	Sb	42%	0.3%	1%	7%	50%	82%	1.0%	1%	14%	2%	0%	0%	97%	0.1%	1%	2%	98%	0.4%	2%	0.3%	0.0%	0.0%	60%	1%	32%	2.9%	2.5%	1.2%	0%	10%	21%	30.2%	25.6%	13.0%	48%	0%	45%	4.1%	1.3%	1.6%	73%	20%	3%	3.9%
	As	38%	0.0%	1%	23%	39%	61%	0.1%	1%	36%	2%	0%	0%	92%	0.0%	1%	8%	94%	0.1%	6%	0.3%	0.0%	0.0%	96%	2%	1%	0.4%	0.2%	0.0%	0%	69%	9%	14.7%	6.4%	1.0%	97%	0%	2%	0.7%	0.1%	0.0%	75%	25%	0%	0.1%
	Ba	26%	0.1%	2%	36%	35%	38%	0.2%	3%	52%	7%	0%	0%	81%	0.0%	3%	16%	85%	0.2%	13%	1.6%	0.0%	0.0%	79%	7%	4%	7.1%	3.4%	0.1%	0%	35%	8%	38.1%	17.9%	0.4%	77%	1%	7%	12.3%	2.2%	0.1%	41%	56%	3%	0.1%

Table E-27. Contribution of environmental media to overall dietary dose for wildlife receptors

		Mallard					Belted Kingfisher							Sandpiper				Mink						Robin						Tree Swallow						Short-Tailed Shrew						Meadow Vole			
CSM Unit	**Metal**	**SD**	**SW**	**BI**	**OA**	**AP**	**SD**	**SW**	**BI**	**OA**	**FF**	**PF**	**AM**	**SD**	**SW**	**BI**	**OA**	**SD**	**SW**	**OA**	**FF**	**PF**	**AM**	**SO**	**TP**	**EW**	**SI**	**AI**	**SW**	**SO**	**TP**	**BI**	**SI**	**AI**	**SW**	**SO**	**TP**	**EW**	**SI**	**AI**	**SW**	**SO**	**TP**	**SI**	**SW**
Mean from all CSM Units and Metals =		**33%**	**0.6%**	**5%**	**10%**	**52%**	**60%**	**1.2%**	**7%**	**16%**	**6%**	**9%**	**1%**	**90%**	**0.2%**	**5%**	**4%**	**91%**	**0.9%**	**3%**	**1%**	**3%**	**1%**	**66%**	**10%**	**15%**	**7%**	**2%**	**0.2%**	**0%**	**42%**	**8%**	**38%**	**11%**	**1.2%**	**63%**	**2%**	**22%**	**11%**	**1%**	**0.3%**	**48%**	**47%**	**4%**	**0.3%**
	Be	22%	9.5%	1%	20%	48%	34%	25.1%	1%	30%	10%	0%	0%	84%	4.4%	1%	10%	73%	17.5%	7%	2.2%	0.0%	0.0%	76%	15%	2%	3.4%	0.5%	2.7%	0%	69%	1%	15.3%	2.4%	12.7%	81%	4%	3%	6.5%	0.4%	4.9%	22%	75%	1%	2.1%
	Cd	46%	0.0%	0%	5%	48%	88%	0.0%	1%	9%	3%	0%	0%	98%	0.0%	0%	1%	99%	0.0%	1%	0.3%	0.0%	0.0%	56%	0%	43%	0.2%	0.1%	0.0%	0%	57%	7%	27.0%	8.9%	0.1%	42%	0%	57%	0.2%	0.0%	0.0%	90%	10%	0%	0.0%
	Cr	27%	0.0%	2%	30%	41%	43%	0.1%	3%	48%	6%	0%	0%	85%	0.0%	2%	13%	88%	0.0%	11%	1.2%	0.0%	0.0%	77%	2%	13%	4.9%	4.3%	0.0%	0%	14%	8%	41.4%	36.0%	0.1%	69%	0%	20%	7.8%	2.6%	0.0%	71%	25%	4%	0.0%
	Co	28%	0.4%	1%	23%	47%	51%	1.3%	2%	41%	4%	0%	0%	89%	0.2%	1%	10%	91%	0.8%	8%	0.8%	0.0%	0.0%	87%	0%	5%	3.6%	3.0%	0.8%	0%	3%	16%	39.4%	32.8%	8.8%	82%	0%	8%	6.0%	1.9%	1.2%	89%	5%	3%	2.1%
	Cu	27%	0.0%	1%	24%	48%	49%	0.0%	3%	44%	5%	0%	0%	87%	0.0%	2%	11%	90%	0.0%	9%	0.9%	0.0%	0.0%	77%	0%	22%	0.5%	0.6%	0.0%	0%	24%	12%	30.1%	34.0%	0.1%	66%	0%	33%	0.8%	0.3%	0.0%	92%	8%	1%	0.0%
	Fe	36%	0.0%	2%	33%	30%	47%	0.0%	2%	44%	8%	0%	0%	87%	0.0%	2%	11%	90%	0.0%	9%	1.5%	0.0%	0.0%	47%	25%	25%	1.7%	1.8%	0.0%	0%	86%	2%	6.0%	6.1%	0.0%	46%	5%	44%	3.0%	1.2%	0.0%	10%	89%	0%	0.0%
	Hg	34%	0.0%	2%	9%	55%	72%	0.0%	4%	20%	4%	0%	0%	94%	0.0%	2%	4%	97%	0.0%	3%	0.6%	0.0%	0.0%	47%	25%	25%	1.2%	2.1%	0.0%	0%	82%	6%	4.1%	7.0%	0.0%	47%	6%	44%	2.2%	1.4%	0.0%	10%	90%	0%	0.0%
	MeHg	38%	0.0%	0%	0%	61%	94%	0.0%	1%	0%	5%	0%	0%	100%	0.0%	0%	0%	99%	0.0%	0%	0.6%	0.0%	0.0%	48%	26%	26%	0.1%	0.0%	0.0%	0%	99%	1%	0.3%	0.1%	0.0%	49%	6%	46%	0.1%	0.0%	0.0%	10%	90%	0%	0.0%
	Mn	12%	0.1%	4%	71%	13%	13%	0.1%	5%	76%	7%	0%	0%	50%	0.0%	8%	42%	59%	0.1%	38%	3.3%	0.0%	0.0%	80%	3%	3%	9.2%	4.7%	0.2%	0%	11%	44%	29.5%	14.9%	0.7%	76%	1%	5%	15.5%	2.9%	0.3%	55%	39%	6%	0.4%
	Ni	28%	0.1%	2%	25%	46%	48%	0.2%	3%	43%	6%	0%	0%	87%	0.0%	2%	11%	90%	0.1%	9%	1.1%	0.0%	0.0%	45%	24%	24%	5.8%	1.9%	0.0%	0%	74%	2%	18.1%	5.9%	0.1%	43%	5%	41%	10.0%	1.2%	0.1%	10%	89%	1%	0.0%
	Pb	42%	0.0%	1%	18%	39%	65%	0.0%	2%	27%	6%	0%	0%	94%	0.0%	1%	5%	95%	0.0%	4%	1.0%	0.0%	0.0%	94%	0%	6%	0.2%	0.1%	0.0%	0%	26%	23%	27.8%	23.3%	0.2%	90%	0%	10%	0.3%	0.1%	0.0%	97%	3%	0%	0.0%
	Se	42%	0.1%	1%	3%	53%	82%	0.2%	3%	5%	9%	0%	0%	98%	0.0%	1%	1%	98%	0.1%	1%	1.2%	0.0%	0.0%	33%	11%	9%	32.2%	13.5%	0.6%	0%	16%	16%	46.9%	19.7%	1.0%	28%	2%	14%	47.9%	7.6%	0.9%	13%	75%	11%	0.7%
	Ag	34%	0.0%	1%	14%	51%	68%	0.0%	2%	27%	3%	0%	0%	94%	0.0%	1%	5%	95%	0.0%	4%	0.5%	0.0%	0.0%	47%	0%	51%	0.7%	0.9%	0.0%	0%	2%	26%	32.5%	39.9%	0.5%	34%	0%	65%	0.9%	0.4%	0.0%	97%	1%	1%	0.1%
	Tl	47%	0.0%	0%	2%	51%	95%	0.1%	0%	4%	1%	0%	0%	99%	0.0%	0%	1%	99%	0.0%	0%	0.1%	0.0%	0.0%	46%	24%	24%	1.9%	2.5%	1.4%	0%	70%	13%	5.4%	7.3%	4.3%	45%	5%	42%	3.3%	1.7%	2.4%	10%	89%	0%	0.8%
	V	30%	0.2%	1%	33%	36%	45%	0.5%	2%	49%	4%	0%	0%	86%	0.1%	1%	13%	88%	0.3%	10%	0.9%	0.0%	0.0%	87%	0%	2%	6.7%	4.0%	0.2%	0%	2%	8%	55.9%	33.1%	1.6%	83%	0%	3%	11.2%	2.5%	0.3%	90%	4%	6%	0.5%
	Zn	36%	0.0%	2%	26%	36%	53%	0.0%	3%	37%	7%	0%	0%	89%	0.0%	2%	9%	92%	0.0%	7%	1.3%	0.0%	0.0%	87%	3%	7%	1.3%	0.6%	0.0%	0%	61%	7%	22.0%	10.5%	0.0%	84%	1%	12%	2.1%	0.4%	0.0%	60%	39%	1%	0.0%
Site Perimeter (East)	Al	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	41%	21%	21%	17.2%	0.5%	0.0%	0%	53%	2%	44.1%	1.3%	0.0%	36%	4%	32%	27.0%	0.3%	0.0%	10%	86%	4%	0.0%
	Sb	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	39%	1%	20%	40.4%	0.7%	0.1%	0%	1%	0%	96.1%	1.6%	0.4%	27%	0%	24%	49.1%	0.3%	0.2%	46%	12%	41%	0.4%
	As	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	92%	2%	1%	4.7%	0.1%	0.0%	0%	26%	2%	69.7%	1.9%	0.0%	90%	0%	2%	8.0%	0.1%	0.0%	74%	23%	3%	0.0%
	Ba	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	67%	5%	3%	22.6%	1.8%	0.1%	0%	16%	10%	68.2%	5.6%	0.3%	58%	1%	5%	34.8%	1.1%	0.1%	39%	49%	11%	0.1%
	Be	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	76%	14%	2%	4.5%	0.4%	2.5%	0%	65%	1%	20.6%	1.8%	12.0%	80%	3%	3%	8.4%	0.3%	4.5%	24%	73%	1%	2.0%
	Cd	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	26%	1%	46%	25.6%	1.4%	0.0%	0%	4%	1%	89.9%	5.1%	0.0%	17%	0%	53%	29.5%	0.6%	0.0%	38%	30%	33%	0.0%
	Cr	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	66%	1%	10%	21.9%	1.1%	0.1%	0%	5%	4%	85.8%	4.4%	0.3%	53%	0%	14%	31.4%	0.6%	0.1%	62%	20%	18%	0.2%
	Co	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	71%	0%	4%	23.0%	0.9%	0.7%	0%	1%	7%	85.7%	3.2%	2.9%	59%	0%	6%	33.7%	0.5%	1.0%	73%	4%	21%	2.0%
	Cu	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	77%	0%	20%	2.0%	0.6%	0.0%	0%	9%	1%	69.3%	20.5%	0.0%	66%	0%	31%	3.0%	0.3%	0.0%	93%	5%	2%	0.0%
	Fe	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	45%	22%	22%	9.9%	0.4%	0.0%	0%	67%	2%	29.8%	1.3%	0.0%	42%	5%	37%	16.3%	0.3%	0.0%	11%	87%	2%	0.0%
	Hg	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	44%	22%	22%	12.2%	0.1%	0.0%	0%	64%	0%	35.4%	0.2%	0.1%	40%	4%	36%	19.7%	0.0%	0.1%	10%	87%	3%	0.0%
	MeHg	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	49%	25%	25%	0.9%	0.0%	0.0%	0%	96%	0%	3.3%	0.1%	0.2%	49%	5%	44%	1.5%	0.0%	0.1%	11%	89%	0%	0.0%
	Mn	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	72%	3%	2%	20.9%	2.4%	0.0%	0%	8%	27%	58.7%	6.8%	0.1%	63%	1%	3%	32.3%	1.4%	0.0%	53%	34%	13%	0.0%
	Ni	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	37%	19%	19%	24.3%	0.8%	0.3%	0%	41%	3%	53.5%	1.7%	0.7%	31%	4%	28%	36.3%	0.4%	0.4%	10%	84%	6%	0.2%
	Pb	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	60%	0%	6%	33.7%	0.2%	0.0%	0%	1%	1%	97.9%	0.7%	0.0%	46%	0%	8%	45.9%	0.1%	0.0%	64%	5%	31%	0.0%
	Se	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	30%	9%	10%	44.1%	6.9%	0.0%	0%	15%	2%	71.8%	11.2%	0.1%	23%	2%	13%	59.0%	3.4%	0.1%	14%	68%	18%	0.1%
	Ag	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	36%	0%	37%	26.2%	0.1%	0.0%	0%	0%	0%	98.8%	0.5%	0.1%	24%	0%	44%	31.1%	0.1%	0.0%	61%	1%	38%	0.2%
	Tl	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	39%	20%	20%	21.7%	0.1%	0.4%	0%	47%	0%	51.6%	0.3%	1.1%	33%	4%	30%	32.8%	0.1%	0.6%	10%	85%	5%	0.3%
	V	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	80%	0%	2%	17.2%	0.7%	0.1%	0%	1%	6%	88.7%	3.8%	0.7%	70%	0%	3%	26.6%	0.4%	0.2%	81%	3%	15%	0.4%
	Zn	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	60%	5%	15%	18.1%	2.6%	0.0%	0%	17%	9%	64.9%	9.3%	0.0%	49%	1%	22%	26.5%	1.4%	0.0%	39%	51%	10%	0.0%
Site Perimeter (West)	Al	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	47%	24%	24%	3.3%	0.3%	0.0%	0%	86%	1%	11.7%	1.0%	0.0%	46%	5%	42%	5.8%	0.2%	0.0%	10%	89%	1%	0.0%
	Sb	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	63%	1%	32%	3.2%	1.1%	0.0%	0%	18%	2%	60.0%	20.2%	0.0%	50%	0%	45%	4.5%	0.6%	0.0%	77%	19%	3%	0.0%
	As	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	91%	2%	2%	3.3%	1.6%	0.0%	0%	25%	3%	48.6%	22.9%	0.1%	89%	0%	3%	5.8%	1.0%	0.0%	74%	23%	2%	0.0%
	Ba	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	87%	7%	4%	2.0%	0.2%	0.0%	0%	68%	11%	19.6%	1.9%	0.0%	88%	2%	7%	3.6%	0.1%	0.0%	43%	56%	1%	0.0%
	Be	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	81%	15%	2%	0.9%	0.4%	0.0%	0%	91%	1%	5.3%	2.2%	0.0%	91%	4%	4%	1.8%	0.3%	0.0%	24%	76%	0%	0.0%
	Cd	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	40%	1%	54%	4.0%	0.7%	0.0%	0%	18%	2%	68.4%	11.4%	0.0%	28%	0%	67%	4.9%	0.3%	0.0%	66%	28%	6%	0.0%
	Cr	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	81%	2%	13%	4.1%	0.5%	0.0%	0%	25%	8%	59.6%	7.5%	0.0%	73%	0%	20%	6.5%	0.3%	0.0%	72%	25%	3%	0.0%
	Co	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	93%	0%	6%	1.1%	0.2%	0.0%	0%	20%	9%	61.5%	9.3%	0.0%	88%	0%	10%	1.8%	0.1%	0.0%	93%	6%	1%	0.0%
	Cu	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	78%	0%	20%	0.7%	0.4%	0.0%	0%	27%	6%	43.4%	22.9%	0.0%	67%	0%	31%	1.1%	0.2%	0.0%	91%	9%	1%	0.0%
	Fe	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	49%	25%	25%	0.9%	0.1%	0.0%	0%	96%	0%	3.6%	0.4%	0.0%	49%	6%	44%	1.7%	0.1%	0.0%	11%	89%	0%	0.0%
	Hg	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	49%	25%	25%	1.3%	0.4%	0.0%	0%	92%	1%	4.9%	1.5%	0.0%	48%	5%	44%	2.3%	0.3%	0.0%	11%	89%	0%	0.0%
	MeHg	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	49%	25%	25%	0.1%	0.0%	0.0%	0%	99%	0%	0.3%	0.1%	0.0%	49%	6%	45%	0.1%	0.0%	0.0%	11%	89%	0%	0.0%
	Mn	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	92%	4%	2%	2.5%	0.2%	0.0%	0%	44%	23%	29.7%	2.7%	0.1%	92%	1%	3%	4.4%	0.2%	0.0%	59%	39%	1%	0.0%
	Ni	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	49%	25%	25%	0.8%	0.1%	0.0%	0%	96%	0%	3.2%	0.5%	0.0%	49%	6%	44%	1.5%	0.1%	0.0%	11%	89%	0%	0.0%
	Pb	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	90%	0%	7%	1.8%	0.5%	0.0%	0%	10%	7%	64.1%	18.4%	0.1%	85%	0%	12%	3.1%	0.3%	0.0%	93%	5%	2%	0.0%
	Se	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	58%	21%	11%	6.3%	2.7%	0.0%	0%	70%	1%	20.6%	8.9%	0.0%	61%	5%	21%	11.6%	1.9%	0.0%	14%	85%	1%	0.0%
	Ag	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	49%	0%	51%	0.2%	0.1%	0.0%	0%	10%	5%	66.1%	19.5%	0.0%	35%	0%	65%	0.3%	0.0%	0.0%	98%	1%	0%	0.0%
	Tl	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	48%	24%	24%	2.4%	0.8%	0.0%	0%	88%	0%	8.7%	3.0%	0.0%	47%	5%	43%	4.2%	0.5%	0.0%	11%	89%	0%	0.0%
	V	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	92%	0%	2%	5.5%	0.5%	0.0%	0%	3%	7%	83.1%	6.8%	0.0%	87%	0%	3%	9.2%	0.3%	0.0%	92%	4%	5%	0.0%
	Zn	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	79%	5%	12%	3.0%	1.2%	0.0%	0%	50%	5%	32.1%	13.1%	0.1%	73%	1%	20%	4.9%	0.7%	0.0%	50%	48%	2%	0.0%

Notes:

Estimates based on 95% UCL concentrations.

Abbreviations:

AI - aerial/foliar invertebrates	*FF - forage fish*
AM - amphibians	*OA - other aquatic invertebrates*
AP - aquatic plants	*PF - piscivorous fish*
BI - benthic invertebrates	*SD - sediment*
EW - earthworms	*SI - soil invertebrates*
	SO - soil
	SW - surface water
	TP - terrestrial plants