EPA COMMENTS ON DRAFT FINAL OU1 BERA

EPA has reviewed the document titled "Final OU-1 Baseline Ecological Risk Assessment Report" submitted to EPA by e-mail on 06/13/2022. This document is very much improved from the prior version. The authors have done a fine job of implementing a number of difficult technical and organizational changes requested by EPA. Nevertheless, there remain some issues which need attention before finalization.

GENERAL

1. When interpreting HQ calculations, a LOAEL-based HQ that is EQUAL to 1 should be identified as being of potential concern, since the calculations indicate that the exposure to a site receptor is the same as that which caused an adverse effect in the toxicity study. This applies to both large and small home range receptors.

2. For each LOE for each receptor group, use a consistent sequence of presenting the information. This should culminate in a brief confidence-based WOE statement for that specific LOE. A typical sequence would be:

   Results
   Main Findings
   Confidence
   Conclusion**

   ** The conclusion section should be a brief "bottom line" summary statement that identifies the level of concern based on the LOE and the confidence in the findings. For example: "Based on this LOE, there is [high, medium, low] confidence that [risk conclusion]"

   EPA recommends the each of these 4 subsections be indicated with a sub-heading. EPA has illustrated how this could be done in edits for Sections 4, 5, and 6 (see Attachment E). EPA notes that a consistent format has not been used within and between receptor chapters, and that the existing text often mixes discussions of confidence and conclusions. Using a consistent organization and format is very helpful to readers.

3. There are several sections where confidence discussions imply that because some HQs are uncertain, that makes any finding of risk unreliable. However, just because an HQ is uncertain does not make it uninformative. Uncertainty in the precise value of an HQ is not the same as uncertainty in a conclusion that there is a basis for concern. This might be a valid point in cases where the HQ is relatively low (e.g., 1-2), but when HQs are really high (e.g., 10-60), there is no significant doubt that this is an indication of risk, even if the absolute value of the HQ might be somewhat lower. When discussing confidence in such cases, do not seek to diminish the concern simply because the precise value of the HQ is uncertain. Rather, state that even though there are uncertainties, the HQ values are sufficiently high that the finding of risk remains confident.

4. The discussion of minimum viable population (MVP) size implies that "population-level effects" is interchangeable with "effects on population levels", and there is a difference. MVP analysis is an approach that can be used for populations of threatened and endangered species to determine the minimum number of individuals needed for a population to be viable. That is under the jurisdiction of Fish and Wildlife Service and National Marine Fisheries Service (depending on the species of interest), while EPA is focused on environmental impacts. MVP is concerned with effects on population levels while ERA is concerned with population-level effects (i.e., effects on survival, growth and reproduction). Population-level effects are concerned with environmental impacts that may or may not impact the viability of a local population. Chronic exposures to pollutants from site operations may affect the local sustainability of a population. It's not okay to have environmental impacts just because one site alone won't affect population viability, and that is not a reason for concluding that risk is acceptable when exposure concentrations exceed effects levels. EPA recommends removing the MVP text from the BERA unless specific to endangered species. Alternatively, EPA has made suggested revisions to the existing text in Section 2.5.5 (see Attachment 1).

TEXT

See Attachment 1 for comments on the text

TABLES

Table ES-1 and Table 8-1. Delete columns for PRIs not evaluated (PRIs 1, 3, and 11) so font can be increased a little. See Attachment G for changes in these tables that EPA believes are appropriate.

Table 3-8. It is EPA's understanding that Table 3-8 does not show HQ values for northern and southern PRI-14. It shows HQs for total PRI-14 (both northern and southern) vs southern. The impact of northern PRI-14 can only be guessed at by difference. Table 3-8 would be much more informative if the two columns called "EPC=Original UCL" were replaced with results for the northern portion only.

Table 7-1.

- Change "Bioaccessibility" to "Bioavailability"
- Change the entry for Intermittent Longer-Term Exposure to "?"

FIGURES

General

In Figures such as 3-1a that display the NOAEL- and LOAEL-based HQ values for mobile receptors, the green shaded area that represents the NOAEL to LOAEL range for background is easy to misinterpret as the range of individual HQ values observed in the background data set. The instinct is to say "If the LOAEL falls in the green range, all is OK." However, the range in green does not represent variability in concentrations seen in the background area, but the range between effect levels. When comparing site to background, the comparison should be Site LOAEL vs Bkg LOAEL, and never Site LOAEL vs Bkg NOAEL.

Consequently, to minimize the risk of misinterpretation, the green shaded area and the associated footnote should be removed from all figures with this format. Leaving the green shaded area is fine in figures where the range does indicate variability in the background data set (e.g., Figure 2-24).

Specific

Figure 6-3c. The NOAEL-based and LOAEL-based HQs differ by a factor of 1,000,000. This is not expected. Double check for errors (especially unit errors) both in the derivation of the benchmarks and in the calculation of the HQs. Revise and correct as needed.

Figure 6-3w. This figure does not include datapoints for all of the water samples which were analyzed for chlorine (Cl_2). For example, for PRI-7, there are 5 samples, but only two data points. The three missing samples are PRI7-007, PRI7-013, and PRI7-014. A similar situation exists for PRI-8 (one sample) and PRI-12 (two samples). All of these are identified as detects in the database, but the results are shown as a zero. EPA assumes these should be ranked as non-detects. However, the database does not include a detection limit for these samples, so there is no way to assign a surrogate value. If there is a meaningful DL available for this method, and if it is about 0.02 mg/L or lower, then these samples could be included in the figures and that might shift the conclusions about potential risk from chlorine. However, if the DL is higher than about 0.02 mg/L, then adding these data points (plotted at ½ the DL) would only increase the number at or above an HQ of 1. If this is the case, EPA finds it acceptable to make no revisions to this figure.

APPENDICES

APPENDIX A COMPREHENSIVE SPECIES LIST

APPENDIX B PROCESS FOR CALCULATING SURFACE-WEIGHTED AVERAGE CONCENTRATIONS USING CCESSIBLE SAMPLES IN PRI 5 AND PRI 6 LAKEBED SEDIMENT
This appendix may become obsolete depending on strategy for AHUF problem.

APPENDIX C BENCHMARK AND TRV SELECTION

APPENDIX D RETROFITTED WASTE POND HYPOTHETICAL RISK RESULTS OUTPUT
This appendix may require editing depending on strategy for AHUF problem.

APPENDIX E COMPREHENSIVE RISK TABLES AND RISK WORKBOOK

APPENDIX F PROUCL OUTPUT FOR CALCULATION OF 95UCLS

EXECUTIVE SUMMARY

~~The purpose of this Baseline Ecological Risk Assessment (BERA) is to provide a description of the nature and likelihood of adverse effects that might occur in ecological receptors as a result of exposure to chemicals in the soil, sediment, and water at the US Magnesium LLC (USM) Site., along the southwestern shore of the Great Salt Lake. USM is a commercial producer of primary magnesium metal, magnesium alloys, chlorine, hydrochloric acid, and lithium carbonate. Releases of chemicals from the facility may result in exposure of ecological receptors that utilize habitats around the facility~~.

Site Description

U.S. Magnesium LLC (USM) operates a large industrial facility that ~~Site~~ is located 15 miles north of Interstate 80 in Rowley, Utah, in northern Tooele County. The facility~~Site~~ is located in the Lakeside Valley, a north-south-trending valley bordered by the Great Salt Lake ~~and solar evaporation ponds~~ to the east and the Lakeside Mountains to the west. ~~The Site is defined as the area within a 5-mile radius centered on USM's Main Stack, excluding the magnesium production facility itself.~~ The facility has been in operation since 1972. Magnesium is refined from brine obtained from the Great Salt Lake. The facility includes employee offices and process buildings and other ancillary structures and facilities. Surrounding the process buildings are a series of evaporation ponds, a concentrated brine pond, a landfill, electrolytic salt ("smut") storage areas, and a calcium sulfate (gypsum) disposal area. A series of earthen, open-air ditches formerly conveyed liquid waste from the process facility to earthen wastewater evaporation ponds. Currently, liquid wastes are conveyed via piping to the wastewater evaporation ponds. An engineered disposal site for cast house residues containing barium sulfate is located northwest of the facility.

The Site is defined as the area within a 5-mile radius centered on USM's Main Stack, excluding the magnesium production facility itself. ~~The Site was divided into two Operable Units (OUs), each covering a 5-mile radius from the main magnesium production facility.~~ Operable Unit 1 (OU-1) includes areas of soil, sediment, groundwater/surface water, and wastewater that may be affected by waste streams. For the purpose of assessing the likelihood of adverse ecological effects, OU-1 was divided into 16 Preliminary Remedial Investigation (PRI) areas, the Skull Valley Diversion Ditch (SVDD), and the Great Salt Lake Intake Canal (GSLIC). PRIs 1 through 10, a portion of PRI 11, and PRI 12 are located on the USM property and are actively used by USM, while all other PRIs extend outside the property boundaries and represent areas where material from the USM operations may have migrated.

Commented [EPA1]: Add a figure that shows these PRIs and other areas. EPA thinks Figure 2-3 might be best, perhaps with some minor cleanup of text boxes and notes specifically about water features.

As part of the Resource Conservation and Recovery Act (RCRA) activities, PRI 1 and PRI 3 were remediated. Additionally, PRIs 5, 6, and 7 will be merged to create a retrofitted waste pond (RWP). The RWP will receive the current wastewater stream that includes wastewater from the new lithium facility constructed to reprocess smut material in PRI 9. It is anticipated that little of the upland area currently present in PRIs 5 and 6 will remain due to operation of the RWP, but actual water levels and the extent of sediment inundation are not known with certainty. PRI 4 currently receives a slurry of gypsum and will remain in use during future facility operations; however, under future conditions the gypsum will no longer contain elevated levels of bioaccumulative compounds. Additionally, the entire length of the SVDD adjacent to PRI 5 is inside the RWP 7 and the portion of the SVDD adjacent to PRI 7 has been filled and covered by an earthen dike as part of the RWP construction.

BERA Purpose and Approach

The purpose of this BERA is to provide a description of the nature and likelihood of potential

adverse effects that might occur in ecological receptors as a result of exposure to chemicals in soil, sediment, water, and biota in the area of~~surrounding~~ the Site. The BERA follows standard United States Environmental Protection Agency (USEPA) risk assessment procedures and is consistent with State of Utah guidance, and the Administrative Settlement Agreement and Order on Consent (AOC) (USEPA 2011).

The final BERA dataset included abiotic and biotic data collected in support of the remedial investigation and feasibility study (RI/FS) program, biotic data (egg tissue) from USEPA, two Site-specific toxicity studies, and 12 ecological field studies. Chemicals of potential ecological concern (COPECs) were identified in a screening assessment, where bioaccumulative compounds were carried through as COPECs unless concentrations were at or below background. These compounds include Avian Toxicity Equivalency (TEQ) (a sum of dioxins, furans, polychlorinated biphenyls [PCBs], and hexachlorobenzene [HCB]), Mammalian TEQ (a sum of dioxins, furans, and PCBs), total PCBs, HCB, mercury, hexachlorobutadiene, 1,2,4,5-tetrachlorobenzene, and pentachlorobenzene.

Avian TEQ and Mammalian TEQ were calculated using toxicity equivalency factors (TEFs) that are based on the relative toxicity compared to tetrachlorodibenzo-p-dioxin (TCDD) for birds and mammals, respectively. HCB was also included in the summation for Avian TEQ, since HCB was found to have dioxin-like toxicities for birds. Avian species sensitivity to TCDD is grouped into three categories, where Avian TEQ Category 1 birds are most sensitive to TCDD and Avian TEQ Category 3 birds are least sensitive to TCDD. All three Avian TEQ categories were evaluated in the BERA.

Environmental Setting

The environmental setting for the Site is characterized by a semi-arid climate. Surface water has been or may be present in various areas with salinity levels that are mostly hypersaline (> 35 parts per thousand salinity). Water discharged from the facility into the waste ponds (PRIs 5, 6 and 7) is acidic.

For the BERA, land covers/habitats within the Site were categorized into “upland” and “lakebed” for purposes of evaluating the different biota types found within these habitats. The upland category represents terrestrial habitat that supports soil invertebrates, plants, birds, and mammals. The lakebed category represents wetland/playa habitat that may support aquatic/benthic invertebrates (e.g., brine shrimp and brine flies), plants, and “shoreline” wildlife (e.g., wading birds~~i.e., birds and mammals~~).

Much of the upland habitat at the Site does not support terrestrial plant communities and/or has plants that are ruderal, sparse, patchily distributed, short in stature, and do not provide suitable refuge or foraging habitat for wildlife. In the lakebed habitat, salinity levels are mostly hypersaline, thus no fish are present in the Site and aquatic organisms in surface water are limited to brine shrimp, brine flies~~(brine fly larvae are considered to be benthic invertebrates in the BERA)~~, and aquatic plants. Field~~Past~~ studies indicate~~reported~~ that shorebirds utilize the ~~at~~ waste ponds (PRIs 5, 6, 7) only occasionally, ~~are generally observed less frequently, and when observed, are~~usually restricted to short visits before flying off ~~(BIO-Logic 2002, 2003)~~. ~~In general, PRIs within the facility boundary tend to have less bird usage due to disturbed habitat and/or ongoing physical disturbances~~. Trails of large mammal prints in lakebed habitat suggest these animals are likely to be transient visitors. Currently, facility waste ponds support little or no emergent vegetation. Adult and larval brine flies have been observed in aquatic habitats within the lakebed habitat, excluding the acidic waste ponds~~; however, the brine flies may have blown in from another location since brine fly casts have been rarely observed~~.

Conceptual Site Model

The Conceptual Site Model considers the Site setting in an ecological context, presents schematically the relationship between chemical sources and organisms at the Site, and identifies exposure pathways for ecological receptors (USEPA 1992a). The chemical sources include: (1) gases and fine particulate materials released to air; (2) solid materials placed in piles on the ground or released from USM facility buildings as fugitive dusts that fall to the ground; and (3) liquid wastes and slurries discharged historically through ditches (now closed and capped) and currently conveyed through pipes into waste impoundments (waste ponds) and the gypsum pile. These processes have led to the presence of Site- related chemical contaminants in air, soil, waste piles, surface water, sediments, and groundwater.

The USM facility is currently active. Its land is zoned as industrial and is anticipated to be industrial for the foreseeable future. Currently, PRIs within the facility boundaries (PRIs 2 through 12) support an industrial use that is characterized by frequent physical anthropogenic ~~anthropomorphic~~ disturbance and/or management of waste streams from the active facility. As a result, much of the upland and lakebed habitat within the facility boundaries does not support prey items for birds and mammals, which results in an acute exposure to soil or sediment.

Exposure Pathways and Representative Species

A chemical exposure pathway is deemed “potentially complete and potentially significant” if that pathway is reasonable for a receptor given its habitat and dietary preferences. Exposure routes evaluated in the BERA include:

- Direct contact/uptake of constituents in surface water by aquatic invertebrates (brine shrimp) and aquatic plants (including algae)
- Direct contact/uptake of constituents in sediment by benthic invertebrates (brine fly larvae)
- Direct contact/root uptake of constituents in soil by terrestrial plants
- Direct contact/uptake of constituents in soil by soil invertebrates
- Incidental ingestion of constituents in soil by wildlife
- Ingestion of constituents in surface water by wildlife
- Ingestion of constituents in food items (i.e., plant, invertebrate, or small mammal) by

wildlife Representative wildlife species selected for use in the BERA are as follows:

- Gleaning invertivorous bird (upland habitat only) – horned lark (*Eremophila alpestris*)
- Aerial invertivorous bird (upland and lakebed habitat) – tree swallow (*Tachycineta bicolor*)
- Probing invertivorous bird (lakebed habitat only) – snowy plover (*Charadrius nivosus*) and American avocet (*Recurvirostra americana*)
- Herbivorous bird (upland and lakebed habitat) – mourning dove (*Zenaida macroura*)
- Carnivorous bird (upland and lakebed habitat) – American kestrel (*Falco sparverius*). The American kestrel was used as a surrogate for the golden eagle, which has been observed nesting in the Lakeside Mountains in PRI 16 and is protected at the individual level due to the Bald and Golden Eagle Protection Act.
- Invertivorous mammal (upland and lakebed habitat) – grasshopper mouse (*Onychomys arenicola*)

- Herbivorous mammal (upland and lakebed habitat) – Ord's kangaroo rat (*Dipodomys ordii*)
- Carnivorous mammal (upland and lakebed habitat) – badger (*Taxidea taxus*)
- Large herbivorous mammal (upland habitat only) – pronghorn antelope (*Antilocapra americana*). Large herbivorous mammals are only expected to occur in the buffer areas (PRIs 14, 15, and 16).

Exposure and Effects Estimation

When possible, e~~E~~xposure and effects to receptors and representative species were estimated using multiple~~five~~ lines of evidence (LOEs)~~ within a weight of evidence (WOE) process~~, which are briefly described below.

Hazard Quotients Lines of Evidence (Direct Contact, Dietary Dose, Tissue)

Hazard quotients (HQs) are comparisons of Site-specific exposure measures to toxicity benchmarks or toxicity reference values (TRVs). Benchmarks and TRVs were based on no observed adverse effect levels (NOAELs) and lowest observed adverse effect levels (LOAELs), which resulted in NOAEL HQs and LOAEL HQs. A NOAEL HQ less than or equal to 1 suggests that adverse effects at the organism level are unlikely. A LOAEL HQ greater than or equal to 1 indicates that potential adverse effects at the organism level may occur~~cannot be ruled out~~. The three types of HQ LOEs calculated for the BERA include:

- Direct contact HQs – HQs were developed for terrestrial plants, soil invertebrates, benthic invertebrates, and aquatic biota using measured concentrations in soil/sediment or water compared to benchmarks.
- Dietary dose HQs – HQs were developed for birds and mammals using calculated ~~a modeled~~ daily dose from oral ingestion of food, solids, and/or water compared to acute, chronic, or intermittent longer-term dietary TRVs.~~ An intermittent longer-term scenario was evaluated for probing birds (snowy plover, American avocet) in the acidic waste ponds where a conservative estimate of exposure for probing birds in the waste ponds was assumed to be one visit a month, based on survey data for American avocets~~.
- Tissue HQs – HQs were developed for measured concentrations of contaminants in bird eggs compared to chronic tissue benchmarks. HQs were also developed for modeled concentrations in biotic tissue (small mammal whole carcass, plant tissue, or invertebrate tissue) compared to chronic tissue benchmarks.

Site-Specific Toxicity Studies Line of Evidence

Site-specific toxicity studies describe effects that occur when test animals are exposed to contaminated media (e.g., soil, water) collected from a site. At this Site, ~~The Site-specific toxicity studies LOE was only applicable to birds since it is based on~~ two studies (Parametrix 2004; Hooper et al. 2008) on the palatability and toxicity of acidic waste pond water to birds were available~~(Parametrix 2004; Hooper et al. 2008)~~.

Ecological Field Surveys Line of Evidence

Ecological field surveys describe the occurrence and condition of ecological receptors at a site. At this Site, two ~~The~~ ecological field surveys were available ~~LOE is derived from studies~~ on the reproductive success of birds near the Old Waste Pond (PRI 7 and nearby areas). In addition, ~~, as well as~~ a number of field surveys were available reporting ~~the~~ comparisons of organism health at the

Site to organism health under normal conditions for vegetation, benthic invertebrates, birds, and mammals.

Weight of Evidence

A Weight of Evidence (WOE) process was used to evaluate and integrate the different LOEs described above. ~~The approach for the BERA is a narrative WOE.~~ First, the results of the different LOEs are considered together. If the LOE results are consistent with each other (or if there is only one LOE), the risk conclusions are derived and the WOE concludes the findings. However, if the LOEs do not have results consistent with each other, then the LOEs are evaluated narratively for strength, reliability, and relevance. The LOE(s) with the highest weight (strongest, most reliable, and most relevant) then drive the risk conclusion. Conclusive results and key uncertainties are emphasized as appropriate.

Risk Assessment Findings

A summary of the WOE findings is presented below for each ecological receptor followed by summaries by exposure unit and media. As described previously, all results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP.

BERA Findings for Birds

Four LOEs were used to characterize risk to birds, resulting in the following main findings:

1. Dietary dose LOAEL HQs are below a level of concern or are similar to background in most areas of the site. However, HQs are above a level of concern ~~highest due to chronic intake of TEQ with the highest values generally~~ for probing birds (American avocet, snowy plover) in lakebed habitats and for gleaning/aerial invertivores (horned lark, tree swallow) and carnivores (American kestrel) in upland habitats around PRIs 5, 6, 7, and 8. This is due mainly to intake of TEQ. LOAEL HQs for single or repeated acute exposures are low in magnitude and frequency.

2. Tissue HQs for bird eggs around the waste ponds are generally above a level of concern, due mainly to ~~showed~~ elevated levels of TEQ and PCBs in the eggs ~~around the waste ponds~~.

3. Site-specific toxicity studies indicate that (1) most birds preferentially avoid acidic wastewater, even when dehydrated, (2) consumption of acidic wastewater is not acutely toxic to mallards or finches, (3) birds that have acute exposures to acidic wastewater readily recover any lost body weight from reduced water and feed consumption after the exposure ends, and (4) dermal exposure of feet or skin to acidic wastewater causes only mild irritation, and (5) exposure of~~to~~ eggs to acidic water does not result in weight loss but may alter egg camouflage characteristics. ~~The logical interpretation of this information is that acute exposures to acidic wastewater are unlikely to result in adverse effects to bird populations at the Site.~~

~~4.~~ Ecological field surveys found no statistically significant differences in reproductive success in areas around the waste ponds at the Site compared to the reference areas, although nest hatchability at the Site for snowy plover was noticeably lower and nearly statistically significant in one of the study years. The cause of the decrease is not known and could be due either to Site contamination or to environmental factors such as ~~author also notes that the Site is likely~~ poor quality breeding habitat, ~~due to~~ low food availability, higher thermal and osmotic stress, increased distance to freshwater, and

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higher predator density. ~~The poorer condition of both the breeding habitat and the breeding adults may lead to lower hatchability or higher seasonal variation. Additionally, the bird observation studies clearly indicate that birds are present at the Site, and that their use of the Current Waste Pond and Old Waste Pond is substantially less than other areas of the Site.~~

These four LOEs were integrated into the WOE finding that risks for individual birds are unlikely across much of the spatial area of the Site, including PRIs 2, 4, 9, 10, 12, 13, the portion of PRI 14 south or east of the P-11 canal, 15, 16, the GSLIC, and the SVDD. Acute risks to individual birds in the lakebed habitats of PRIs 5, 6, and 7 are also unlikely, due to limited exposure as most birds are expected to avoid the acidic waste pond water. However, COPECs in the following areas may represent a cause for concern:

- **Upland Habitats of PRIs 5 and 6** – Adverse effects are possible for individual birds, particularly due to TEQ, PCBs, and HCB.
- **Lakebed Habitats of PRI 7 and PRI 14 (north of the P-11 canal)** – Adverse effects due to chronic exposure to TEQ are possible for individual birds in PRI 7 and the portion of PRI 14 north of the P-11 canal.
- **Upland Habitat of PRI 8** – Risks to individual birds are possible in the upland habitats of PRI 8, due to TEQ.

These ~~While the above areas may pose a~~ risks to individual birds~~, which may be~~ are of potential concern for the snowy plover, which is a species of Utah Greatest Conservation Need. For other species, it is unclear whether these risks for individual birds may be of sufficient severity and magnitude to lead to population-level impacts. Populations are typically more resistant to stress than organisms, since~~;~~ the loss of a few ~~sensitive~~ organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Moreover, each of the above areas with potential risk to individual birds is relatively~~noted to be~~ small in size, ranging from 28 to 340 hectares (ha) ~~large~~, and is~~also~~ composed of relatively poor quality habitat. ~~This represents a fraction of bird populations.~~ Thus, it is considered relatively unlikely that decreased reproductive success in the limited number of nests present in the above areas would elicit ecologically significant changes in the populations of bird species utilizing habitat at the Site.

BERA Findings for Mammals

Three LOEs (dietary dose HQs, tissue HQs, and ecological field surveys) were available to characterize risk to mammals. The main findings for each LOE are listed below.

1. Dietary dose chronic LOAEL HQs indicate that HQs are below a level of concern in most areas but are above a level of concern for one or more species in upland and/or lakebed areas of PRIs 5, 6, 7, 8. The risks are highest due to chronic intake of TEQ. The most sensitive mammals are the grasshopper mouse in upland habitats and the badger in lakebed habitat. Single acute exposures result in no LOAEL HQs above 1.
2. No tissue HQs were above 1 for any of the bioaccumulative COPECs.
3. Ecological field survey results report the presence of small mammals with robust body condition, which suggests that overt toxicity from Site contaminants is not occurring in PRIs 2 to 10, 12, and 15. However, because no quantitative comparison to reference areas was provided, this LOE has only limited confidence ~~due to COPECs, but cannot be used as a conclusive evaluation for chronic adverse effects~~.

Based on this information, WOE findings are that risks are unlikely for individual mammals for all areas

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Commented [EPA4]: Seems like a brief discussion of the conflict between LOE 1 and LOE 2 would be appropriate here, and why you are deciding to identify concerns based on dose based HQs in preference to tissue HQs.

of the Site, except:

- **PRI 5 (Upland Habitat), PRI 7, and PRI 8 (Upland Habitat)** – Mammalian TEQ may pose a risk to individual mammals within the upland habitat of PRI 5, the lakebed habitat of PRI 7, and the upland habitat of PRI 8. However, these exposure areas are small in size (68, 339, and 67 ha, respectively) and support a maximum of approximately 200 individual mammals per species. This represents a fraction of the population; thus, it is unlikely that any adverse effects on individual mammals in the above areas would translate to population-level effect. Therefore, risks to mammal populations are considered unlikely.

Commented [EPA5]: Based on the HQ rules presented in Attachment B, risks to mammals should be ranked as being of potential concern for mouse and/or rat in PRI-6 (Figs 4-2a and 4-2b). Moreover, there is not much difference from PRI-8, which you do identify as a concern.

BERA Findings for Terrestrial Plants

The three LOEs used for evaluating plants were: direct contact HQs, tissue HQs, and ecological field surveys. The main findings for each LOE are:

1. Direct contact HQs above 1 were observed only for~~are limited to~~ inorganic COPECs, but values are similar to ~~which are also consistent with~~ background ~~HQs. Thus, inorganic HQs are due to naturally occurring concentrations in the soil.~~
2. No tissue HQs were above 1 for the bioaccumulative COPECs.
3. Ecological field surveys report dead vegetation in PRIs 6, 7, and 8, which is ascribed to physical soil conditions and/or water levels. Report of healthy vegetation in other PRIs suggest that adverse effects on plants are not occurring in those areas of the Site. However, in the absence of quantitative comparison to approriare reference areas, this LOE has limited confidence.~~, but cannot be used as a conclusive evaluation for chronic adverse effects from soil COPECs.~~

Taken together, these~~The~~ LOEs indicate~~were combined to generate a WOE finding~~ that risks to the terrestrial plant community at the Site are unlikely~~,~~ for all evaluated upland habitat areas.

BERA Findings for Invertebrates

Two LOEs were used to evaluate soil invertebrates, benthic invertebrates, and aquatic biota. Main findings are listed below.

1. Direct contact HQs for soil invertebrates are all either consistent with background inorganic HQs or are below 1. HQs for benthic invertebrates are above 1 for total PCBs, phenol, carbon disulfide, and inorganics. Of these COPECs, only total PCBs could reach a level of concern for benthic invertebrates, which may occur in PRI 7 if the sediment is not flooded with acidic wastewater. For aquatic biota, direct contact HQs above 1 in surface water are highest in frequency and magnitude for total PCBs, chlorine, aluminum, and iron. However, benchmarks for these COPECs have low relevance to Site conditions, thus are likely overestimating risks to aquatic invertebrates.

2. Tissue LOAEL HQs above 1 are low in magnitude and frequency for soil invertebrates. No tissue LOAEL HQs are above 1 for aquatic invertebrates.

The WOE integrated the results of two LOEs (direct contact HQs and tissue HQs) into the following findings:

- **Soil invertebrates** – There is compelling evidence that risks to the soil invertebrate community in the upland habitats of PRIs 5, 6, 8, 10, 12, 14, 15, and 16 are unlikely.
- **Benthic invertebrates** – Benthic invertebrate community risk is low for the lakebed habitats of PRIs 7, 8, 13, 14, the GSLIC, and the SVDD. In the active ponds (PRIs 5 and 6), the acidic water

precludes presence of benthic invertebrates. PRI 7 is intermittently acidic, so even though there may be some risk from total PCBs in PRI 7, growth of benthic invertebrates in this PRI is likely to be limited.

- **Aquatic biota** – Due to a number of uncertainties leading to overestimations of risk, interpretation of the results for aquatic biota are challenging. However, the evidence suggests that overall risks to the aquatic biota community in the surface waters of PRI 7, 8, 14, and the SVDD are probably low.

Uncertainties

In general, assumptions used in this BERA were intended to overestimate (rather than underestimate) characterizations of potential ecological risk. The following sources of uncertainties associated with the LOEs resulted in an overestimation of potential ecological risk:

Commented [EPA6]: First, it is not certain that each of the factors listed below results in an overestimation of risk.

Second, simply listing these topics without any description is not effective. In keeping with the strategy used for both the OU1 HHRA and the OU2 HHERA, replace this section with more specific bullets.

- HQ LOEs
  - Representative Species
  - Site Use Factors
  - Relative Bioavailability~~accessibility~~
  - Intermittent Longer-term Dose Estimation
  - Chronic NOAEL-equivalent TRVs
  - Species-to Species Extrapolations
  - Unbounded NOAEL Effects Levels
- Site-Specific Toxicity Studies LOE
  - Representativeness of Single Wastewater Sample
  - Unrealistic Exposure Conditions
- Ecological Field Surveys LOE
  - Variable Applicability across Spatial Areas

The following assumptions used in the BERA were likely to have a negligible influence on the potential for adverse effects or were likely to have an unidentified (direction and/or magnitude) influence on the potential for adverse effects:

- HQ LOEs
  - Bioaccumulation Models (particularly TEQ Models for Brine Fly)
  - Avian TEQ Concentrations
  - Scenarios Not Evaluated (Inhalation Pathway, Dermal Contact Pathway)
  - Uncertain COPECs Not Quantitatively Evaluated
  - Threatened and Endangered Species
  - Cumulative Effects Due to Exposure to Multiple COPECs
- Site-Specific Toxicity Studies LOE
  - Lack of Analysis for other COPECs
  - Wild-Caught Test Subjects

- Limited Number of Test Species and Small Sample Sizes
- Temporal Variability in House Finch Responses

- Ecological Field Surveys LOE
  - Species Applicability
  - Interpretation of Adult Body Mass Endpoint

Conclusions

The BERA presents results for up to five LOEs for birds, mammals, terrestrial plants, soil invertebrates, benthic invertebrates, and aquatic biota. The LOEs were integrated into a WOE analysis for each ecological receptor resulting in a determination of potential risk for each exposure unit at the Site. A summary of the COPECs that may potentially result in risk for each receptor and exposure unit is presented in Table ES-1 and described below.

In summary, the WOE analysis finds that risks to birds and mammals are mostly due to intake of TEQ, although two bioaccumulatives (HCB and total PCBs) may also present potential risk. The upland habitats of PRIs 5, 6, and 8, which are in the areas surrounding the waste ponds, may present risk to individual birds from exposure to bioaccumulative COPECs (PRIs 5, 6, and 8) and vanadium (PRI 8 only). Birds in lakebed habitats of PRIs 7, 8, and 14, also located around the waste ponds, may be at risk of potential adverse effects due to intake of TEQ (PRIs 7, 8, and 14) and vanadium (PRI 8 only). Risk to mammals is limited to the upland habitat in PRI 5 and the lakebed habitat in PRI 7 from exposure of TEQ. The WOE analysis finds no conclusive evidence for risks to plants or invertebrates.

The above areas may pose a risk to individual birds, which may be of concern for the snowy plover in lakebed habitats of PRIs 7 and 14 since the snowy plover is a species of Utah Greatest Conservation Need. For other birds and mammals, it is unclear whether these risks for individual organisms may be of sufficient severity and magnitude to lead to population-level impacts. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Moreover, each of the above areas with potential risk is composed of poor quality habitat that is unlikely to support the minimum number of individuals necessary to sustain a population. Thus, it is considered unlikely that impacts to individuals in these areas would elicit changes in the populations utilizing habitat at the Site. Additionally, the prediction of risks to birds and mammals is likely overestimated due to the conservative assumptions used to calculate the HQ LOEs.

Based on these findings, it is concluded that ecological risks are not of significant concern to plants or invertebrates and are unlikely to be of concern to the majority of bird and mammal populations, although individual organisms, such as snowy plover, may be impacted. These conclusions are applicable to current and future conditions of all exposure units with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP.

2.5.1.5 Hazard Quotient Interpretation

As described further in Section 2.5.4.2, because an HQ is not derived from a quantitative exposure-response model, the value of the HQ should not be interpreted as a quantitative indicator of risk.

For mobile receptors (birds, large mammals), a NOAEL-based HQ that is less than or equal to 1 provides a strong indication that no adverse effects are expected. However, a NOAEL-based HQ above 1 does not provide strong evidence that an adverse effect is likely, since many NOAEL-based TRVs and benchmarks may be well below the threshold for adverse effects. For this reason, attention is usually focused on the LOAEL-based HQ as the primary indicator of potential risk. Any LOAEL-based HQ that is equal to or greater than 1 is interpreted as an indication that adverse effects could occur, although LOAEL-based HQs of 1 or above are not proof that an effect will occur (see Section 7 for further discussion). In general, LOAEL-based HQ values in the low range (e.g., 1-3), suggest that effects are likely to be low to moderate in severity, with higher HQs indicating that effects could become more substantial. However, the interpretation of each HQ depends on the accuracy and relevance of both the estimate of exposure and of the toxicity value (TRV or benchmark) used in the calculation.

For sessile or small home range receptors (e.g., plants, invertebrates, mice, etc.), each sample is considered to represent a potential exposure area, so HQs are calculated for every sample, rather than a single value for an entire exposure area. Interpreting the resultant distribution of HQ values is a matter of judgement. As above, if all or most of the NOAEL-based HQs are at or below 1, there is high confidence that risks are minimal. If all or nearly all of the LOAEL-based HQs are below 1, risk of adverse effects is likely to be low, even if some or all of the NOAEL-based HQs are above 1. However, as the fraction of LOAEL-based HQs that are above 1 increases, the level of concern increases. In general, if the fraction of HQs remains below about 20%, then it is possible that some members of a population could be impacted, but a population-level effect is unlikely. If more than about 20% of the LOAEL-HQ values exceed 1, especially if the exceedances are large, then adverse effects on both individuals and the population are possible.

PROBLEMS WITH AHUF

1. The text in Section 2.3.2.4 presents the approach for estimating an AHUF value based on Table 1 in BIO-Logic (2003). The text says "It is suspected that actual AHUF values for avocets and other species of probing birds are likely lower, since the mean monthly exposure estimate by BIO-Logic (2002, 2003) was based on the total number of avocets (n = 10) rather than an individual avocet." This is a misinterpretation of the value of 10 shown in BIO-Logic (2003) Table 1. The value of N is defined as "Total number of observations of an individual in contact with active pond water." However, an observer cannot tell if it is the same or a different bird each observation. As stated in BIO-Logic (2003): "Some observations include a group of more than 1 bird, and total number of individual bird observations was 26, a few of which may represent an individual bird seen at different times on the same day or on different days." So, 10 is the maximum possible number of individual birds (i.e., least conservative), and is not the (unknown) actual number of individual birds.

2. The data value taken from Table 1 (362.1 minutes per month for avocets) is the average across three time intervals (July, August, October-November). However, all of the observations occurred in July and August, and none were observed in Oct-Nov. This is almost certainly because avocets migrated away from the site as summer ended. If the authors had made additional observations for other winter months, it is expected that all of those values would also be zero. What is needed is not a year-long average AHUF, but a value that represents months when avocets are present. If that were done, the AHUF would be the average for July and August only, which is higher than the value in Table 1 by a factor of 1/3.

3. The largest problem is that the value taken from Table 1 (321.8 minutes/month) appears to be calculated incorrectly. Based on the Table and the text, the equation is supposed to be:

   Exposure/month = (exposure minutes / observation minutes) * (total minutes per month)

   However, based on the data values given in Table 1, the computed value is too low by a factor of 60. For example, for avocets in July:

   Exposure minutes = 894
   Observation minutes = 2067
   Minutes in a month = 44,640

   Thus, exposure minutes per month = (894/2067) x 44,640 = 19,307

   The ratio of calculated vs reported (19,307 / 321.8) is precisely 60. It seems pretty clear they used hours per month rather than minutes per month as the multiplier. This error applies to all of the values in Table 1 (not just avocets in July).

   However, this "corrected" value seems to be entirely inconsistent with text descriptions of avian usage of the active waste ponds, which describe mainly infrequent and brief visitations. For avocets, in July the data indicate one or more avocets was present 43% of the time. In August, the value is 102%.

RECOMMENDED NEW STRATEGY

Because of the apparent error in Table 1 calculations and the apparent inconsistency between the "corrected" value and what the field studies describe, EPA believes that we cannot utilize Table 1 to estimate a value for the AHUF term. Rather, EPA proposes the following:

> Even if we had an AHUF value, calculating an HQ for repeated acute exposures separated by this many days (perhaps 60) using a chronic TRV is not really logical [although, because of the bio-persistence of TEQ, it is perhaps not entirely unreasonable]. If we decided that attempting such a calculation is just too dubious, both because we don't know what the AHUF is and we don't know what the best TRV is, we can change to a purely qualitative discussion, saying something like this after the discussion of acute exposures:
>
> > REPEATED ACUTE EXPOSURES
> >
> > If an individual bird were to engage in repeated acute exposures, risks could potentially rise to a level of concern, depending on how often the repeat exposures occurred. However, estimation of HQ values for such a scenario is not possible because the frequency of any such repeated acute exposures of individual birds is not known, and a TRV that would be appropriate for such intermittent exposures is not available. Because field observations suggest avian utilization of the CWP is low and that most birds are present only for brief intervals, it is suspected that risk from repeated exposures is likely to be minimal, and would likely apply only to a small number of individuals."

3.3 Weight of Evidence

WOE is conducted narratively, as described in Section 2.5.4. Four LOEs are available for birds: dietary dose HQs, egg tissue HQs, ecological field surveys, and Site-specific toxicity studies. The different LOEs have different advantages and limitations, as discussed in Section 2.5.4.2. Not all LOEs are available for each exposure area. The presentation of the WOE findings is organized by exposure areas and exposure durations with similar available LOEs.

3.3.1 Acute Exposures

Risk for acute exposures is characterized separately for upland and lakebed habitats using WOE in the below sections.

3.3.1.1 Upland Habitats (PRIs 2, 4, and 9)

Field studies indicate that birds are present within PRIs 2 (Landfill), 4 (Gypsum Pile), and 9 (Smut Pile), though avian use of these areas is expected to be minimal due to the industrial nature of these areas, including barren ground largely devoid of vegetation (ERM 2014a). ~~Two LOEs, dietary dose HQs, and ecological field surveys, are used to characterize risk to birds from acute exposures in PRIs 2, 4 and 9.~~ As discussed in Section 3.2.1, there are few NOAEL-based and no LOAEL-based HQs at or above a level of concern. ~~The ecological field surveys LOE has limited usefulness and low confidence, particularly for these areas, but noted no discernable signs of toxicity to the birds observed at the Site~~. Thus, acute exposures in PRIs 2, 4, and 9 are not expected to pose a risk to individual birds and are unlikely to result in population-level risk to avian species. Confidence in the above finding is high, as the HQs represent a conservative estimate of risk and there were no LOAEL-based HQs greater than 1.

3.3.1.2 Lakebed Habitats of the Waste Ponds (PRIs 5, 6, and 7)

Surface water in PRIs 5 and 6 is generally acidic, with pH values as low as approximately 1 (see Section 3.2.3). PRI 7 may also have acidic surface water, depending on seasonal variation in water levels and the influx of wastewater from PRI 5. Because the acidity of the water is likely to limit the growth of aquatic or benthic prey organisms, especially in PRIs 5 and 6, it is anticipated that most avian receptors will not utilize the acid ponds as a regular foraging area. This expectation is supported by field observations reported by BIO-Logic (2002, 2003, 2006) and Beltman and Stackhouse (2007), which indicated that the active ponds did not appear to be attractive to water birds or shore birds, and that the active ponds are~~were~~ utilized far less than the mudflats and pools of PRI 7. However, several species were observed to have contact with the water in the active ponds, so it is considered reasonable that some birds may occasionally attempt to forage in or drink from the acid ponds.

Three LOEs are available~~used~~ to characterize risk to birds from acute exposure in lakebed habitats of the waste ponds:

- Dietary Dose HQs
  - ~~**Single Exposures.**~~ As discussed in Section 3.2.1, if a 1-day foraging event were to occur in the waste ponds, intake of TEQ and HCB from sediment and water would only rarely result in LOAEL-based HQ values at or above a level of concern in PRI 5, and would not reach or exceed a level of concern for any receptor at any location in PRIs 6 or 7 (see Figures 3-4a to 3-4d). In PRI 5, only 2 samples out of 12 have HQs greater than 1; these samples are on opposite sides of the PRI from each other. Because nearly all LOAEL-based HQ values are less than 1, this line of evidence indicates that single acute exposures to sediment and water in the lakebed habitat of PRIs 5, 6, and 7 are not expected to pose a risk to most individual birds and are unlikely to result in population-level risk to avian species
  - ~~.~~If repeated acute exposures were to occur, risks might be higher, depending on the length of time between exposures. However, such repeated acute exposures are believed to be unlikely, and if they were to occur, it is likely only a small number of individuals would be involved. Thus, while

uncertain, risk from repeated acute exposures is judged to be of low concern.

- ~~**Intermittent Longer-Term Exposures**. Because prey items are absent in PRIs 5 and 6 and are likely absent for most of the year in PRI 7, it is suspected that if a bird were to forage in the acid ponds or OWP, that same individual bird would be unlikely to repeat the foraging activity. This is supported by BIO-Logic (2002, 2003), which indicated that if repeat acute exposures were to occur, the frequency would likely be no more than once per month, and probably less. As discussed in Section based on the dietary dose HQ LOE, intermittent longer-term exposures of this frequency do not reach a level of concern (see Figure 3-5a to 3-5c). Moreover, even if risks were to reach a level of concern, the number of individuals that might engage in repeated exposures is likely to be small. On this basis, intermittent longer-term exposures in the lakebed habitat of PRIs 5, 6, and 7 are not expected to pose a risk to individual birds, and are unlikely to cause population-level risk to avian species.~~

- **Confidence**. Uncertainties associated with the dietary dose HQs LOE are discussed fully in Section 7.1 and confidence in this LOE is described in Section 3.2.1.1. Most ~~Taken in total, the~~ uncertainties associated with the HQs LOE are more likely to overestimate than underestimate risk to birds. Thus, there is high confidence that the results from the dietary dose HQs LOE are a conservative estimate of risk. Consequently, there is good confidence in the conclusion that acute or intermittent exposures are not of significant ecological concern for birds.

- Site-Specific Toxicity Studies
  - **Acute Oral and Dermal Exposure to Acidic Wastewater**. As discussed in Section 3.2.3, two laboratory-based toxicity studies have been performed in which birds were provided with drinking water collected from the acidic ponds for periods of 1 to 2 days. Both studies found that birds provided with acid water tended to reduce their water intake compared to controls, presumably because of the acidity. This in turn resulted in decreased food intake, which resulted in decreased body weight, but this effect was temporary once access to clean water was restored. Neither study reported any evidence of significant toxic effects of contaminants in the water (either the acidic content or dissolved COPECs) after several days of observation. Exposure of eyes, skin, or feet to the acid water resulted in mild irritation only. Taken together, these two studies indicate that acute oral exposure to acidic water from PRIs 5 and 6 does not cause acute toxicity other than transient secondary effects on body weight, and that dermal or ocular effects from direct contact are minimal.
  - **Confidence**. Overall confidence in the Site-specific toxicity studies LOE is detailed in Section 3.2.3.3, and the associated uncertainties are presented fully in Section 7.2. Overall, there are few sources of uncertainty for this LOE, leading to high confidence in the LOE findings.

- Ecological Field Surveys
  - **Qualitative statements of bird condition**. Only qualitative statements on bird condition, as compared to normal conditions, are available to evaluate acute exposures within these exposure areas (Glover 1983; Halford et al. 1999; BIO-Logic 2006; and Beltman and Stackhouse 2007). These studies provide no good evidence of poor health or abnormal behaviors in the birds that were observed~~either indicate no discernable effects on birds, or uncertainty as to whether the observed behaviors were normal~~.
  - **Confidence**. As discussed in Section 3.2.4.6, there is ~~very~~ low confidence in the qualitative comparisons between Site conditions and normal conditions from the available studies. Thus, for acute exposures in these exposure areas, this information is minimally useful for the WOE.

Combined Weight of Evidence on Acute Risks

All three of the above LOEs indicate that toxic effects from acute exposures to water or sediment in the acid ponds are unlikely to result in any meaningful adverse effects on individual birds or on avian populations under current Site conditions. The confidence associated with that finding is high, as the three LOEs are in agreement, the HQs LOE is conservative, and the Site-specific toxicity studies LOEs has few sources of uncertainty.

However, it is important to note that this absence of significant risk is due to limited exposure, not limited contamination. Given the levels of contamination measured in pond sediments, if Site conditions were to change in the future such that prey items could grow in the ponds, foraging by avian species would likely increase, and this in turn would result in increases in exposure and risk that might well exceed a level of concern. Risk estimates for this scenario are presented in Appendix C.

3.3.2 Chronic Exposures

For chronic exposures to birds, risk is characterized using WOE as described by spatial area groups below.

3.3.2.1 Areas Around the Waste Ponds (PRIs 5, 6, 7, 13, and 14)

Lakebed habitat in PRI 7 is poor due to the occasional presence of acidic wastewater, and birds are estimated may be half as likely to use habitat in PRI 7 about half as much as in compared to adjacent habitat areas (BIO-Logic 2006; ERM 2014a). However, fField studies indicate that berms and other areas in the vicinity of the waste ponds and northerninner PRI 14 (the area north of the P-11 canal, abutting the waste ponds of PRIs 5 and 7) are utilized for nesting and foraging by several avian species (BIO-Logic 2002, 2006; Beltman and Stackhouse 2007; Cavitt 2008, 2010; ERM 2014a). Solids samples in these areas are impacted by elevated show comparatively higher concentrations of TEQ and HCB in PRIs 5, 6, and 7 than in PRIs 13 and 14.

For chronic exposure in exposure areas around the waste ponds, three LOEs are availablrused to characterize risk:

- Dietary Dose HQs
  - **Chronic Exposures**. As discussed in Section 3.2.1, chronic LOAEL-based HQ values for sample locations in PRIs 5, 6, and 7, as well as northerninner PRI 14 are often greater than 10 and may range up to 60. Adverse effects, particularly due to TEQ and to a much lesser extent HCB, are possible for individual birds in these areas, with TEQ in PRIs 5, 6, and 7 representing the highest level of concern. In PRI 13, LOAEL-based HQs rarely exceed 1 and only for avian TEQ Category 1, and the magnitude is low (maximum HQ = 2). Thus, adverse effects on individual birds are not expected to be low in PRI 13. As seen in Table 3-8, TEQ HQs in PRI 14 are substantially different in the inner area that is west of Solar Pond 1 North and north of the P-11 canal, compared to the outer areas south or east of the P-11 canal (Figure 2-3). The LOAEL-based HQs for TEQ in the outer part of PRI 14 rarely exceed 1, and the magnitude is low (maximum observed LOAEL HQ = 3). Thus, COPECs in the outer portion of PRI 14 are unlikely to pose a risk to individual birds.
  - **Confidence**. Confidence for this LOE is described in Section 3.2.1.1 and varies with the COPEC. Confidence is higher in the HQs for HCB than for TEQ. For TEQ, even though actual HQ values might be somewhat lower than calculated (see Section 3.2.1.1), the values are sufficiently high that confidence remains high that concern for adverse effects is valid., and the TEQ HQs likely overestimate the potential for adverse effects on individual birds (see Section 3.2.1.1). As above, uncertainties associated with the dietary HQs LOE are likely to yield a conservative estimate of risk to birds (see Section 7.1).
- Egg Tissue HQs
  - **Eggs**. Avian eggs of snowy plover and several other species collected from nests in the areas around the waste ponds and inner PRI 14 show evidence of elevated levels of TEQ, PCBs, and to a lesser extent, HCB (see Section 3.2.2) compared to background levels. These data suggest that adult female birds nesting in the area of the ponds are exposed to Site-related contaminants and that these contaminants are transferred to egg tissue. These data do not identify the source of the uptake, but maternal exposure through diet (ingestion of contaminated soil and prey at the Site) is the most likelya reasonable source. Based on the measured levels of COPECs in the eggs, a majority of the eggs yield LOAEL-based HQs for TEQ that are at or above 1, mainly in the 2 to 10

Commented [EPA1]: EPA recommends use of northern and southern for distinguishing the two sub-areas of PRI-14, rather than inner and outer. Table 3-8 uses the term "south"

Commented [EPA2]: As above, use northern and southern instead of inner and outer.

Table 3-8 does not show HQ values for northern and southern PRI-14. It shows HQs for total PRI-14 (both northern and southern) vs southern. The impact of northern PRI-14 can only be guessed at by difference. Table 3-8 would be much more informative if the two columns called EPC=Original UCL were replaced with results for the northern portion only.

Commented [EPA3]: See general comment 3.

range, with a few somewhat higher (Figures 3-6a to 3-6h). The results indicate a level of concern that hatchability and survival of chicks from nests in areas around the ponds might be impaired.

- **Confidence**. See Section 3.2.2.1 for a discussion of confidence in the egg tissue HQs LOE, which varies by COPEC. There is moderate confidence in the HQs for HCB and TEQ, but low confidence in the total PCB HQs which are likely to overestimate risk.

- Ecological Field Surveys
  - **Reproductive Success**. Two field studies (Cavitt 2008, 2010) have been performed that provide direct observations of avian reproductive success in snowy plover nests located in the vicinity of the Site waste ponds compared to three reference locations that are not believed to be impacted by the Site (see Section 3.2.4). In the 2008 study, hatchability was high (0.95) and was similar to the reference areas (0.94 to 1.00). However, in the 2010 study, hatchability at the Site was low (0.75) compared to the reference areas (0.93 to 0.98, p = 0.07). This low hatchability did not translate to a decrease in the mean young produced per successful nest in 2010. The author discussed a number of plausible hypotheses for the low hatchability, but noted that without chemical analysis of the eggs, the cause could not be determined. The possibility that the low hatchability was related to chemical exposure cannot be excluded.
  - **Confidence**. Uncertainties associated with the ecological field surveys LOE are discussed fully in Section 7.3, and the moderate to high confidence in this LOE is discussed in Section 3.2.4.6. However, the ecological field surveys LOE has varying relevance by PRI; numerous nests were found in PRIs 7 and 14 near the boundaries of PRIs 5 and 6, but a single nest was found in PRI 13. Thus, this LOE has high relevance to exposures in PRIs 5, 6, 7 and 14, and low relevance to PRI 13. Uncertainties associated with the Cavitt (2008, 2010) studies may lead to either over- or underestimation of risk.

Combined Weight of Evidence for Chronic Risks Near the Waste Ponds

Because of uncertainties that may exist in both the estimate of dietary exposure and in the benchmarks used to evaluate risk (see Section 7.1), an elevated dietary intake HQ value is not proof that adverse effects will definitely occur. However, the indication of risk based on dietary dose HQ values is supported by the egg tissue HQs, which indicate that a majority of eggs from nests in the vicinity of the waste ponds are contaminated with Site COPECs, and that some eggs have contaminant levels that could impair hatchability. This is also consistent with the observation of decreased hatchability in one of two field studies, although other causes could be responsible, in part or in whole. Because all of these LOEs either indicate or are consistent with the occurrence of decreased reproductive success in birds nesting near the waste ponds, adverse effects could occur for ~~individual~~ birds in this area. Whether the magnitude and severity of the effect could lead to a significant population level effect is not certain. However, nesting density at the Site, particularly around the waste ponds, is low compared to reference areas, likely due to poor quality habitat. With an observed nesting density of 0.0114 to 0.0464 nests per ha (Cavitt 2008, 2010), the above areas (upland habitat of PRI 5, upland habitat of PRI 6, the portion of PRI 7 not underwater during spring [ERM 2018b], and the inner portion of PRI 14, totaling 337 ha) represent only 4 to 16 nests and thus a maximum of 36 breeding adults. With a maximum of 16 nests with potentially decreased reproductive success, a substantial impact on the populations of exposed species is not expected. However, effects on a small number of individual snowy plovers ~~may~~ is still~~be~~ of concern, as these are a species of Utah Greatest Conservation Need.

Commented [EPA4]: Maybe 32 ??

No eggs were collected for chemical analysis in PRI 13 or the portion of PRI 14 south and east of the P-11 canal. A single nest was observed in PRI 13 as part of the ecological field surveys LOE, and the outer part of PRI 14 was not included in the Cavitt (2008, 2010) survey area. Thus, conclusions for PRI 13 and the outer portion of PRI 14 rely on the dietary dose HQs LOE. This LOE indicates that adverse effects on ~~individual~~ birds are unlikely in PRI 13 and the portion of PRI 14 south and east of the P-11 canal (see Section 3.2.1); thus it is determined that risks to bird populations in these areas do not pose a level of concern.

Confidence in the WOE finding above is moderate, as the three LOEs are in agreement, even though~~but~~ two of the three LOEs may tend to overestimate risk to individual birds. Confidence is higher in the findings for PRI 13 and the outer portion of PRI 14, as the conservative HQs indicate that effects on individual birds are unlikely. ~~The population-level context from the ecological field surveys LOE provides important realism regarding impacts at the population level.~~

Commented [EPA5]: First, this is redundant.

Second, why is fair to describe a qualitative expectation about low population risk as "realism", when HQ values of 10-10 are not to be taken as a serious indicator of risk? This bias toward trusting low risk findings but not trusting high risk findings is not appropriate.

3.3.2.2 Exposure Areas Away From the Waste Ponds (PRIs 8, 10, 12, 15, 16, SVDD, and GSLIC)

Birds have been observed using the upland habitats away from the waste ponds to a greater degree than at the waste ponds themselves, and may be twice as likely (BIO-Logic 2006) to forage or breed in the areas away from the waste ponds. Measurements of COPECs in these areas show notably lower concentrations than around the waste ponds, with the exception of PRI 8.

Two LOEs, dietary dose HQs and ecological field surveys, are available to assess risk to birds in PRIs 8, 10, 12, 15, 16, the SVDD, and the GSLIC.

- Dietary Dose HQs
  - **Chronic Exposures**. This LOE has LOAEL-based HQs greater than 1 in PRIs 8, 12, 15, the SVDD, and the GSLIC. For the remaining PRIs (10 and 16), there are no LOAEL-based HQs greater than 1 (see Section 3.2.1). Adverse effects on ~~individual~~ birds are possible in PRI 8, due to exposure to TEQ and vanadium, with LOAEL HQs ranging up to 40. In PRIs 12, 15, the SVDD, and the GSLIC, the only LOAEL-based HQs greater than 1 are for Avian TEQ Category 1 (maximum HQ = 5). However, these specific HQs have uncertainties that lead to overestimations of risk (see Section 3.2.1.1). For TEQ, the TRV likely overestimates oral bioavailability of TEQ, perhaps substantially. For vanadium, the calculated EPC is not relevant to current conditions in PRI 8, after installation of the overflow pipe, and substantially overestimates exposure. Given the overestimation inherent in the TEQ HQs and the low magnitudes, it is concluded that adverse effects to individual birds are unlikely in PRIs 12, 15, the SVDD, and the GSLIC, as well as the lakebed habitat of PRI 8. For the upland habitat of PRI 8, adverse effects to individual birds are possible due to exposure to TEQ, but not vanadium.
  - **Confidence**. Confidence in this LOE is discussed in Section 3.2.1.1. The confidence in the findings for PRIs 8, 12, 15, the SVDD, and the GSLIC is moderate. ~~, as the degree of overestimation of TEQ oral bioavailability is uncertain.~~ There is high confidence ~~in the compelling evidence~~ that risks to individual birds and bird populations are unlikely in PRIs 10 and 16.

Commented [EPA6]: See General comment 3.

Revise statement on TEQ as follows:

For TEQ, HQ values are likely overestimated due the assumption of 100% bioavailability, but even if a lower bioavailability were used, HQ values would remain well above a level of concern.

For vanadium, as noted in a previous comment, if the data are not relevant, the data should not be used. Modify this text as needed after revising calcs for vanadium.

- Ecological Field Surveys
  - **Qualitative statements of bird condition**. For these exposure areas, only qualitative statements on bird condition compared to normal conditions are available (Glover 1983; Halford et al. 1999; and BIO-Logic 2006). These studies indicate no discernable effects on birds.
  - **Confidence**. As discussed in Section 3.2.4.6, there is ~~very~~ low confidence in the qualitative comparisons between Site conditions and normal conditions from the available studies. Thus, this information is minimally useful for the WOE for these exposure areas.

Combined WOE for Chronic Risks Away from the waste Ponds

Based on the HQ LOE~~Thus,~~ for chronic exposures in areas away from the waste ponds, only the upland habitat of PRI 8 has possible adverse effects on individual birds. The Field Survey LOE does not contribute any meaningful additional information. The upland area of PRI 8 is small (67 ha) and likely supports a maximum of three nests from six breeding adults; therefore a potential decrease in reproductive success in nests of this limited area is not expected to have a substantial impact on bird populations. However, effects to individual snowy plovers in PRI 8 is~~may still be~~ of concern, as this is a species of Utah Greatest Conservation Need. The confidence in this WOE finding for PRI 8 is moderate, as the dietary dose HQs for TEQ are expected to overestimate risk.

3.4 Summary of Findings for Birds

Risk evaluation was conducted for avian AEs at the population level. AEs represent the following feeding guilds: gleaning invertebrate-consuming birds, aerial invertebrate-consuming birds, herbivorous birds, and carnivorous birds. Representative receptor species were selected for each feeding guild. PRIs 5 (upland), 6 (upland), 7, 8, 10, 12 through 16, and the GSLIC and SVDD were evaluated for chronic exposures, and PRIs 2, 4, 5 (lakebed), 6 (lakebed), 7, and 9 were evaluated for acute exposures. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix C; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

Four LOEs were used to characterize risk to avian AEs for the different exposure units: dietary dose HQs, egg tissue HQs, Site-specific toxicity studies, and ecological field surveys. Uncertainties associated with the LOEs used to characterize risk to birds are presented in Section 7. ~~Due to the conservative assumptions used to calculate HQs, there is high confidence in results where risks are not expected for individual birds.~~ The above LOEs were integrated into a WOE finding (see Section 3.3 above), which is summarized below.

Risks for individual birds are unlikely across much of the spatial area of the Site, including PRIs 2, 4, 9, 10, 12, 13, the portion of PRI 14 south or east of the P-11 canal, 15, 16, the GSLIC, and the SVDD. Acute risks to individual birds in the lakebed habitats of PRIs 5, 6, and 7 are also unlikely, due to limited exposure as most birds are expected to avoid the acidic waste pond water. However, COPECs in the following areas may pose a risk to individual birds:

- **Upland Habitats of PRIs 5 and 6** – Adverse effects are possible for individual birds, particularly due to TEQ, PCBs, and HCB.
- **Lakebed Habitats of PRI 7 and PRI 14 (north of the P-11 canal)** – Adverse effects due to chronic exposure to TEQ are possible for individual birds in PRI 7 and the inner portion of PRI 14 north of the P-11 canal shown on Figure 2-3.
- **Upland Habitat of PRI 8** – Risks to individual birds are possible in the upland habitats of PRI 8, due to TEQ.

The above areas may pose a risk to individual birds, which may be of concern for the snowy plover, which is a species of Utah Greatest Conservation Need. For other species, it is unclear whether these risks for individual birds may be of sufficient severity and magnitude to lead to population-level impacts. Each of the above exposure areas with potential risk to individual birds are noted to be small in size, ranging from 28 to 340 ha ~~large~~, and are also composed of mostly poor quality habitat. ~~Using the observed Site-specific nesting density from Cavitt (2008, 2010), the above areas together are estimated to support a maximum of 38 nests from 76 breeding adults. This represents a fraction of bird populations (see Section 2.5.5).~~ Thus, it is considered unlikely that decreased reproductive success in the limited number of nests present in the above areas would elicit changes in the populations of bird species utilizing habitat at the Site. There is moderate confidence in these findings~~, as the HQs LOE is likely to overestimate risk, particularly for TEQ~~.

4. RISK EVALUATION FOR MAMMALS

Section 4 presents the risk evaluation findings for lakebed and upland mammals at the Site.

4.1 Mammal Usage of the Site

Understanding how and where the upland and lakebed mammals use the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence and behavior of mammals at each exposure unit. In general, observations have included sightings and/or scat of rodents (deer mouse, kangaroo rat, and white-tailed antelope squirrel), medium-sized mammals (black-tailed jackrabbit and desert cottontail), and larger mammal (badger, deer, and coyote). Small mammals are present (and likely residents) at or near PRIs within the Site. Trails of large mammal prints in lakebed habitat suggest these animals are likely to be transient visitors. Scat and prints of large mammals in upland habitat suggests these animals are likely to forage in upland PRIs. Like birds, most mammals are anticipated to be attracted to undisturbed habitat offering superior (relative to disturbed areas) refuge and foraging habitat.

As discussed in Section 2.2.5, representative mammalian species selected for quantitative assessment are listed below:

- Grasshopper mouse (upland and lakebed habitat)
- Ord's kangaroo rat (upland and lakebed habitat)
- Badger (upland and lakebed habitat)
- Pronghorn antelope (upland habitat)

4.2 Risk Estimates

Risk estimates for mammals were evaluated with the dietary dose HQs LOE, tissue HQs LOE, and ecological field survey LOE. No Site-specific toxicity studies were identified as LOEs for mammals.

HQs were developed using dietary dose and tissue body burden. All results are representative of current and future conditions with the following exceptions: exposure units in the RCRA Carve-Out Cleanup Project Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after the realignment (Table 2-9).

The results of the dietary exposure and tissue body burden risk analysis for mammals are presented below. The comprehensive results for these evaluations are provided in Appendix E. Only the COPECs that showed potential risk, as determined by an HQ at or above 1, are presented below and in the tables and figures.

4.2.1 Dietary Dose Hazard Quotient Line of Evidence

The results of the dietary dose HQ analysis for mammals are presented below. Exposure units supporting a chronic exposure for the badger and pronghorn antelope were evaluated using the 95UCL EPC in the dose model. Exposure units supporting a chronic exposure for the small mammals (grasshopper mouse and Ord's kangaroo rat) were evaluated using point-by-point EPCs in the dose model. Exposure units where the habitat does not support dietary items for mammals have an assumed acute exposure pathway and all mammals were evaluated on a point-by-point basis. ~~HQs are only presented for COPECs with HQs greater than 1.~~

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4.2.1.1 Dose-Based HQ Results

- For the large home range upland mammals evaluated with chronic exposure (i.e., badger and

pronghorn antelope), the NOAEL and LOAEL HQ results are presented in Table 4-1 and illustrated on Figures 4-1a to 4-1b. For small home range mammals (i.e., grasshopper mouse and Ord's kangaroo rat) evaluated under acute and chronic exposure scenarios in upland habitat, and for the badger under acute exposure scenarios in upland habitat, the NOAEL and LOAEL HQ results are presented in Table 4-2 and illustrated on Figures 4-2a to 4-2d.

- For lakebed habitat, the large home range mammal (i.e., badger) was evaluated with chronic exposure and the NOAEL and LOAEL HQ results are presented in Table 4-3 and illustrated on Figures 4-3a to 4-3b. The HQ results for small home range mammals (i.e., grasshopper mouse and Ord's kangaroo rat) evaluated under acute and chronic exposure scenarios in lakebed habitat, and for the badger under acute exposure scenarios in lakebed habitat are presented in Table 4-4 and illustrated on Figures 4-4a to 4-4d.

4.2.1.2 Main Findings

The following main risk evaluation findings for mammal receptors are derived from the dietary dose HQ results presented in Tables 4-1 to 4-5 and Figures 4-1a to 4-4d:

- In all cases, the highest HQ values for mammalian receptors are due to intake of TEQ (maximum LOAEL HQ = 10). HQs from other COPECs (HCB,[13] total PCBs, aluminum, iron) are lower in magnitude (maximum LOAEL HQ = 3) and/or are consistent with background HQs.

Commented [EPA2]: Delete this footnote. HCB is not included as part of mammalian TEQ.

- In upland habitats, HQ values for TEQ are generally highest for the grasshopper mouse. HQs for the Ord's kangaroo rat, badger, and pronghorn antelope are lower. The grasshopper mouse diet consists of invertebrates, which has higher uptake rates of TEQ in comparison to prey items of other species. The pronghorn antelope and the badger have low HQs due to large foraging ranges, which leads to lower exposures within a PRI for these species. The Ord's kangaroo rat has a much smaller home range, but the primary food source for this species, plants, has low uptake of TEQ.
- In lakebed habitat, HQ values for TEQ are generally highest for the badger at PRI 7, while HQs for the Ord's kangaroo and grasshopper mouse are low.
- For chronic dietary exposure, TEQ reaches a level of potential concern in the upland habitat of PRIs 5, 6, and 8 (Table 4-1, Figures 4-1a and 4-1b), and in the lakebed habitat of PRI 7 (Table 4-3, Figures 4-3a and 4-3b). Table 4-5 shows that intake from solids and/or prey items are the main source of exposure and elevated HQs. Elevated LOAEL HQs are generally not attributable to intake from water with the exception of TEQ HQs in PRI 5 upland habitat.
- For some COPECs, the magnitude of the HQs at the Site are comparable or less than the magnitudes for background (Figures 4-1a to 4-4d). This is true of aluminum in lakebed and upland habitats of PRI 8 for both the grasshopper mouse and Ord's kangaroo rat. In these situations, any potential risk is considered to be consistent with background conditions and thus is not due to a Site-release~~does not reach a level of concern~~.
- For single acute exposures to large and small home range receptors, no LOAEL HQs are above 1 in any of the PRIs with an acute exposure pathway (PRI 2, PRI 4, PRI 9, [Table 4-2] and lakebed areas of the waste ponds [Table 4-4, Figure 4-4a]).

4.2.1.3 Confidence

For dietary dose HQs, confidence in the main finding above is dependent on the magnitude of the HQ (i.e., strength) and the relevance and reliability of the TRV~~specific COPEC~~. Since a number of conservative assumptions were used to calculate HQs (see Section 7.1), there is generally good~~high~~ confidence that HQs less than 1 indicate the potential for

[13] ~~This refers to HCB evaluated based on a TRV for HCB. Risks from HCB acting as a dioxin-like compound are included in the HQ for TEQ~~.

adverse effects on organisms is unlikely, particularly for NOAEL HQs less than 1. For LOAEL HQs at or above 1 and higher than background levels (TEQ, total PCBs, and HCB), the confidence depends on the reliability and relevance of the specific underlying calculation parameters noted below.

- **Mammalian TEQ**. The chemistry data and bioaccumulation models used to estimate uptake are reliable and Site-specific. However, the bioaccumulation model for brine flies is a constant value (see discussion in Section 7.1.1.4), which introduces uncertainty in the dose model for receptors that eat brine flies. This uncertainty is likely to overestimate dietary doses in exposure areas with comparatively lower TEQ concentrations in solids (i.e., lakebed habitat of PRI 8) and underestimate dietary doses in exposure areas with comparatively higher TEQ concentrations (i.e., lakebed habitats of PRI 7). The TRV is selected from a reliable study with no specific uncertainties. There is moderate confidence in the calculation parameters.
- **Total PCBs**. The chemistry data and bioaccumulation models are both reliable and Site-specific. The TRV study is relevant and presents no specific uncertainties. Thus, there is moderate confidence in the calculation parameters.
- **HCB**. The chemistry data and bioaccumulation models are both reliable and Site-specific. The TRV study is relevant and presents no specific uncertainties. Thus, there is moderate confidence in the calculation parameters.

4.2.1.4 Conclusion for the Dose-Based HQ LOE

Based on the dietary dose-based HQ LOE, there is moderate confidence that risks to mammals from TEQ may be above a level of concern in PRIs 5, 6, 7 and 8.

4.2.2 Tissue Hazard Quotient Line of Evidence

Small mammal tissue was evaluated by modeling tissue concentrations and comparing against tissue benchmarks. Modeled tissue HQs were evaluated in exposure units assumed to provide habitat that could result in chronic exposure: PRIs 5 (upland), 6 (upland), 7, 8 (lakebed and upland), 10, 12, 13, 14 (lakebed and upland), 15, and 16, and the SVDD and GSLIC.

4.2.2.1 Tissue HQ Results

Site-specific u~~U~~ptake models for mammalian tissues were available for TEQ, HCB, PCBs, and mercury.~~-~~. However, tissue-based benchmarks for mammals were only available for TEQ, total PCBs, and mercury. Therefore, HQs were derived only for these three COPECs. The NOAEL and LOAEL HQ results are presented in Appendix E.

4.2.2.2 Main Findings

In brief, no HQs were greater than 1. ~~As with the dietary dose HQs above, confidence is high that HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section~~ **Error! Hyperlink reference not valid.**

4.2.2.3 Confidence

Because each Site-specific uptake model was based on limited data, the predictions of tissue concentration may not be precise in all cases. However, results based on Site-specific data are considered to be much more reliable that uptake models derived at other sites or from literature studies, and confidence in the tissue EPCs is moderate. Confidence in the tissue-based benchmakrs …INSERT NEEDED.

Commented [EPA3]: Insert specific statements about confidence in these tissue benchmark values. Just because the HQs are below 1 does not automatically mean the results are reliable if we have serious doubts about the benchmarks.

4.2.2.4 Conclusion for the Tissue-Based HQ LOE

Based on the tissue-based HQ LOE, there is moderate confidence that risks to mammals from TEQ or other bioaccumulative COPECs are not of concern.

4.2.3 Site-Specific Toxicity Studies Line of Evidence

There are no available data for the Site-specific toxicity studies LOE for mammals (see Section 2.1.1).

4.2.4 Ecological Field Surveys Line of Evidence

Limited data are available for mammals for the ecological field surveys LOE. These data provide limited observations~~superficial assessments~~ of mammal health. No quantitative comparisons between Site and a reference area were conducted. Thus, this LOE does not specifically answer the question of whether mammal species at the Site have been impacted by COPECs, but provides circumstantial evidence on mammal health.

4.2.4.1 Field Survey Results

Glover 1983

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Methods for Glover (1983) are described in Section 3.2.4.2. Glover (1983) notes the relative abundance of mammal species as: abundant (black-tailed jackrabbit), common (desert cottontail and coyote), and scarce (pocket mouse, kangaroo rat, whitefooted mouse, woodrat, and pocket gopher). The reduced diversity of animals observed was attributed to the homogeneity and dryness of the survey area. The author reports "no discernable effects on the animals nor their habitats evident at the time of this survey." These observations cannot be linked to specific PRIs from the limited documentation available in the report.

Halford et al. 1999

General methods for Halford et al. 1999 are described in Section 3.2.4.3. ~~In addition, s~~Small mammals were identified and inventoried by placing overnight trapping transects in four selected areas in the Site. Trapping transects comprised approximately 10 stations placed 15 meters apart. Signs of mammals or direct observations (visual or trapping) were made for rabbits, coyote, badger, and mice at survey locations within PRIs 5, 6, 9, 10, and 15. Halford et al. reports that none of the animals appeared to show outward signs of toxicity and the trapped small mammals appeared to be robust and in good condition.

4.4.4.2 Main Findings

The survey efforts described above noted the presence of mammals and visually assessed body condition. However, they did not conduct any quantitative comparisons between Site and an appropriate reference. The main finding is:

- The presence of mammals with robust body condition suggests that overt toxicity is not occurring in PRIs 2 to 10, 12, and 15 due to COPECs, but cannot be used as a conclusive evaluation.

4.2.4.3 Confidence

Confidence in the above main finding is very low, due to the generalized qualitative nature of the comparison between mammal body condition at the Site and a normal body condition for the species in question. Uncertainties associated with these surveys are discussed in Section 7.3.

4.2.4.4 Conclusions for the Field Study LOE

Observations of mammal condition and health reported in Site-specific field studies do not provide a basis for concern, but such unquantified observations have low power to detect an effect if one were present, so confidence in the LOE is low.

4.3 Combined Weight of Evidence

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For mammals, three LOEs are available to characterize risk.~~; uncertainties associated with these LOEs are discussed in Section~~ **Error! Hyperlink reference not valid.** The dietary dose HQs LOE is available for all exposure units. The ecological field surveys LOE is also available for all exposure units, but due to their qualitative comparisons to normal conditions they do not provide definitive evidence on whether mammal species have been impacted at the Site. Finally, the tissue HQ LOE is available for all

exposure units that support chronic exposure. The following subsections are organized by exposure duration (e.g., acute or chronic), as the different exposures have different LOEs. WOE for mammals is conducted according to the methods described in Section 2.5.4.

~~4.3.1~~4.3.4 Acute Exposures

~~The WOE for acute exposures to mammals is presented below by habitat type.~~ Mammal presence has been documented in field studies of the upland habitats of PRIs 2, 4, and 9, and in the lakebed habitats of PRIs 5, 6, and 7 (see Section 4.2.4). However, mammal use of these areas is expected to be minimal due to the poor quality habitat, lack of food, and presence of acidic wastewater in the waste ponds.

Dietary dose HQs indicate that there is minimal risk from acute exposures, as there are no LOAEL-based HQs greater than 1 and almost no NOAEL-based HQs greater than 1 (see Section 4.2.1). The ecological field surveys LOE is in agreement with this finding. Thus, acute exposures are not expected to pose a risk to individual mammals or to mammalian populations~~. This is compelling evidence with high confidence that population-level risk to mammal species is unlikely~~ in the upland habitats of PRIs 2, 4, and 9 and the lakebed habitats of PRIs 5, 6, and 7.

~~4.3.2~~4.3.5 Chronic Exposures

The areas that support chronic exposure for mammals have higher quality habitat ~~and presumably a larger available food supply~~ than the areas that support acute exposure. Risk to mammal populations was evaluated for chronic exposures in the upland habitats of PRIS 5, 6, 7, 10, 12, 14, 15, and 16, as well as the lakebed habitats of PRIs 7, 8, 13, 14, SVDD, and the GSLIC. Mammal presence has been observed in these areas (see Section 2.2.1.4).

The dietary dose HQs LOE indicates that mammalian TEQ may elicit adverse effects in ~~individual~~ mammals, particularly in PRI 5s, 7, and 8, and to a lesser degree PRIs 6 and 12 (see Section 4.2.1). There are no LOAEL-based HQs greater than 1 for PRIs 10, 13, 14, 15, 16, SVDD, and GSLIC; thus, no adverse effects on individual mammals are expected in these areas. All sample locations in PRI 5 have LOAEL-based HQs greater than 1 for TEQ; thus, this evidence strongly indicates adverse effects on individual mammals may occur in the upland habitats of PRI 5. PRIs 7 and 8 (upland habitat only) have a lower frequency but a higher magnitude (maximum HQ = 10 and 6, respectively) of LOAEL-based HQs above 1, which is also considered an indication of potential adverse effects on individual mammals. The LOAEL-based HQs in PRIs 6 and 12 are infrequently above 1 and low in magnitude (maximum frequency of 30 percent and maximum HQ = 3); thus, adverse effects on individual mammals are considered unlikely.

In contrast, t~~T~~he tissue HQ LOE ~~strongly~~ indicates that, across all exposure units, risks to individual mammals from chronic exposures to TEQ and other bioaccumulative COPECs are unlikely, as there are no NOAEL-based or LOAEL-based HQs greater than 1 (see Section 4.2.2). Because both the tissue HQ LOE and the dietary dose HQ LOE have similar uncertainties that are likely to overestimate risk (see Section 7.1), no specific uncertainties related to TRVs, and they use the same solids sample data as well as TEQ bioaccumulation models derived from the same source (ERM 2018a), reliability and relevance (see Section 2.5.4.1) is considered roughly equivalent for these two LOEs. ~~The tissue HQ LOE strongly indicates adverse effects to individual mammals are unlikely because there are no NOAEL-based HQs above 1, while the dietary dose HQ LOE indicates effects are possible to individual mammals in PRIs 5, 7, and the upland habitat of 8 and indicates effects are unlikely for individual mammals in PRIs 6 and 12~~.

Because each of these two contradictory LOEs have approximately similar confidence, it is not possible to identify one LOE as being more reliable than the other. Consequently in order to be conservative, risks to mammals in ~~After a conservative integration of these two LOEs together, the areas retained as posing potential risk for individual mammals due to chronic exposure to TEQ are~~ PRIs 5, 6, 7, and the upland habitat of 8 are considered possible but uncertain~~, due to the high frequency and/or moderate magnitude of LOAEL-based dietary dose HQ exceedances~~.

If there are risks to mammals in these areas, ~~Similar to bird receptors in Section~~ **Error! Hyperlink reference not valid.** the exposure areas over which adverse effects are possible are small in size (68 ha

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for PRI 5 upland habitat, 129 ha for PRI 7 areas that are not underwater at some point of the year, and 67 ha for PRI 8 upland habitat), representing a limited number of individual mammals. The mammalian receptors expected to be most numerous at the Site, grasshopper mouse and Ord's kangaroo rat, are both territorial (California Department of Fish and Wildlife 2014), and thus their home range may be used to estimate population density. Using the home ranges presented in Table 2- 18, it can thus be estimated that a maximum of 115 grasshopper mice and 189 Ord's kangaroo rats may be residents of the exposure areas where adverse effects are possible. The number of individual mice and rats at risk of adverse effects due to TEQ in these areas represents a small fraction of the population. In addition, the habitat quality is poor in PRIs 5 and 7 (see Section 2.2.1.4), thus mammal densities are expected to be lower at the Site than in areas with optimal habitat. Particularly in the lakebed habitat of PRI 7, the lack of vegetation cover, lack of food items, and marshy or salt-crusted substrates are unlikely to support frequent use by mammals. Thus, any risks due to TEQ to individual mammals in PRIs 5 (upland habitat), 7, and 8 (upland habitat) are not expected to translate to overall population-level risks.

There is good~~high~~ confidence in the WOE finding that risks to mammals in other areas of the Site are not of significant concern, since both LOEs indicate risks are low.~~or PRIs 8 (lakebed habitat), 10, 13, 14, 15, 16, the SVDD, and GSLIC, as the conservative HQs LOEs indicate that risks to individual mammals are unlikely. For PRIs 5, 6, 7, 8 (upland habitat), and 12, the confidence in the WOE finding is moderate, as either the evidence has weak strength or the two HQ LOEs are contradictory, but ultimately any impacts would be limited to a small number of individual mammals~~.

~~4.2~~4.4 Summary of Findings for Mammals

Risk evaluation was conducted for mammalian AEs at the population level. AEs represent the following feeding guilds: invertebrate-consuming mammal, herbivorous mammal, carnivorous mammal, and large herbivorous mammal. Representative receptor species were selected for each feeding guild. PRIs 5 (upland), 6 (upland), 7, 8, 10, and 12 through 16, and the GSLIC and SVDD were evaluated for chronic exposures; and PRIs 2, 4, 5 (lakebed), 6 (lakebed), 7, and 9 were evaluated for acute exposures. Three LOEs (dietary dose HQs, tissue HQs, and ecological field surveys) were available to characterize risk to mammal AEs across the different exposure areas of the Site. Uncertainties associated with the LOEs used to generate the WOE findings above are discussed in Section 7.

The available evidence is contradictory regarding risks to mammals. One LOE (the dose-based HQ LOE) indicates that risks from TEQ could be of concern to mammals in ~~The WOE findings are that risks are unlikely for individual mammals for all exposure areas of the Site, except:~~

~~**PRI 5 (Upland Habitat), PRI 7, and PRI 8 (Upland Habitat)** – Mammalian TEQ may pose a risk to individual mammals within~~ the upland habitat of PRI 5, 6, the lakebed habitat of PRI 7, and the upland habitat of PRI 8. A second LOE (measured or calculated tissue concentration-based HQ values) indicate that risks from TEQ are not of apparent concern. Consequently, no form conclusion can be drawn.

In order to be conservative, it is considered prudent to tentatively consider the dose-based HQ evidence as an indicator of concern in these areas. However, these exposure areas are small in size ~~(68, 339, and 67 ha, respectively)~~ and support a only a relatively small fraction of individuals in the site populations of mammels. Consequently, ~~maximum of approximately 200 individual mammals per species. This represents a small fraction of the population; thus,~~ even if risks to mammals from TEQ are of authentic concern to ~~it is unlikely that any adverse effects on~~ individual mammals in the above areas, it is unlikely this would translate to population-level effects. ~~Therefore, risks to mammal populations are considered unlikely.~~

~~The c~~Confidence ~~in the above WOE findings~~ is moderate to high that risks to mammals in other areas of the site are not of concern.~~. The HQs were calculated with conservative assumptions, and thus provide compelling evidence that risks are unlikely for all exposure areas except PRIs 5 (upland habitat), 7, and 8 (upland habitat). In PRIs 5 (upland habitat), 7 and 8 (upland habitat), the two conservative HQ LOEs have contradictory results, but ultimately the small number of individual mammals that might be impacted is unlikely to translate to impacts on the population.~~

5. RISK EVALUATION FOR PLANT COMMUNITIES

Section 5 presents the risk evaluation findings for terrestrial plants at the Site.

5.1 Plant Occurrences at the Site

Understanding where the terrestrial plants are present in the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. As described in Section 2.2.1.4, upland habitat at the Site generally includes invasive grasses, mixed greasewood scrub, and ruderal vegetation. Much of the Site does not support plant communities and/or has plants that are ruderal, sparse, patchily distributed, short in stature, and do not provide suitable refuge or foraging habitat for wildlife. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence of plants at each exposure unit.

5.2 Risk Estimates

Risk estimates for terrestrial plants were evaluated with the direct contact HQs LOE, tissue HQs LOE, and ecological field survey LOE only. No Site-specific toxicity studies were identified as LOEs for plants. Risk estimates for terrestrial plants exposed through direct contact with soil were evaluated on a point-by-point basis using NOAEL and LOAEL benchmarks, when available, resulting in a NOAEL or LOAEL HQ. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The results of the direct contact exposure and tissue body burden analyses for terrestrial plants are presented below.

5.2.1 Direct Contact Hazard Quotient Line of Evidence

5.2.1.1 Direct Contact HQ Results

~~The results of the direct contact exposure risk analysis for terrestrial plants are presented below.~~ Exposure units supporting a chronic exposure in upland habitat were evaluated using point-by-point EPCs (PRIs 5 [upland], 6 [upland], 8 [upland], 10, 12, 14 [upland], 15, 16). Terrestrial plants were not evaluated in exposure units where current conditions do not allow for meaningful plant growth (PRIs 2, 4, and 9) or exposure units with lakebed habitat only (PRIs 7 and 13, GSLIC, and SVDD).

The NOAEL and LOAEL HQ results for COPECs with an HQ equal to or greater than 1 are presented in Table 5-1 and illustrated on Figures 5-1a to 5-1i. The NOAEL and LOAEL HQ results for COPECs that do not have HQs equal to or greater than 1 are presented in Appendix E.

5.2.1.2 Main Findings

The following main risk evaluation findings for plant receptors are derived from the direct contact HQ results presented in Table 5-1 and Figures 5-1a to 5-1i:

- The highest LOAEL HQ values for plant receptors are due to direct contact with aluminum and chromium. However, HQ values for these metals are consistent with background HQs (Table 5-1 and Figures 5-1a to 5-1i). Thus, aluminum and chromium concentrations at the Site are due to naturally occurring concentrations in the upland soil.
- Several other inorganics (barium, selenium) have LOAEL HQs above 1 but are low in frequency (e.g., only one sample) and magnitude (LOAEL HQ = 2). Because of the very low exceedance frequency, these COPECs ~~which~~ are not considered to be a concern to the plant community.
- ~~Risk to plants does not reach a level of concern for any COPECs.~~

5.2.1.3 Confidence

In general, confidence is high in HQ findings below 1 because most HQs are derived in a way that is intentionally conservative.

5.2.1.4 Conclusions for the Direct Contact LOE

For the direct contact HQ LOE, confidence is high that risks to plants do not reach a level of concern from Site-related releases of COPECs. ~~HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section~~ **Error! Hyperlink reference not valid.**

~~5.2.1~~5.2.2 Tissue Hazard Quotient Line of Evidence

5.2.2.1 Tissue HQ Results

Terrestrial plant tissue was evaluated by comparing plant tissue benchmarks to tissue concentrations modeled from soil sample concentrations (uptake models described in Section 2.3.3). Exposure units supporting a chronic exposure in upland habitat were evaluated using point-by-point EPCs. Plants were not evaluated in exposure units where current conditions preclude the growth and development of meaningful plant communities. Results are shown in Appendix [??].

5.2.2.2 Main Findings

Plant uptake models were available for the following bioaccumulative~~s~~ COPECs: TEQ, HCB, PCBs, hexachlorobutadiene, pentachlorobenzene, and mercury. However, tissue-based benchmarks for plants were only available for PCBs and mercury. Therefore, HQs were derived only for these two COPECs. The NOAEL and LOAEL HQ results are presented in Appendix E. In brief, no HQs were greater than 1.

5.2.2.3 Confidence

As with the direct contact HQs above, confidence is high that HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section 7.1). Lack of TRVs for TEQ, HCB, hexachlorobutadiene, and pentachlorobenzene precludes using this LOE for these COPECs. However, these COPECs are identified as bioaccumulative based on their properties in humans and animals, and there is little reason to expect that they tend to preferentially accumulate in plants. Consequently, despite the limited availability of benchmarks, confidence is moderate.

5.2.2.4 Conclusion for Tissue-based HQ LOE

This LOE indicates that risks from bioaccumalative COPECs to plants are low. However, this is based on only two COPECs, so confidence is only moderate.

~~5.2.2~~5.2.3 Site-Specific Toxicity Studies Line of Evidence

There are no available data for the Site-specific toxicity studies LOE for plants (see Section 2.1.1).

~~5.2.3~~5.2.4 Ecological Field Surveys Line of Evidence

Similar to mammals, limited data are available for plants for the ecological field surveys LOE. These data provide documentation of observed plant presence and overall health at the Site, as well as an assessment of plant species composition over time. ~~None of the studies conducted a quantitative comparison between Site and a reference area. Thus, determinations about whether impacts have occurred on plants at the Site due to soil COPECs have a degree of uncertainty~~.

5.2.4.1 Field Survey Results

Thompson 1983

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The study by Thompson (1983) reports the findings of a vegetation survey conducted on 25 October 1983 at a number of sites within 3 miles of the facility. Some of the sites in the survey were qualitatively compared to results from a previous plant survey done prior to the operation of the facility, on 8 June 1971. The eight sites from the 1971 survey were located within a 0.5-mile radius of the facility and included a count of the major plant species within a 36-foot-diameter circle. An additional six sites that were not in the 1971 survey were also surveyed by Thompson and these sites were located within 3 miles of the facility. The report's limited descriptions of the survey sites preclude the identification of these sites with specific PRIs. The objective of the survey by Thompson (1983) was to determine if any major changes in plant species composition had occurred after 12 years of production. In addition to evaluating plant species at each site, Thompson (1983) also examined the lichen population.

Thompson (1983) found that the predominant species that were present in 1971 were still present at the time of the survey in 1983. However, many of the sites experienced disturbance due to heavy equipment, which was assumed to have caused the changes in some plant populations. For example, the disturbed areas were quickly colonized by halogeton, cheatgrass, and clasping pepperweed (*Lepidium perfoliatum*). Heavy cattle grazing was assumed to have affected plant populations as well, as evidenced by squirreltail (*Sitanion hysterix*) being present under the protection of saltbushes (*Atriplex*) and greasewood plants. Black sagebrush (*Artemisia nova*) was found at two sites in the previous 1971 survey, but were absentwhen surveyed by Thompson. Reasons for this decrease were hypothesized as physical disturbances or fluctuating levels of the lake resulting in high-water tables or rising saline levels. Thompson observed heavy lichen growth on soil, twigs, and rocks in the majority of the sites, and suggested that this sensitive plant species is not affected by emissions from the facility. However, lichen were not surveyed in the 1971 study, thus there are no previous observations that can be used as a comparison. Overall, Thompson (1983) concluded that his findings showed no significant plant damage, with the caveat that the survey was conducted after several heavy frosts, which did not allow for careful observation of phytotoxic reactions in plant species.

Glover 1983

The survey methods for Glover (1983) are presented in Section 3.2.4.2. The Glover (1983) results specific to terrestrial plants are limited to a list of habitats used by wildlife species: greasewood, saltbrush, cheatgrass, rocky outcrops, marsh edges, marsh flats, lake edge, and ditch. The author reports "no discernable effects on the animals nor their habitats evident at the time of this survey." These observations cannot be linked to specific PRIs from the limited documentation available in the report.

Halford et al. 1999

Methods for Halford et al. (1999) are presented in Section 3.2.4.3. Halford et al. made observations on plant species and general plant health in the following locations: west margin of the Smut Area (PRIs 9 and/or 15), Barium Sulfate Area (PRI 10), and around the waste ponds (PRIs 5, 6, 7). Live vegetation was observed on the west margin of the Smut Area (PRIs 9 and/or 15), the Barium Sulfate Area (PRI 10), north pond island (PRI 6), and the south pond berm (PRI 5). The plants in the Barium Sulfate Area and on the west margin of the Smut Area were noted as appearing healthy. Dead vegetation was observed at the old wastewater pond (PRI 7) and the barrow pits of PRI 6,[14] possibly due to fluctuating pond water levels.

~~5.2.3.1~~ 5.2.4.2 *Main Findings*

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The survey efforts described above noted the presence/absence of live vegetation and visually assessed plant condition and species composition. While the surveys provided a comparison to a normal plant conditions, the surveys did not conduct any quantitative comparisons between the Site and an appropriate reference. Main findings are:

- Dead vegetation is noted in PRIs 6, 7, and 8, though the cause of plant mortality is often ascribed to physical soil conditions and/or waterlevels.
- The presence of healthy vegetation in other PRIs and/or other studies suggests that adverse effects on plants are not occurring in those areas of the Site, but cannot be used as a conclusive evaluation.

5.2.4.3 Confidence

Confidence in the ecological surveys LOE is low due to the generalized qualitative nature of the comparisons between Site and normal conditions. The Thompson (1983) comparisons of species composition are relevant to plant communities, but lack temporal relevance to current conditions due to any facility changes that have occurred since 1983. These studies suggest a lack of phytotoxicity at the Site, but are not conclusive. Uncertainties associated with this LOE are detailed in Section 7.3.

5.2.4.4 Conclusion for the Field Survey LOE

Direct observations of plant communities at the Site have not identified any adverse effects attributable to COPEC effects, but confidence in this LOE is low.

5.3 Combined Weight of Evidence

WOE is conducted as described in Section 2.5.4. Three LOEs are available for the terrestrial plant community risk characterization: direct contact HQs, tissue HQs, and ecological field surveys. Field

[14] The barrow pit in PRI 6 is no longer hydrologically separate from the acidic wastewater; thus, vegetation is no longer present in this area.

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surveys document observations of plants growing in locations across the Site, although habitat is poor (Glover 1983; Thompson 1983; Halford et al. 1999).

All three LOEs are in agreement that risk to individual plants is unlikely for all exposure areas evaluated for plants (upland habitat of PRIs 5, 6, 8, 10, 12, 14, 15, and 16). For the direct contact HQs LOE, no COPECs raise to a level of concern: either HQs at the Site are consistent with those from background areas, or LOAEL-based HQ exceedances are rare and of low magnitude (see Section 5.2.1). As described in Section 5.2.2, there are no HQs greater than 1 for the tissue-based HQ LOE. The ecological field surveys indicate that plants are growing at the Site, although the poor habitat quality (poor physical soil conditions, compacted soils, high osmotic stress, or fluctuating water levels near ponds) may lead to pockets of dead vegetation in some areas (see Section 5.2.4). The three LOEs together provide ~~compelling~~ good evidence that risks from COPECs to ~~individual terrestrial plants are unlikely. Thus, risk to~~ the terrestrial plant community is ~~also unlikely~~low. There is high confidence in these findings, as the LOEs are in agreement and the HQs LOEs, which are derived using conservative assumptions, indicate unlikely risks.

~~5.3~~5.4 Summary of Findings for Plants

Risk evaluation was conducted for the terrestrial plant community AE in upland habitat. PRIs 5 (upland), 6 (upland), 8 (upland), 10, 12, 14, 15, and 16 were evaluated for chronic exposures. Exposure units where current conditions do not allow for meaningful plant growth were not evaluated. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The three LOEs used for evaluating plants were: direct contact HQs, tissue HQs, and ecological field surveys. ~~These LOEs were combined to generate a WOE finding (see Section~~ **Error! Hyperlink reference not valid.** ~~above).~~ The WOE finding is that risks to the terrestrial plant community at the Site are unlikely, for all evaluated upland habitat areas, and there is high confidence in these findings. The uncertainties associated with the above LOEs are described in Section 7.

6. RISK EVALUATION FOR INVERTEBRATES AND AQUATIC BIOTA

Section 6 presents the risk evaluation findings for soil invertebrates, benthic invertebrates, and aquatic biota (aquatic invertebrates and aquatic plants) at the Site.

6.1 Invertebrate Occurrences at the Site

Understanding where the upland and lakebed invertebrates are present in the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. As described in Section 2.2.1.4, invertebrates in upland habitat at the Site include soil invertebrates such as beetles, ants, and wasps. Adult and larval brine flies are present in ~~(exposed at)~~ lakebed habitats. The survey efforts from BIO-Logic (2004) and ERM (2014a) indicate waste pond water (PRIs 5, 6, and 7) is invertebrate-poor, likely due to the influx of acidic wastewater. Limited brine fly reproduction may occur when acidic wastewater is not present in PRI 7. While BIO-Logic (2004) observed brine flies in PRI 6, this former barrow pit area is no longer hydrologically separate from the acidic wastewater of the active waste pond, thus eliminating brine fly reproduction in PRI 6. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence of invertebrates at each exposure unit.

Commented [EPA10]: Add discussion of brine shrimp occurrence

6.2 Risk Estimates

Risk estimates for invertebrates and aquatic biota were evaluated with the direct contact HQs LOE and tissue HQs LOE. No Site-specific toxicity studies or ecological field surveys were identified as LOEs for invertebrates or aquatic biota. Risk estimates for soil invertebrates, benthic invertebrates, and aquatic biota were evaluated on a point-by-point basis using NOAEL and LOAEL benchmarks, when available, resulting in a NOAEL or LOAEL HQ. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

~~The results of the direct contact exposure analyses are presented below.~~

6.2.1 Direct Contact Hazard Quotient Line of Evidence for Soil Invertebrates with Upland Soil

Soil invertebrates were evaluated for direct contact exposure with upland soil in exposure units with upland habitat. Exposure units supporting a chronic exposure were evaluated using point-by-point EPCs (PRIs 5 [upland], 6 [upland], 8 [upland], 10, 12, 14 [upland], 15, and 16). Risks were not evaluated in exposure units that are judged to provide inadequate habitat for soil invertebrates (PRIs 2, 4, and 9).

6.2.1.1 Direct Contact HQ Results for Soil Invertebrates

~~The results of the direct contact exposure analysis for soil invertebrates are presented below.~~ The NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 6-1 and illustrated on Figures 6-1a to 6-1c. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix D.

~~6.2.1.1~~6.2.1.2 Main Findings

The following main risk evaluation findings for soil invertebrates are derived from the direct contact HQ results presented in Table 6-1 and Figures 6-1a to 6-1c:

- The highest HQ values for soil invertebrate receptors are due to direct contact with chromium. However, HQ values for this metal are consistent with background HQs (Table 6-1 and Figure 6-1b).

Thus, chromium concentrations at the Site are due to naturally occurring concentrations in the upland soil. The other COPECs with HQs greater than 1 are barium and mercury. HQs above 1 for both of these COPECs are very low in magnitude and frequency~~, which is not a concern for soil invertebrate communities~~.

6.2.1.3 Confidence

For direct contact HQs, confidence in the findings above is dependent on the magnitude of the HQ and the frequency of which HQs exceed 1 (i.e., strength) and the specific COPEC. HQs less than 1, particularly NOAEL HQs less than 1, have high confidence that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). For LOAEL HQs above 1 and higher than background levels (mercury), the confidence depends on the reliability and relevance of the specific underlying calculation parameters. As the chemistry data is both reliable and Site-specific, and the benchmark is relevant and presents no specific uncertainties, there is moderate confidence in the calculation parameters.

6.2.1.4 Conclusion for Sediment Direct Contact HQ LOE for Soil Invertebrates

Based on the direct contact HQ LOE, there is good confidence that ~~r~~Risk to soil invertebrates does not reach a level of concern for any COPECs ~~(Table 6-1 and Figure 6- 1a to 6-1c).~~

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6.2.2 Direct Contact Hazard Quotient Line of Evidence for Benthic Invertebrates with Sediment

Benthic invertebrates were evaluated for direct contact exposure with sediment in lakebed habitat where the surface water was not acidic (PRIs 7 [chronic exposure assumption], 8, 13, and 14, the GSLIC, and the SVDD) on a point-by-point basis. Benthic invertebrates were not evaluated in lakebed exposure units with an assumed acute exposure pathway for birds and mammals because acidic wastewater precludes growth of benthic invertebrates (PRIs 5 and 6).

6.2.2.1 Direct Sediment Contact HQ Results for Benthic Invertebrates

In general, there were a number of organics and metals that have HQs greater than 1 in the lakebed exposure units. The results are summarized in Table 6-2 and illustrated on Figures 6-2a to 6-2l. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E. As noted in Section 2.4.1.1, it is unclear whether saltwater and freshwater benchmarks are more relevant to species at the Site. Thus, the lower of the saltwater and freshwater benchmarks were used for HQ calculations in lieu of toxicity data on brine shrimp and/or hypersaline conditions. The uncertainty of using these benchmarks to evaluate hypersaline surface water and sediment toxicity is discussed in the Uncertainty Analysis (Section 7).

6.2.2.2 Main Findings

The following main risk evaluation findings for benthic invertebrates are derived from the direct contact HQ results presented in Table 6-2 and Figures 6-2a to 6-2l:

- The highest LOAEL and unbounded NOAEL HQ values for benthic invertebrate receptors are due to direct contact with total PCBs, phenol, carbon disulfide, and inorganics. Other COPECs with LOAEL or unbounded NOAEL HQs above 1, such as HCB and pentachlorobenzene, are low in frequency (less than 10 percent of samples with HQ above 1) and magnitude. The HQ values for inorganics are consistent with background values and do not reach a level of concern in sediment. The unbounded NOAEL HQs above 1 are relatively low in frequency (20 to 32 percent of samples with HQ above 1) with a maximum NOAEL HQ of 10 for phenol and 7 for carbon disulfide. Given the consistencies with inorganic background HQs, low frequency or magnitude unbounded NOAELs for SVOCs/VOCs, and the likelihood that a LOAEL HQ would not be above 1, the only COPEC of potential concern to

benthic invertebrates is total PCBs.

- Total PCBs reach a level of potential concern to benthic invertebrates in PRI 7 sediments under the assumption of a chronic exposure pathway, which is unlikely to occur given the periodic flooding of PRI 7 with acidic wastewater. While LOAEL HQ values are elevated for total PCBs in the GSLIC and PRI 14, the magnitude and frequency of the HQs above 1 are limited, thus not reaching a level of concern in GSLIC sediments.

6.2.2.3 Confidence

Similar to direct contact HQs for soil invertebrates, HQs less than 1, particularly NOAEL HQs less than 1, have high confidence that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). For unbounded NOAELs and LOAEL HQs above 1 that are higher than background levels and greater than 10 percent in frequency (i.e., total PCBs, phenol, and carbon disulfide), the confidence depends on the reliability and relevance of the specific underlying calculation parameters.

- **Total PCBs** – The chemistry is reliable and Site-specific, but assumes the entirety of PRI 7 is suitable habitat for benthic invertebrates, which is not relevant to the acidic conditions that occur during periodic flooding of wastewater. Additionally, the benchmark has low relevance as it is based on saltwater benthic invertebrates rather than Site-specific hypersaline brine shrimp and brine fly larvae. There is low to moderate confidence that the potential for adverse effects to benthic invertebrate is likely, but the COPEC is still considered to be a potential concern due to the high magnitude and frequency of LOAEL HQ above 1.
- **Phenol** – The EPC values used in the unbounded NOAEL HQ calculation for phenol are likely overestimated as only three out of nine sampling locations with HQs above 1 are detected concentrations. The benchmark has low relevance since it is based on a freshwater aquatic benchmark for the Great Lakes rather than Site-specific hypersaline brine shrimp and brine fly larvae (see Section 7.1.2.2). There is low confidence in the findings that adverse effects may potentially occur based on overestimated EPCs, low relevance benchmark, and low frequency of NOAEL HQs above 1~~, phenol is not considered to be a COPEC of potential concern to benthic invertebrates~~.
- **Carbon disulfide** – The chemistry used in the HQ calculation is reliable and Site-specific. Similar to the phenol benchmark discussed above, the carbon disulfide benchmark has low relevance as it is based on a freshwater aquatic benchmark for the Great Lakes (see Section 7.1.2.2). There is low confidence in the findings that adverse effects may potentially occur. ~~Because t~~There is low confidence in this finding due to a low relevance benchmark, and the frequency of NOAEL HQs above 1 is limited~~, carbon disulfide is not considered to be a COPEC of potential concern to benthic invertebrates~~.

6.2.2.4 Conclusions for Sediment Direct Contact HQ LOE for Aquatic Invertebrates

PCBs in sediment may pose a significant risk to aquatic invertebrates in PRI-7. Confidence in this conclusion is low. There is moderate confidence that risks from other COPECs are of minimal or low concern.

6.2.3 Direct Contact Hazard Quotient Line of Evidence for Aquatic Invertebrates with Surface Water

Aquatic biota were evaluated for direct contact exposure with surface water in lakebed habitat where the surface water was not acidic and where surface water was collected (PRIs 7 [chronic exposure assumption], 8, and 14, and the SVDD). Aquatic biota were not evaluated in lakebed exposure units with an assumed acute exposure pathway for birds and mammals because acidic wastewater prohibits the growth of aquatic biota (PRIs 5 and 6).

6.2.3.1 Surface Water Direct Contact HQ Results

The results are summarized in Table 6-3 and illustrated on Figures 6-3a to 6-3w. The NOAEL and LOAEL

HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E.

6.2.3.2 Main Findings

~~The following main risk evaluation findings for aquatic invertebrates are derived from the direct contact HQ results presented in Table 6-3 and Figures 6-3a to 6-3w:~~

- Nearly all LOAEL-based HQs for most COPECs are below 1. Any exceptions~~The majority of LOAEL-based HQs above 1~~ are infrequent and low in magnitude~~,~~ except for chlorine. ~~with high variability of concentrations within an exposure unit, resulting in low risk to aquatic invertebrates~~.
- For chlorine, HQs are in a range of concern in PRIs 7, 8, and 14.
- For PCBs, aluminum, and iron, only NOAEL-based (but not LOAEL-based) benchmarks are available. Unbounded NOAEL and LOAEL HQ values for these three COPECs frequently exceed 1, so the potential for risk cannot be excluded. ~~aquatic invertebrates are highest in frequency and magnitude for direct contact with total PCBs, chlorine, aluminum, and iron. The COPECs with low frequency unbounded NOAEL or LOAEL HQs above 1 (indicating high variability of concentrations) include chromium, copper, manganese, mercury, vanadium, and zinc; these COPECs do not reach a level of concern for aquatic biota.~~
- Background surface water was not collected for the BERA and thus, HQs for Site COPECs were not compared to background HQs, resulting in ~~high~~ uncertainty as to whether COPEC concentrations are attributable to naturally occurring background, especially for inorganics.

6.2.3.3 Confidence

In general~~As with other direct contact HQs~~, HQs less than 1, particularly NOAEL HQs less than 1, have good~~high~~ confidence that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). This applies to a majority of COPECs in surface water. COPECs that are or might be of concern include chlorine, PCBs, aluminum and iron.~~For unbounded NOAELs and LOAEL HQs above 1 that are relatively high in magnitude or frequency (i.e., total PCBs, chlorine, aluminum, and iron), the c~~Confidence in these results depends on the reliability and relevance of the specific underlying calculation parameters, as discussed below.

- **Total PCBs** – HQs may reach a potential level of concern in PRIs 7 and 8, based on frequency and magnitude of NOAEL HQs. However, no LOAEL HQs could be calculated due to unavailability of a benchmark, meaning it is uncertain if an actual effect concentration has been exceeded. In addition, total PCB bioavailability is likely overestimated due to low solubility of PCBs in surface water (see Section 7.1.2.2). Thus, confidence in total PCBs HQs for aquatic biota is low~~are unlikely to pose a concern for aquatic biota~~.
- **Chlorine** – LOAEL HQs range from 8 to 10 in PRIs 7, 8, and 14. These HQs are~~While the benchmark is~~ based on the National Ambient Water Quality Criteria (NAWQC) for saltwater, which may not be optimal for the ~~it has low relevance to aquatic organisms in~~ hypersaline environments in these PRIs (see Section 7.1.2.2). While exposure data for chlorine in PRIs 7 and 14 are reliable, ~~Additionally, the chemistry in PRI 8 surface water has overestimated concentrations under current conditions since~~ the majority of ~~the~~ samples from PRI 8 were collected prior to the installation of the overflow pipe. Since the overflow pipe has been installed, wastewater from PRI 6 no longer enters PRI 8, and it is expected that chlorine levels would now be ~~, which removed the wastewater from PRI 8.~~ low or zero. Consequently, confidence in chlorine HQs in PRI 8 are low~~The LOAEL HQs are highly uncertain and likely overestimated. Therefore, chlorine is not considered to be a potential concern~~.
- **Aluminum** – No LOAEL benchmark is available for aluminum. The NOAEL HQs for aluminum are likely resulting in overestimated NOAEL HQs since the aluminum benchmark does not account for the extremely hard water at the Site, which will cause reduced bioavailability of aluminum to aquatic organisms. In addition, aluminum concentrations in measured surface water samples are highly variable even within the same sample locations (Section 7.1.2.2). Consequently, confidence in the HQ values is low. ~~Aluminum is not a potential concern to aquatic invertebrates.~~

Commented [EPA11]: EPA found no results based on unbounded LOAEL benchmarks.

Also, Figure 6-3w shows results for both a NOAEL and LOAEL for chlorine, but the text describes chlorine as having only a NOAEL. Calculations in Appendix E list a NOAEL TRV of 7.5E-03 mg/L and a LOAEL TRV of 1.3E-02 mg/L. EPA has assumed the Appendix and figure are correct, and has suggested edits based on this.

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- **Iron** – Similar to aluminum, iron HQs are likely overestimated as elevated iron concentrations at the Site are above the expected solubility of iron in seawater (see Section 7.1.2.2). Consequently, confidence in the HQ values is low. ~~As such, iron is not considered to be a potential concern to aquatic invertebrates.~~

6.2.3.4Conclusions for the Surface water HQ LOE for Aquatic Invertebrates

There is good confidence that chlorine in surface water is of above a level of ecological concern in PRIs 7 and 14. It is considered very likely this also applies to PRIs 5 and 6. There is good confidence risks from other COPECs in surface water are of minimal concern.

6.2.4 Soil Invertebrate Tissue Hazard Quotient Line of Evidence

Soil invertebrate tissue was evaluated by comparing soil invertebrate tissue benchmarks to tissue concentrations modeled from soil sample concentrations (soil invertebrate uptake models described in Section 2.3.2). Modeled tissue was evaluated for tissue body burden in PRIs 5, 6, 8, 10, 12, 14, 15, and 16. PRIs 2, 4, and 9 were not evaluated for modeled tissue body burden since the habitat does not support soil invertebrate communities (Section 2.2.3).

6.2.4.1 Results for Tissue HQ LOE for Soil Invertebrates

Soil invertebrate uptake models were available for TEQ, PCBs, HCB, mercury, hexachlorobutadiene, and pentachlorobenzene. However, soil invertebrate tissue benchmarks were only available for total PCBs, mercury, and pentachlorobenzene. Thus, HQs were only derived for these three COPECs. The NOAEL and LOAEL HQ results are presented in Table 6-4 and illustrated on Figure 6-4, although there is only one sample in PRI 5 that has an HQ greater than 1. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E.

~~6.2.4.1~~6.2.4.2 ~~-~~Main Findings

The following main risk evaluation findings for soil invertebrates are derived from the tissue HQ results presented in Table 6-4 and Figure 6-4:

- The only COPEC with an HQ above 1 is total PCBs. Only the NOAEL benchmark for total PCBs is exceeded, and this low-magnitude HQ is only at one sample location in PRI 5. Thus, total PCB HQs do not reach a level of potential concern for tissue concentrations of soil invertebrates.

6.2.4.3 Confidence

Tissue-based HQs are based on tissue concentration values derived from Site-specific models (see Section 2.3.2). Because the models are based on Site data, these models are considered to be reasonably reliable, but all models have inherent uncertainty, so predicted tissue concentrations may not be accurate in all cases. Nevertheless, f~~F~~or tissue HQs less than 1, particularly NOAEL HQs less than 1, confidence is high that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). Given that there are no LOAEL HQs above 1, there is moderate ~~to high~~ confidence that COPECs are not a potential concern for soil invertebrate tissue.

6.2.4.4 Conclusions for the Tissue HQ LOE for Soil Invertebrates

Based on the tissue HQ LOE, risks to soil invertebrates does not appear to be of concern. However, tissue concentrations were estimated from models, and benchmarks were not available for all COPECs. Consequently, confidence in this finding is only moderate.

6.2.5 Aquatic Invertebrate Tissue Hazard Quotient Line of Evidence

Aquatic invertebrate (both benthic invertebrates and aquatic biota) tissue was evaluated by comparing aquatic invertebrate tissue benchmarks to tissue concentrations modeled from sediment sample concentrations (aquatic invertebrate, i.e., brine fly, uptake models are described in Section 2.3.2). Modeled aquatic invertebrate tissue was evaluated for tissue body burden in PRIs 7, 8, 13, and 14, the SVDD, and the GSLIC.

6.2.5.1 Results of the Tissue HQ LOE for Aquatic Invertebrates

Aquatic invertebrate uptake models and tissue-based benchmarks were available for TEQ, PCBs, HCB, mercury, hexachlorobutadiene, and pentachlorobenzene. Thus, HQs were derived for all of these COPECs. The NOAEL and LOAEL HQ results that are above 1 are presented in Table 6-5 and illustrated on Figure 6-5. The NOAEL and LOAEL HQ results are presented in Appendix E.

~~6.2.5.1~~6.2.5.2 *Main Findings*

The following main risk evaluation findings for aquatic invertebrates are derived from the tissue HQ results presented in Table 6-5 and Figure 6-5:

- HCB is the only COPEC with an HQ above 1, and these are limited to NOAEL HQs in PRI 7 and PRI 14. Given that no LOAEL HQs are above 1, and that NOAEL HQs are low in frequency and magnitude, HCB does not reach a level of potential concern for tissue concentrations of aquatic invertebrates.

6.2.5.3 Confidence

Tissue-based HQs are based on tissue concentration values derived from Site-specific models (see Section 2.3.2). Because the models are based on Site data, these models are considered to be reasonably reliable, but all models have inherent uncertainty, so predicted tissue concentrations may not be accurate in all cases. Nevertheless, f~~F~~or tissue HQs less than 1, particularly NOAEL HQs less than 1, confidence is high that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). Since no LOAEL HQs are above 1 for aquatic invertebrate tissue, there is moderate ~~to high~~ confidence that COPECs are not a potential concern.

6.2.5.4 Conclusions for the Tissue HQ LOE for Aquatic Invertebrates

Based on the tissue HQ LOE, risks to aquatic invertebrates does not appear to be of concern. However, tissue concentrations were estimated from models. Consequently, confidence in this finding is only moderate.

6.2.6 Site-Specific Toxicity Studies Line of Evidence

There are no available data for the Site-specific toxicity studies LOE for invertebrates (see Section 2.1.1).

6.2.7 Ecological Field Surveys Line of Evidence

There are no available data for the ecological field surveys LOE for invertebrates (see Section 2.1.1). Of the field studies discussed in Section 2.1.3.3, none had either a quantitative comparison between the Site and reference areas or a qualitative comparison between the Site and normal conditions appropriate for invertebrates.

6.3 Combined Weight of Evidence

WOE is conducted as described in Section 2.5.4. Two LOEs were available for use in characterizing risk to invertebrates: direct contact HQs and tissue HQs. Uncertainties associated with these LOEs are discussed in full in Section 7 and the confidence in each LOE is described in Sections 6.2.1 through 6.2.5.

6.3.1 Soil Invertebrates

Soil invertebrates were evaluated for chronic exposures in upland habitats of PRIs 5, 6, 8, 10, 12, 14, 15, and 16. ~~, and live s~~Soil invertebrates have been observed in these areas (see Section 6.2.7). Both LOEs were available for use in these areas, and are in agreement that risks to soil invertebrates are unlikely. No COPECs reach a level of concern for the direct contact HQs or the tissue HQs (see Sections 6.2.1 and 6.2.4). Based on the two HQ LOEs, risks are not anticipated for either individual soil invertebrates or the soil invertebrate community due to Site COPECs, and there is moderate to high confidence in these

findings due to the LOE agreement.

6.3.2 Benthic Invertebrates

The exposure areas evaluated for benthic invertebrates include the sediments of PRIs 7, 8, 14, 13, the GSLIC, and the SVDD. Only total PCBs in PRI 7 reaches a level of concern from the direct contact HQs (see Section 6.2.2). For the tissue HQs, no COPEC reaches a level of concern (see Section 6.2.5). ~~Since PRI 7 provides poor habitat for brine flies due to periodic influxes of acidic wastewater, the risk to benthic invertebrates due to total PCBs in PRI 7 is ultimately low.~~ Confidence in these WOE findings is moderate to high, as the LOEs are in agreement and the HQs LOEs are calculated using conservative assumptions that are more likely to overestimate than underestimate risk (see Section 7.1).

Commented [EPA14]: In essence, you are arguing that risks from COPEC 1 (PCBs) are minimal because all the organisms are killed by COPEC 2 (HCl). EPA hopes the irony of that is not lost on you.

6.3.3 Aquatic Biota

Evaluations for aquatic biota were performed for~~limited to~~ lakebed habitats outside of the waste ponds with available surface water samples: PRIs 7, 8, 14, and the SVDD. The results indicate that chlorine is above a level of concern in PRI-7 and 14. A challenge with the interpretation of results for aquatic biota is that background values are not available for surface water; thus, results for naturally occurring constituents should be interpreted with caution. The direct contact NOAEL-based HQs indicate that aluminum (PRIs 7, 8, and SVDD), iron (SVDD), and total PCBs (PRIs 7, 8, and SVDD)~~, and chlorine (PRIs 7, 8, and 14)~~ may pose a risk to aquatic invertebrates (see Section 6.2.3). However, these results are likely overestimated, due to: (1) the use of unbounded NOAEL benchmarks and/or benchmarks with low relevance to species that live in hypersaline waters, (2) low solubility of PCBs in surface water, and (3) decreased bioavailability in extremely hard Site surface waters, as discussed in Section 7.1. For constituents with available LOAELs, no other COPEC(s) raise to a level of concern~~ due to the rarity of HQs above 1 (frequencies of one in six or one in two samples) and the low magnitude (HQs of 2 to 8) of those exceedances~~, as seen in Table 6-3. ~~Same as for the benthic invertebrates above, t~~The tissue HQ LOE does not provide evidence of concern~~s yield no COPECs of concern~~ (see Section ~~**Error! Hyperlink reference not valid.**~~ and the field surveys discussed in Section **Error! Hyperlink reference not valid.**~~ suggest that PRI 7 provides limited habitat for aquatic biota, due to the presence of acidic wastewater~~. The integration of the above LOEs, along with an understanding of the uncertainties and likely overestimations of risk (see Section 7.1), yields a WOE conclusion that risks at the Site to aquatic biota are likely low from COPECs other than chlorine. There is low to moderate confidence in these findings, as the direct contact LOE has a number of uncertainties that make interpretation challenging.

6.4 Summary of Findings for Invertebrates and Aquatic Biota

Risk evaluation was conducted for the invertebrate community AEs: soil invertebrates, benthic invertebrates, and aquatic biota. The LOEs used to evaluate invertebrates and aquatic biota are direct contact HQs (upland soils, lakebed sediments, and lakebed surface water) and HQs using modeled tissue from soil/sediment chemistry. PRIs 5 (upland), 6 (upland), 7, 8, 10, 12 to 16, and the GSLIC and SVDD were evaluated for chronic exposures. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The WOE integrated the results of the three LOEs listed above into the following findings:

- **Soil invertebrates** – There is compelling evidence that risks are unlikely for the soil invertebrate community in the upland habitats of PRIs 5, 6, 8, 10, 12, 14, 15, and 16.
- **Benthic invertebrates** – Benthic invertebrate community risk is low for the lakebed habitats of PRIs 7, 8, 13, 14, the GSLIC, and the SVDD. In the active ponds (PRIs 5 and 6), the acidic water precludes presence of benthic invertebrates. PRI 7 is intermittently acidic, so even though there may be some risk from total PCBs in PRI 7, growth of benthic invertebrates in this PRI is likely to be limited.

- **Aquatic biota** – Chlorine in surface water is above a level of concern in PRIs 7 and 14. Risks from other COPECs in surface water appear low, but because of~~Due to a number~~ of uncertainties~~ leading to overestimations of risk~~, interpretation of the results for aquatic biota is uncertain~~are challenging. However, the evidence suggests that overall risks to the aquatic biota community in the surface waters of PRIs 7, 8, 14, and the SVDD are probably low.~~

~~Confidence in the above WOE findings is moderate to high. The LOEs are all in agreement, but for aquatic biota there are increased uncertainties, which decreases confidence. Uncertainties associated with the above LOEs are discussed in Section~~ **Error! Hyperlink reference not valid.**

7. UNCERTAINTY ANALYSIS

Analyses in support of a BERA are typically subject to a number of uncertainties. An analysis of these uncertainties is a standard element of all risk assessments. Accordingly, this uncertainty analysis will:

- Identify sources of uncertainty related to assessments of exposure and effects;
- Identify assumptions used to address these uncertainties; and
- Discuss potential consequences these assumptions may have on characterizations of risk.

In general, assumptions used in this BERA are intended to overestimate (rather than underestimate) characterizations of potential ecological risk. A summary of the uncertainties by LOE, including their potential to over- or underestimate the potential for adverse effects, is presented in Table 7-1.

7.1 Uncertainties for Lines of Evidence based on Hazard Quotients

Many uncertainties and assumptions were made in the formulation of the dietary dose HQs LOE, tissue HQs LOE, and direct contact HQs LOE. The uncertainties around these HQs are detailed below, organized by exposure-related and effects-related uncertainties.

7.1.1 Exposure-Related Uncertainties

Sources of uncertainty related to characterization of exposures in this BERA are described below.

7.1.1.1 Representative Species

Given the number of species and the complexity of biological communities at the Site, it is impracticable to individually evaluate all species that may be present within the Site. Representative species were selected with the intent to overestimate (i.e., produce a protective estimate of) exposure in taxonomically and functionally related species (i.e., other guild members) (ERM 2020a). Accordingly, in addition to being present within the Site, exposure factors of representative wildlife species were selected to minimize underestimates of exposure to other species at the Site—i.e., preferable traits include, but are not limited to, small body size, small home ranges, and high body-weight normalized ingestion rates.

~~It should be noted that exposures of terrestrial plants, soil invertebrates, aquatic biota, and benthic invertebrates were not inferred from representative species—risks were evaluated using state-of-the- practice organism-level toxicity values (ERM 2020a).~~

Commented [EPA1]: 1) Out of place
2) What do toxicity values have to do with estimation of exposure?
3) Self-aggrandizing to say "state-of-the practice". What else are you going to use? Values known to be of poor quality ?

7.1.1.2 Site Use Factors

Site use by wildlife is a fundamental factor when estimating exposure. Given limited detailed monitoring, the SUF by receptors was used to estimate the fraction of time that a receptor is likely to spend (be exposed) at a particular exposure unit and is the ratio of the exposure unit area relative to an individual's home range or foraging area. Moreover, to ensure a protective BERA, it is assumed that wildlife receptors obtain all their drinking water from water occurring at the exposure unit.

SUFs are purely mathematical constructs and do not account for cues (e.g., presence and quality of refuge habitat, prey resources) that are known to influence decisions by animals regarding frequency

and duration of occurrence at locations. As described in Section 2.2.1.4, the PRIs that are within the facility boundaries are significantly disturbed with low-quality habitat. The SUFs used to estimate exposure are based on the species' home ranges within a high-quality habitat. It is unlikely that Site usage in the low- quality habitats at the Site is the same as Site usage in an undisturbed high-quality habitat. Assuming that the SUF is applicable to all PRIs within the Site boundaries that have disturbed habitat (PRIs 2 to 7, and 9 to 12) will tend to result in overestimates of exposure for these PRIs.

Moreover, AEs are typically concerned with receptors at the population level (consisting of multiple individuals) or community level (consisting of multiple populations)[15]; however, SUFs are calculated using data (e.g., home range) for a typical individual. In general, both populations and communities are considered to occupy an area several times larger than an individual's home range—only a portion of the population or community may be exposed at smaller exposure units depending on the MVP for that habitat and quality of habitat. Low-quality habitats will have fewer individuals that can be maintained, while higher quality habitats can have more. Accordingly, SUFs used in this BERA are likely to overestimate the exposure for a population- or community-level receptor of concern at smaller exposure units.

7.1.1.3 Relative Bioavailability~~Bioaccessibility~~

Bioavailability is a measure of~~accessibility is~~ the amount of chemical~~an administered dose~~ that is taken up into the body from an ingested dose~~available for uptake across cell membranes (i.e., uptake into the organism) and is commonly expressed as a proportion or percentage of the total administered dose~~. Relative bioavailability (RBA) is the ratio of the bioavailability of a chemical in a site medium (soil, water) compared to the bioavailability in the study used to derive the TRV. Studies indicate that RBA~~bioaccessibility~~ of contaminants in soil is dependent on several factors (e.g., soil pH, particle size, ~~constituent speciation~~chemical and physical properties of the COPEC) and the value~~proportion of the total dose available for uptake~~ is often~~typically~~ less than 100percent, especially for some inorganics and for some organic COPECs such as TEQ~~100 percent of the administered dose~~ (Ruby et al. 1993; NRC 2002; Drexler et al. 2003). Nonetheless, for this BERA it was assumed that RBA is 100 percent ~~of the administered dose (e.g., ingested dose) is available for uptake into the organism~~for all COPECs in all Site media. This assumption is considered likely to result in an overestimate of potential risk to biota for some COPECs.

7.1.1.4 Bioaccumulation Models

~~To evaluate the dose due to the ingestion of prey, a Site-specific bioaccumulation study was conducted and Site-specific bioaccumulation models were developed to support this BERA (ERM 2018a). Tissue from the following prey types were collected in the early/mid-summer~~**Error! Hyperlink reference not valid.**~~and analyzed for bioaccumulative COPECs:~~

- ~~Herbaceous portions of dominant grasses, forbs, and shrubs~~
- ~~Soil invertebrates captured in pit fall traps~~
- ~~Small mammals captured in Sherman live traps~~
- ~~Brine flies captured in array traps~~

~~Site-specific bioaccumulation models were developed assuming the samples of prey materials are characteristic of the long-term average composition of the diet.~~**Error! Hyperlink reference not valid.**~~Prey species composition is likely to vary seasonally and year-to-year. However, dominant herbaceous plant species that were collected are characteristic of upland habitats and are anticipated to be~~

Commented [EPA2]: All of the preceding text correctly refers to bioavailability, not bioaccessibility. The two are not the same. Edit as shown. Add citation to USEPA guidance on TCDD/TEQ RBA.

Commented [EPA3]: Re-describing what was done is not an uncertainty analysis. The question to be answered is "How confident are we in the models we used?". Delete all but the last paragraph and replace with the following:

Tissue concentrations of key bioaccumulative COPECs (TEQ, PCBs, HCB, mercury) in prey tissue were estimated using Site-specific uptake models (ERM 2018a). While Site-specific models provide much higher confidence in calculated tissue concentration values than non-site-specific models, model predictions are still uncertain because of random statistical variation in the available measurements and because the samples of biotic material collected might not be entirely representative of the long-term dietary intake by the ecological receptors. Nevertheless, because the Site models were based on an adequate number of data points from representative sampling locations, the models are considered to be good predictors of tissue level in most prey items, and uncertainty in the models is unlikely to be a significant source of uncertainty in the exposure levels for most receptors, except as noted below.

~~representative plant "food" for herbivores. Similarly, soil invertebrates captured (e.g., darkling beetles, carpenter ants) are commonly, often- observed soil invertebrates that are characteristic of upland habitats and are anticipated to be representative invertebrate "food" for invertivores. Capture and use of small mammals to develop a Site- specific bioaccumulation model is a potential source of uncertainty in this BERA. These rodents are mobile and relative abundances are likely to change from season-to-season and year-to-year. However, the effect (under- or overestimate of dose) due to the variability of representative small mammal prey is not known.~~

~~[15] Generally, community-level for plants and soil invertebrates and population-level for wildlife.~~

~~[16] This time period coincides when prey (particularly brine flies) are generally abundant and when many of the wildlife of interest are actively feeding and supporting offspring.~~

~~[17] To attain sufficient sample mass, composite samples comprising different herbaceous plant species or different soil invertebrate species collected at a particular sampling location were constructed and analyzed for COPECs.~~

~~Site-specific bioaccumulation models were selected based on an understanding of biological processes and statistical "best fit" to the empirical data. Selected models were not "forced" through the origin and, hence, best represented tissue burdens over the range of environmental concentrations observed within the Site. Investigations suggest that "best fit" regression models are preferred over point-estimate BAFs as they do not *a priori* presume a monotonic relationship~~.

For bioaccumulative COPECs that were not analyzed in ERM 2018a, (hexachlorobutadiene and pentachlorobenzene), tissue burdens were estimated using bioaccumulation models from standard~~, well-recognized~~literature sources (USEPA 1999). Although use of non-site-specific models may result in less accurate predictions of tissue concentration, ~~Despite the fact that these models were developed based on abiotic and biotic media that are not characteristic of conditions or habitats observed in the Site~~, these particular COPECs ~~(hexachlorobutadiene and pentachlorobenzene)~~ are not ~~considered to be~~ primary risk drivers at the Site. Hence, whether and/or the degree to which these bioaccumulation models are reasonable predictors of bioaccumulation for representative prey within the Site is likely to have a negligible influence on the estimate of potential risk to biota.

Commented [EPA4]: Move this paragraph to follow the discussion of the limits in the TEQ models for brine flies.

~~*Toxicity Equivalency Models for Brine Fly*~~

~~The u~~Uptake models for Avian TEQ and Mammalian TEQ into brine flies were used to predict concentrations of TEQ in ~~invertebrate prey items (i.e.,~~ brine flies and brine shrimp~~)~~ in the diet of the snowy plover, American avocet, tree swallow (lakebed habitat only), and grasshopper mouse (lakebed habitat only). ~~There are some specific uncertainties with the Avian TEQ and Mammalian TEQ uptake models in brine flies that are associated with the uptake models and the samples used to develop the models.~~

Based on the data available, no clear relation between the concentration of TEQ is solids and in tissue could be detected. Consequently, the concentration in tissues is modeled as a constant (i.e., is independent of the level in the environment). The basis for this unexpected result is not known, but is likely because~~The bioaccumulation models for Avian TEQ and Mammalian TEQ in brine flies are based on a constant because none of the brine fly models were significantly different from the null models for Avian and Mammalian TEQ (ERM 2018a). The use of a constant to predict concentrations of brine flies assumes that the uptake into the tissue is not dependent on the concentration in sediment and occurs at a constant rate. However, for brine fly samples collected for the model, there~~

was high variability in the brine fly tissue concentrations when sediment concentrations were the highest. For example, the tissue sample with the highest concentration of the dataset and the tissue sample with the lowest concentration of the dataset were both co-located with high sediment concentrations.

Given this variability in tissue concentrations, it is possible that the brine flies in these samples either accumulated the TEQ concentrations from an area outside the collection area or there was high-concentration soil/sediment on the exterior of the brine flies (not accumulated in the tissue). For example, bBrine flies collected around the waste ponds (PRIs 5 and 6) were likelypotentially blown in from another location than the collection areas since the acidity of the wastewater would preclude the brine flies from hatching in that area. As such, it is possible that brine flies did not accumulate TEQ body burdens from the waste ponds, and that the brine flies with high tissue concentrations of TEQ accumulated dust on the dermis while in the collection area. That dust would have contributed to the TEQ concentrations measured in the laboratory, potentially overestimating body burden concentrations and uptake.

Commented [EPA5]: This is not logical. If the TEQ is inside or on the outside the organism, if it comes from the same location as where they were collected, then there should be a correlation.on

The use of a these models to predict constant based on high variability in tissue concentrations is presents a significant source of uncertainty in the modeled concentrations of brine flies and brine shrimp which comprise the diets of insectivorous birds and mammals, most likely tending to overestimate exposure at locations with low TEQ and to underestimate exposure in locations with high TEQ.. This results in uncertainty in the HQ values calculated for insectivorous birds and mammals in the lakebed habitat.

7.1.1.5 Avian Toxicity Equivalency Concentrations

The Avian TEQ concentrations were calculated using concentrations for D/F congeners and coplanar PCBs; the Avian TEQ concentrations also included HCB (described in Section **Error! Hyperlink reference not valid.** The constituents in the TEQ calculation can be referred to as DLCs, since the mode of toxicity is similar to TCDD. TEFs express the toxicity of DLCs in relation to the potency of TCDD, which is thought to be the most toxic form of DLCs. However, there are a number of *in vitro* and *in vivo* Recent studies on birds in recent years that have shown there are significant interspecies and inter-individual variations in TCDD sensitivities and in the relative potencies of other DLCs to TCDD. This variation of responses to DLCs presents significant challenges and uncertainties in estimating the appropriate TEQtoxic concentration for each avian receptor as well as the appropriate TRV to estimate effects. Uncertainties in the calculation of Avian TEQ exposure are presented in this section, and uncertainties related to TEQ TRVs presented in Section 7.1.2.1.

Interspecies Differences in TCDD Sensitivity

Toxicity of DLCs is associated with concentration-dependent induction of cytochrome P4501A (CYP1A) enzymes. The CYP1A induction has been linked to the sequence of the ligand-binding domain of the AhR and its ability to bind DLCs and initiate changes in gene expression. *In vitro* studies on avian species indicate there are varying degrees of sensitivity to TCDD, which are dependent on the species' amino acid sequence of the AhR (Head et al. 2008; Farmahin et al. 2013b). In other words, the sequence of the AhR ligand-binding domain influences the between-species relative sensitivity to TCDD (Herve et al. 2010a; Farmahin et al. 2013b; Wei et al. 2016).

There are three variations of the amino acid sequences that correlate with three categories of differential sensitivity among avian species. Based on the available evidence, the domestic chicken (*Gallus gallus domesticus*) is the most sensitive species to the toxic effects of DLCs, and is considered a Category 1 species. The rank order of sensitivity to TCDD is Category 1 > Category 2 > Category 3. Phylogenetic relationships among species do not always correspond to sensitivity

classifications or AhR genotypes, which makes predictions on a species' sensitivity level very challenging if the species' AhR ligand-binding domain has not been sequenced (Farmahin et al. 2013b).

A recent study by Bianchini and Morrissey (2020) suggests that differences in avian diet, habitat, and migration may have influenced avian exposure to naturally occurring DLCs, which in turn became the primary factor contributing to the evolution of the three variations of amino acid sequences of the AhR. Using species traits, phylogeny, and the AhR sequence, Bianchini and Morrissey (2020) found the strongest predictors of the sequence (which determines TCDD sensitivity) are egg incubation period and habitat type. Birds with longer incubation times and those that reside in lake/pond and marsh habitats tend to be in Category 3, which is the least sensitive to TCDD. The most sensitive to TCDD, which are birds in Category 1, were associated with open woodland and scrub habitats, shorter fledge periods, lower testes masses (due to lower sexual competition), and use inland migration routes or were non- migratory. Phylogeny was not found to be a strong predictor of any of the categories (Bianchini and Morrissey 2020).

Commented [EPA6]: Repeating the detailed technical basis of category assignment is not uncertainty analysis. Replace the top 3 paragraphs with the following:

Recent studies have shown that the variability in avian sensitivity to TCDD is due to differences in the amino acid sequence of the ArR receptor protein (Head et al. 2008; Herve et al. 2010a, Farmahin et al. 2013b, Wei et al. 2016). Farmahin et al (2013b) sequenced the AhR sequence for 89 different bird species, and found that there were three categories of receptor: Category 1 (most sensitive), Category 2 (intermediate sensitivity), and Category 3 (least sensitive).

The ligand-binding domain was sequenced and presented in Farmahin et al. 2013b for three of the avian representative receptor species in this BERA. The tree swallow and mourning dove were found to be Category 2 species and the American kestrel was found to be a Category 3 species (Farmahin et al. 2013b). The other avian receptors (snowy plover, American avocet, and horned lark) have not been sequenced. However, whether or not the sensitivity category for the indicator species at the Site is known, these species are intended to serve as indicators for all of the other species in each of the feeding guilds they represent, and there is no certainty that all members of a feeding guild will be in the same category.~~sensitivity categories are not known for most of the avian species that utilize the Site~~. It is for this reason that HQ values have been calculated for each sensitivity category for each indicator species. However, the data of Farmahin et al. (2013b) along with an~~the~~ analysis by Bianchini and Morrissey (2020), indicate that most birds are likely to be Category 2 or Category 3, and that Category 1 birds are not likely to be common. For example, of the 89 species evaluated by ~~based on the amino acid sequencing results in~~ Farmahin et al. (2013b), only 4.5 percent ~~of the 89 species sequenced~~ were found to be in Category 1, with 55% in Category 2 and 40% in Category 3. ~~Those four species were red jungle fowl (*Gallus gallus*), European starling (*Sturnus vulgaris*), gray catbird (*Dumetella carolinensis*), and ruby-throated hummingbird (*Archilochus colubris*). Most species in the dataset (55 percent) were found to be in Category 2. Thirty-six of the 89 species (40 percent) were found to be in Category 3 (Farmahin et al. 2013b)~~. Based on this, ~~information, it is considered likely that upland habitat at the Site have Category 2 species, and that lakebed habitat is likely to have mainly Category 2 and 3 species.~~ HQ results based on an assumption of Category 1 sensitivity may not be applicable to a majority of species and feeding guilds at the Site. However, the occurrence of occasional Category 1 species cannot be excluded.

Interspecies Differences in Relative Potency of Dioxin-like Compounds

The Avian TEQ concentrations were calculated using TEFs for D/F and coplanar PCBs based on Van den Berg et al. (1998), and using TEFs for HCB based on Mundy et al. (2012). The avian TEFs from Van den Berg et al. (1998) were adopted by the World Health Organization and were based on the assumption that the TEF assigned to each DLC is the same for all species within a vertebrate class and the most potent constituent is TCDD. However, the avian TEFs were derived with relative potency (ReP) values (i.e., the potency of the DLC relative to TCDD) that were based on a small number of studies on the chicken.

More recent studies indicate that the ReP values of some DLCs vary among avian species (Herve et al. 2010a, 2010b; Farmahin et al. 2012; Manning et al. 2012; Farmahin et al. 2013a, 2013b; Manning

et al. 2013; Zhang et al. 2013). Interspecies variation of relative potency values for DLCs appears to be attributable to differences in the AhR amino acid sequence. For the chicken AhR sequence, ReP values of all DLCs were less than that for TCDD, meaning TCDD was the most toxic DLC, which is consistent with the TEFs developed by Van den Berg et al. (1998). For the Japanese quail AhR sequence (Category 3 species), except for octachlorodibenzodioxin (OCDD) and octachlorodibenzofuran (OCDF), ReP values of other DLCs were greater than that of TCDD, with values 1-fold to 22-fold greater than that of TCDD (Wei et al. 2016). Study data available for 2,3,4,7,8-pentachlorodibenzofuran (PeCDF) suggest that between-species relative sensitivity to PeCDF differs from TCDD/2,3,7,8-Tetrachlorodibenzofuran (TCDF) (Cohen-Barnhouse et al. 2011). Farmahin et al. (2014) found that PeCDF and TCDD bind with equal affinity to chicken AhR, but PeCDF binds with greater affinity than TCDD to pheasant (3-fold) and Japanese quail (5-fold) AhR.

Since there are no studies reporting the species-specific TEFs for all of the avian receptors in the Site, TEFs were based on the historically used values for D/F and coplanar PCBs from Van den Berg et al. (1998). Thus, it is possible that the TEFs used to calculate the TEQ dose are not accurately estimating the contribution of the various DLCs to the overall TEQ concentration. However, the TEF for OCDF (i.e., the relative potency) was found to be an order of magnitude larger for the pheasant and the Japanese quail compared to the chicken (Wei et al. 2016). This suggests that the OCDD TEF from Van den Berg et al. (1998) is potentially underestimating the contribution of OCDF to the overall TEQ concentration for birds in Category 2 and Category 3.

The TEF for HCB also appears to vary among species according to the amino acid sequence of the AhR. Mundy et al. (2012) tested 7-ethoxyresorufin-O-deethylase (EROD) and CYP1A induction (markers of a dioxin-like response) by HCB in avian hepatocyte cultures from chicken, ring-necked pheasant, and Japanese quail (Category 1, Category 2, and Category 3 species, respectively) and compared it to CYP1A induction by TCDD. The author found that HCB induced a relatively similar dioxin-like response in each species, but the relative potency to TCDD was different among species due to the species' differential sensitivity to TCDD. Mundy et al. (2012) found HCB to have the highest relative potency (i.e., HCB TEF) in the Category 3 bird species since this category is the least sensitive to TCDD, which in turn results in HCB contributing a larger fraction of the overall TEQ concentration (Category 3 HCB TEF = 0.01). HCB contributed less to the TEQ concentration in the ring-necked pheasant than in the Japanese quail since the Category 2 bird species is more sensitive to TCDD (Category 2 HCB TEF = 0.001). The chicken, a Category 1 bird species, is the most sensitive to TCDD, thus the HCB contributed the least amount to the TEQ concentration (Category 1 HCB TEF = 0.0001).

While other studies have established the concept of using relative potencies of DLCs in avian embryo hepatocytes to predict the *in ovo* response in birds (Kennedy et al. 1996; Head and Kennedy 2010), these studies have not been conducted using HCB. It is likely that this concept applies to HCB as well, but the lack of direct evidence presents a level of uncertainty in the HCB TEFs derived from avian embryo hepatocytes. Further studies using egg injection or other *in vivo* methods would decrease this uncertainty.

Inter-individual Variation of AhR Response

A recent study has shown that the cytochrome P4501A response to TCDD can also vary among an individual test species, where herring gull embryo hepatocytes ranged from no response above baseline values to as much as 57-fold above baseline levels (Head and Kennedy 2019). This inter-individual variation is an additional uncertainty that complicates the estimates of dioxin sensitivity in birds. It is unknown if this uncertainty results in underestimation or overestimation of risk for each receptor.

7.1.1.6 Intermittent Longer-term Dose Estimation

As described in Section 2.3.2, the intermittent longer-term dose estimation was developed to evaluate potential hazards of probing birds attempting to forage in the acidic waste ponds (PRIs 5, 6, and 7) repeatedly over several months. Since there are no data on how often an individual bird may return to an acidic waste pond at the Site, the hazard was characterized by calculating the dose from one Site visit per month.

One major source of uncertainty in this calculation is the estimation of sediment ingestion. Typically, sediment ingestion rates used in dose estimations are based on the amount of sediment that a bird will ingest while it is foraging for food. It is assumed that a bird will forage longer when there is a food source near/in the sediment, which, in turn, results in a higher sediment ingestion. Thus, it is also likely that a bird is ingesting less sediment when there is no food source, as in the acidic waste ponds. However, the sediment ingestion rate that is currently being used to estimate the dose is based on birds that are in an optimal habitat (Beyer et al. 1994). It is highly likely that the amount of sediment the probing birds are ingesting while foraging in the waste ponds is overestimated using the sediment ingestion rate from Beyer et al. (1994).

Additionally, as discussed in Section 2.3.2, the AHUF used in this evaluation is based on the study by BIO-Logic (2002, 2003), which estimated a mean exposure for American avocets of only 6 hours per month (AHUF = 0.033), which is a very conservative estimate as it is based on all individuals, not per individual. An AHUF based on individual American avocets would be 0.0033, since BIO-Logic based their estimation on 10 individual birds. Additionally, the AHUF is based solely on American avocets since BIO- Logic did not observe any other species in the waste water for more than 1 minute per month. Given the overly conservative nature of the AHUF and the low relevance to the snowy plover, the HQs presented in Table 3-5 are likely substantially overestimated.

Commented [EPA7]: Depending on AHUF discussion, this section can be deleted. No special paragraph needed if we discuss repeated acute exposures qualitatively.

Intermittent Longer-Term Hazard Quotient Results Using a 95UCL EPC

As discussed in Section 2.3.2, the SWAC was selected as the sediment EPC for this evaluation, as opposed to the 95UCL, because an area-weighted concentration is less influenced by high-concentration outliers that are located in relatively small foraging areas of the waste ponds. However, the intermittent longer-term exposure was also evaluated by estimating the dose using the 95UCL EPC for sediment, mainly to provide results that are consistent with the methodology for other area-wide evaluations. These results are considered to be highly conservative due to the high-concentration outliers (e.g., sample 1-11 in PRI 5) that heavily influenced the 95UCL, as well as the overly conservative AHUF and low relevance to the snowy plover (as discussed above). The results of this analysis are shown in Table 7-2.

Commented [EPA8]: Same as above

7.1.1.7 Scenarios Not Evaluated

Inhalation and dermal contact by wildlife were considered negligible exposure pathways and were not quantitatively evaluated in this BERA.

Inhalation Pathway

The inhalation pathway was considered negligible for wildlife. VOC vapors are rapidly dispersed in aboveground air following volatilization from soil or surface water and are considered to result in very low EPCs of VOCs in aboveground air (USEPA 1998). Further, though fugitive dust is assumed to be inhaled, the majority of inhaled fugitive dust adheres to mucous and the mucous is subsequently swallowed (therefore, it is accounted for in the incidental ingestion of soil pathway). Hence, while potentially complete, inhalation exposures are considered an insignificant exposure pathway or are

already accounted for in exposure assessments for wildlife (USEPA 2005b).

The omission of quantitative evaluations of exposure due to inhalation may result in underestimates of potential risk; however, this omission is considered unlikely to significantly impact the overall findings of this evaluation as it pertains to AEs of this BERA.

Dermal Contact Pathway

Dermal absorption by wildlife is considered to be a negligible exposure pathway relative to ingestion of food and incidental ingestion of soil because:

- Dense undercoats or down are likely to effectively limit contact of contaminants with the skin of wildlife species and significantly reduce the total surface area of exposed skin (Peterle 1991); and
- Results of exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (USEPA 2005b; Peterle 1991).

The omission of quantitative evaluations of exposure due to dermal contact may result in underestimates of potential risk; however, this omission is considered unlikely to significantly impact the overall findings as it pertains to AEs of this BERA.

7.1.2 Effects-Related Uncertainties

Sources of uncertainty related to characterization of effects in this BERA are discussed below.

7.1.2.1 General Uncertainties of Relevant Benchmarks and Toxicity Reference Values

In general, there are a number of uncertainties inherent in the derivation and application of benchmarks and TRVs used in ERAs. These general uncertainties and described in this section, while specific uncertainties associated with the specific benchmarks and/or TRVs used in this BERA are discussed in Section 7.1.2.2.

Use of NOAELs as Chronic NOAEL-Equivalent Benchmarks

By definition, the NOAEL is the highest dose where no effect was observed in a toxicological study. Hence, the reported NOAEL may be affected by several study design factors (independent of the toxicity), including, but not limited to, the sensitivity of a method to observe (detect) an effect and the scale and finite precision of the serial dosing regimen.

Given the study design, the “actual” no-effect concentration can occur anywhere within the “flat” portion of the “no-effect” range. Therefore, NOAELs reported in toxicity studies commonly underestimate the “actual” no-effect concentration (the threshold). Because of this, exceedance of a NOAEL-based benchmark should not be interpreted as proof that an adverse effect is likely. For example, USEPA (2005b) considers chronic NOAELs to generally be about 10 times more sensitive than LOAELs. Thus, use of NOAELs as chronic benchmarks provides a substantially greater level of protection than the use of LOAELs.

Species-to-Species Extrapolations

A source of uncertainty in the BERA is the lack of applicable wildlife species-specific toxicity data. Because of this data limitation, TRVs were developed using available toxicity data for laboratory test species. For example, TRVs for the kangaroo rat were developed from toxicity data for laboratory mice and rats.

Species vary with respect to sensitivity to specific chemicals (Calabrese and Baldwin 1993). Based on reviews of the lethality data, the range of sensitivity for avian species were typically within a factor of 10 (Chapman et al. 2009; Calabrese and Baldwin 1993). Based on reviews of the subchronic and chronic dietary toxicity data, the range of sublethal toxicity sensitivities for mammal and bird species were typically within a factor of 50 (Chapman et al. 2009; Calabrese and Baldwin 1993). Chapman et al. (2009) suspected that the variability in sublethal studies was greater than lethality studies because:

- Lethality studies were conducted following standardized protocols, whereas the chronic studies were variable in design; and
- Lethality studies measured only mortality, whereas the sublethal studies measured different reproductive, developmental, and other nonlethal endpoints (e.g., clutch or litter size, number of fledglings or weanlings, growth rate, change in organ weight, presence of stress indicators).

Although a range in sensitivity may be described, the relative sensitivity (and the "direction" of sensitivity) to COPEC exposures by representative species and wildlife species observed in the Site as compared to laboratory test species is not known.

Since chemical sensitivity may vary between different ecological species, the use of a single TRV for all species in a group (mammals, birds, plants) is a potential source of uncertainty. For this reason, TRVs used in this assessment were selected from the low end of the range of values identified in the literature, and this tends to minimize the potential for underestimation of potential adverse effects.

Laboratory-to-Field Toxicity Extrapolations

A number of studies (primarily for aquatic systems) have evaluated the ability of single-chemical laboratory toxicity test results to predict adverse effects of that chemical on organisms under field conditions. Preliminary chemical contaminant studies suggest that laboratory toxicity tests represent more conservative exposure scenarios than those that occur in nature (USEPA 1991). ~~Furthermore, concentrations of chemicals causing no effect in laboratory tests also do not appear to affect communities in the field.~~ Thus, chronic ~~NOAEL-equivalent~~ benchmarks based on laboratory-based toxicity studies are likely to provide a conservative level of protection to plant and wildlife communities and populations observed in the field.

Commented [EPA9]: Praising the use of NOAELs for decision-making is not helpful, since all of the risk evaluations in this document are based on LOAEL exceedances.

Organism-to-Population Level Effect Extrapolations

The individual organism is the smallest biological "unit" that interacts directly with the environment (Suter 1992). Toxicity data selected to derive benchmarks and TRVs are from studies that evaluate potential reproductive and developmental effects on organisms. Chronic reproductive impairment and abnormal development toxicity values were then used to infer effects at the population and community level; if effects are not anticipated at the organism level, effects are not expected at the population or community level either. However, the reverse is not necessarily true, as effects may occur at the organism level that do not manifest as measurable effects at the population or community level. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Therefore, the increasing robustness with increasing biological organization would suggest that inferences from toxic effects on organisms should provide a greater level of protection to populations and communities (Suter 1992).

7.1.2.2 Uncertainties of Specific Benchmarks and Toxicity Reference Values

General uncertainties associated with the derivation of ecotoxicological benchmarks and TRVs are described in Section 7.1.2.1. Notable uncertainties in the derivation and/or application of specific benchmarks and TRVs used in this assessment are described below.

Unbounded NOAEL Effects Levels

Some of the HQ evaluations for invertebrates and plants in this BERA were based on an unbounded ~~effect levels, meaning there was only a~~ NOAEL-equivalent ~~or a LOAEL~~-equivalent benchmark that was not paired with a corresponding LOAEL benchmark. In these cases, evaluation of hazard from the HQ approach is uncertain, since exceedances of a NOAEL HQ of 1 may not be strong evidence of risk. ~~(not both) for characterizing potential adverse effects. The margin between the two benchmark values can be broad and evaluating the potential for adverse effects solely based on an unbounded NOAEL-equivalent benchmark can lead to overly conservative assumptions. In other words, in cases where only an unbounded NOAEL-equivalent benchmark is exceeded, there is uncertainty as to whether the EPC is greater than the measurable adverse effects level (i.e., the LOAEL). Conversely, if an unbounded NOAEL benchmark is not exceeded, there is high certainty that a threshold for measurable adverse effects has not been reached.~~ Unbounded NOAEL benchmarks resulted in HQs greater than 1 in the following receptors and COPECs.

- **Aquatic biota** – Many benchmarks for aquatic biota are unbounded NOAEL-equivalent benchmarks (see Table 2-23 for specific COPECs with unbounded NOAEL-equivalent benchmarks). Across PRIs 7, 8, and 14, and the SVDD, HQs above 1 occur for the following COPECs based on unbounded NOAELs: aluminum, iron, and total PCBs.
- **Benthic invertebrates** – COPECs with unbounded NOAEL-equivalent benchmarks have HQs greater than 1 in PRIs 7, 8, and 14, the SVDD, and the GSLIC. Barium (in PRI 8) is consistent with background levels, HCB and pentachlorobenzene have an HQ above 1 for a single sampling location in PRI 7. Carbon disulfide has HQs above 1 in four sampling locations of PRI 7, all falling below an HQ of 10. Phenol has sampling locations with HQs that fall below 10 solely in PRI 14.
- **Soil invertebrates** – The only COPEC with unbounded NOAEL HQs greater than 1 is barium. For barium, only one sampling location in each of PRIs 8 and 10 have NOAEL HQs above 1 (2 and 3, respectively).

~~COPECs with unbounded NOAEL-equivalent benchmarks have HQs greater than 1 for aquatic biota and benthic invertebrates. For benthic invertebrates, the overly conservative nature of these benchmarks produce moderate to high magnitude HQs (greater than 10) for only barium; all other COPECs with unbounded NOAEL-equivalent benchmarks either have no HQs greater than 1, or HQs of 10 or less~~.

Given the limited frequency and magnitude~~spatial occurrence~~ of unbounded NOAEL-equivalent HQs greater than 1, ~~as well as most being low-magnitude HQs,~~ the use of these unbounded NOAEL-equivalent benchmarks does not substantially influence the confidence in the risk findings for benthic invertebrates. There is, however, uncertainty regarding risk findings for risks to aquatic biota from ~~, as~~ PCBs, aluminum, and iron. ~~many COPECs for the receptor type have unbounded NOAEL-equivalent benchmarks~~ (see Figures 6-3a, 6-3b, and 6-3i). Because most LOAEL values are about 10-fold or more higher that the corresponding NOAEL values (see Figure 6-3), NOAEL-HQ values of 10 or less are judged to be of relatively low concern (e.g., PCBs). However, some higher NOAEL-HQ values occur for aluminum and iron, and these could be of concern. However, water quality parameters such as high hardness often tend to reduce the toxicity of dissolved metals (see below), so the actual hazard to aquatic receptors from these COPECs remains uncertain.~~Table 2-23). As the benchmarks are based on concentrations that elicit no adverse effects or only elicit adverse effects in a small~~

~~proportion of species (e.g., a 5th or 10th percentile of a species sensitivity distribution) and it is unknown what concentration would elicit measurable adverse effects in a substantial portion of organisms and/or species, the risk narrative for aquatic biota at the Site is likely overly conservative and may report the possibility of adverse effects from COPECs that are not harmful to the aquatic biota.~~

Direct Contact Benchmarks for Aquatic Biota and Benthic Invertebrates in Hypersaline Waters

Due to the limited availability of toxicity literature for hypersaline environments, there is uncertainty regarding the appropriateness of the selected benchmarks. Freshwater and saltwater benchmarks were evaluated to establish appropriate surface water and sediment direct contact benchmarks. The uncertainty of this approach is due to the nature of the test species and the potential for hypersaline conditions to modulate COPEC bioavailability.

The test species used to derive the freshwater benchmarks would not occur in the saline waters present at the Site. Similarly, most of the test species used to derive the saltwater benchmarks, typically present in marine or estuarine environments, would not occur in the hypersaline waters at the Site. It could not be stated whether either benchmark would be over- or under-protective of the species present at the Site. As there was uncertainty regarding which benchmark would be more representative of the Site, the more conservative of the two values was selected for use in the BERA. This is likely to overestimate the potential for adverse effects in the HQs LOE.

The dissolved solids that represent salinity and hardness, such as calcium, magnesium, and sodium ions, are known to modulate bioavailability of constituents by altering the degree of sorption, ligand binding on membranes, and the formation of precipitates; USEPA's NAWQC account for this modulation by the use of hardness-adjusted equations or the Biotic Ligand Model (USEPA 2013b). The NAWQC do not allow for hardness inputs outside the empirical range of data for which they were derived; minimum and maximum hardness values are 25 and 400 mg/L as calcium carbonate for most metals with hardness-dependent equations (USEPA 1996). Calculated hardness values for surface water samples at the Site range from 1,100 to 489,000 mg/L as calcium carbonate, substantially higher than the maximum allowed hardness input for freshwater NAWQC. The degree to which hypersaline conditions, as compared to freshwater or saltwater conditions, may modify bioavailability is not well studied.

Seawater is generally 35 ppt saline and freshwater is considered to be less than 10 ppt (USGS 2018). Salinity in the GSL varies spatially, temporally, and across depth strata, and is dependent on freshwater inputs and lake elevation (Utah DWQ 2014). In 2011 and 2012, the following average salinities were measured in the GSL in the shallow oxygenated surface layer where brine flies and brine shrimp live: 125 ppt (Gilbert Bay), 41 ppt (Farmington Bay), and 10 to 50 ppt (Bear River Bay) (Utah DWQ 2014). Water quality monitoring data from the United States Geological Survey National Water Information System database indicates that nearly all salinity measurements from 2011 through 2019 in the GSL are greater than 80 ppt ranging up to approximately 225 ppt, with only a handful of samples measuring salinities as low as 1 to 5 ppt (Utah DWQ 2019).

Measured salinities at the Site vary by exposure unit (see Section 2.2.1.3). All Site samples are more saline than freshwater, and nearly all samples are also more saline than seawater. Site salinity shows a similar high variability and range compared to the GSL, though a few samples are higher than the maximum measured salinity at the GSL between 2011 and 2019 (Utah DWQ 2019). From this comparison, it is clear that neither freshwater nor saltwater benchmarks are optimal for the hypersaline conditions at the GSL and the Site, and both may be substantially overprotective for COPECs with decreased bioavailability in saline conditions. The use of the lower of the freshwater and saltwater benchmarks to calculate HQs is likely to overestimate the potential for adverse effects from the HQs

LOE.

Since it is unclear if the benchmarks for aquatic biota and benthic invertebrates are relevant and if the surface water concentrations are consistent with background levels, additional research was done to identify (1) how the benchmark was derived, (2) more relevant toxicity and/or bioavailability data, particularly for brine shrimp and hypersaline water, and (3) approximate background levels of COPECs in GSL surface water. This additional information was used to reduce uncertainties for COPECs with an HQ above 1 and is discussed below:

- **Aluminum benchmark for aquatic biota** – The freshwater aluminum NAWQC adjusts for Site-specific bioavailability using inputs for water quality parameters (pH, dissolved organic carbon [DOC], and hardness) (USEPA 2013b). Dissolved aluminum and calcium cations compete for uptake; increasing hardness is observed to decrease aluminum toxicity in daphnids and fish, though this effect is lessened at higher pH (USEPA 2013b). Site-specific aluminum benchmarks using the NAWQC cannot be calculated due to a lack of measured DOC. However, there is uncertainty around the true toxicity thresholds for aluminum because of the extremely hard surface water conditions at the Site that are not appropriately accounted for in the available benchmarks. In addition, aluminum concentrations in measured surface water samples are highly variable even within the same sample locations (see Figure 7-1). Thus, while potential toxicity due to aluminum in surface water cannot be ruled out, there is a high degree of uncertainty in the results of the aquatic biota HQs LOE for aluminum.
- **Chlorine benchmark for aquatic biota** – The NAWQC benchmark for chlorine is based on the 1986 NAWQC report, which necessarily rejects any data obtained using brine shrimp as the saltwater benchmarks are not calculated for waters with salinity greater than 35 grams per kilogram, which brine shrimp would be found in. Therefore, the benchmark used to estimate risk to aquatic biota to chlorine is specifically not intended for use in hypersaline waters.
- **Iron benchmark for aquatic biota** – Iron concentrations in measured Site surface water samples are highly variable, ranging from ND to concentrations above the expected solubility of iron in seawater (Liu and Millero 2002). Measured concentrations of dissolved iron may overestimate the true amount of dissolved iron, as standard filtration methods do not adequately remove iron colloids (Church et al. 1997). Thus, there is a high degree of uncertainty in the iron results for the aquatic biota HQs LOE.
- **Total PCBs benchmark for aquatic biota** – As a chemical class, PCBs have low solubility and thus partition to the organic portion of solids, such as sediments and water column particulates and colloids (Erickson 2001). Therefore, it is uncertain how much of the measured PCBs in Site surface water may actually be bioavailable to aquatic biota.
- **Carbon disulfide and phenol benchmarks for benthic invertebrates** – These benchmarks are derived using data from USEPA's AQUIRE (AQUatic toxicity Information REtrieval) database, which could not be accessed for a complete assessment of its relevance. Significant uncertainty though still remains as they are based off benchmarks for freshwaters of the Great Lakes, which are converted to a sediment ecological screening level by use of the equilibrium partitioning equation that incorporates the soil adsorption coefficient.

Egg Tissue Benchmark

The egg tissue benchmark for total PCBs is based on a 20 percent effect concentration (EC20) for cardiomyopathy in chicken embryos exposed to a PCB mixture (Carro et al. 2013). A large degree of uncertainty in this benchmark is due the PCB mixture and the test species used in this study. The PCB mixture used in the Carro et al. (2013) study was formulated to mimic the relative concentrations

of primary PCB congeners measured in sandpiper eggs collected at the upper Hudson River, New York. However, this mixture is very different from the composition and relative abundance of PCB congeners found at the Site, which is largely dominated by PCB 209, the decachlorobiphenyl (Figure 7-2). In addition, the PCB mixture at the Site is not similar to any of the Aroclor mixtures, which are typically used in avian reproductive toxicity studies (Peakall et al. 1972; Britton and Huston 1973; Gould et al. 1997).

PCB 209 is a non-coplanar PCB congener, which does not bind with the AhR, thus does not exhibit dioxin-like toxic effects. Some studies have suggested that non-coplanar PCBs can have neurotoxic and/or endocrine effects in mammals (Fischer et al. 1998). However, to date, the one study that has evaluated PCB 209 individually has demonstrated that PCB 209 did not exhibit genotoxic or endocrine-modulating effects in mammalian cells (Han et al. 2009). No studies were identified on PCB 209 toxicity in birds.

Previous research has also established that the test species used in the Carro et al. (2013) study, the chicken, is highly sensitive to PCB exposures, in terms of cytochrome P450 induction (Kennedy et al. 1996). In fact, Carro et al. (2013) reported that the concentrations of the PCB mixture in the study were 10 to 100 times lower than those in wild bird populations, but lethal and nonlethal effects were discernable in the chicken at these lower concentrations because it is such a highly sensitive species.

There is a large degree of uncertainty in the relevance of the total PCB egg tissue benchmark given that: (1) the PCB mixture at the Site is very different from the mixture used in the Carro et al. (2013) study and is largely dominated by a nontoxic, non-coplanar PCB congener, and (2) the benchmark is based on a highly sensitive test species that is not found at the Site. Therefore, HQ results using this benchmark should be interpreted as uncertain and likely overestimated.

Terrestrial Plants Tissue Benchmark

There were no tissue residue toxicity studies on terrestrial plant species exposed to PCBs. Therefore, the total PCB tissue residue benchmark was developed using data from an aquatic plant species (green algae). Using this total PCB benchmark, none of the modeled tissue concentrations at soil sample locations throughout the Site had an HQ greater than 1. The use of an aquatic plant species to evaluate potential adverse effects in terrestrial plant species is an uncertainty in this assessment. However, since the assessment using the direct contact total PCB benchmark for plants also resulted in no HQs greater than 1, the tissue residue benchmark for total PCBs is not a significant source of uncertainty in the assessment of plants.

Soil Invertebrate Tissue Benchmarks

When tissue-based benchmarks for soil invertebrates were not available, benchmarks for aquatic emergent insects, if available, were used to evaluate modeled soil invertebrate tissue. The use of aquatic invertebrate tissue data for estimating tissue-based benchmarks in soil invertebrates is an uncertainty in this BERA. However, the tissue benchmarks that are based on emergent insects (total PCBs, arsenic, cadmium, chromium, copper, mercury, selenium, and zinc) are from toxicity studies on early life stages, which are typically more sensitive than later life stages (when they are considered terrestrial). Since it is likely that these benchmarks are based on a more sensitive life stage, the use of the emergent insect tissue-based benchmarks to evaluate modeled tissue for soil invertebrates is not a significant source of uncertainty in the findings of the BERA.

Avian Toxicity Reference Values

The avian TRVs for Avian TEQ Category 1 and Avian TEQ Category 3 were derived by applying a relative sensitivity ratio to the TRV for Avian TEQ Category 2, as described in Section 2.4.1.2. The TEQ Category 1 and Category 3 TRVs were extrapolated because there are limited data on dietary effects of TEQ in birds, and the data are limited to a Category 2 species, the ring-necked pheasant. Therefore, relative sensitivity ratios were developed from egg injection studies on the chicken (a Category 1 species) and the Japanese quail (a Category 3 species). However, as shown in Table C-7 in Appendix C, the study results were variable within each species, which has been shown in other studies as detailed in Section 7.1.1.5. Thus, the relative sensitivity ratios were based on a geomean of variable study results. Given the variability of study results even among the same test species, it is likely that the relative sensitivities of bird species at the Site are different from the relative sensitivities calculated from a geomean of study results. Accordingly, there is an uncertainty in the avian TRVs for Avian TEQ Category 1 and Avian TEQ Category 3. See Section 7.1.1.5 for a full discussion on uncertainties associated with Avian TEQ.

In addition to the uncertainty in extrapolating from TEQ Category 2 to TEQ Categories 1 and 3, the toxicity study used to derive the Avian TEQ TRV, which is used to calculate dietary dose HQs, is conservatively overestimating the bioavailable dose to birds at the Site. The TRV is selected from a reliable study by Nosek et al. (1992a) on ring-necked pheasants; however, the dose administration method of intraperitoneal injection lacks relevance to oral ingestion by wild birds. Intraperitoneal injection bypasses the gut and does not account for differences in bioavailability when the COPEC is bound to food or solids. A companion study by Nosek et al. (1992b) found that oral bioavailability of TCDD in ring- necked pheasants varied with the food or solid substrate, ranging from 30 to 58 percent bioavailable. Thus, HQs above 1 for avian TEQ likely overestimate the potential for adverse effects.

The avian TRVs for total PCBs are based on reproductive effects in mourning doves fed Aroclor 1254 (Tori and Peterle 1983). Similar to the egg tissue benchmark discussed above, the PCB congeners used in the TRV derivation study have a different composition and relative abundance compared to the PCB mixture at the Site (Figure 7-2). The dominant PCB congener at the Site is a non-coplanar PCB (PCB 209) with no demonstrated effects to date (Han et al. 2009). Therefore, there is a large uncertainty in the avian TRV for total PCBs and HQ results for this analysis are likely overestimated.

7.1.2.3 Uncertain COPECs Not Quantitatively Evaluated

"Uncertain COPECs" were identified in the SLERA as compounds that were either: (1) never detected at the Site and the DL was greater than the RBESL, or (2) there was no RBESL available for comparison. The following sections describe these constituents and discuss the uncertainty of not quantitatively evaluating the constituents in the BERA.

Nondetects with Elevated Detection Limits

Across the PRIs, there are 58 constituents that were not detected in Site samples for a given PRI but that had mean detection limits above their respective RBESLs (Table 7-3). Elevated detection limits occurred for a number of reasons, most associated with ~~including the use of RBESLs derived from back calculations and~~ matrix interference effects. These 58 constituents are not evaluated in this BERA. While this introduces uncertainty due to the potential for adverse effects of unevaluated constituents, the level of potential hazard they might pose is likely to be small compared to the hazards presented from other, well characterized COPECs such as TEQ and HCB.

Commented [EPA10]: What does this mean? If an RBESL is reliable, no matter if it is derived by back calculation, that does not make it a "cause" of a DL above the RBESL. Delete this phrase

Lack of Screening Values

Several constituents screened in the SLERA lack sufficient toxicity data to develop a screening value

in one or more exposure media. Since screening values were not available, these constituents were not evaluated in the BERA with the exception of a select few. Constituents lacking screening values are listed in Table 7-4 -- those constituents that had TRVs developed despite the lack of screening values are also noted. Some of these constituents are never or rarely detected at the majority of the Site or in a specific medium. Table 7-4 also includes Site-wide and media-specific detection frequencies for each constituent, which is used to designate the likelihood of originating from Site-related activities. Constituents with a detection frequency of 0 percent are classified as Unlikely, less than 10 percent as Unknown, and greater than or equal to 10 percent as Plausible. The results are summarized below.

In soil, a total of 33 constituents lack a benchmark:

- One metal (iron) was designated as a COPEC in PRIs where Site concentrations exceeded background levels. As all samples for iron were detects, the likelihood of it being related to Site activities is plausible. As dietary TRVs were developed for birds and mammals, uncertainty associated with lack of TRVs is limited to plants and invertebrates.
- Twenty-two are SVOCs, with three not detected in soil samples from any PRI or media, making them unlikely to be related to Site activity. Five have detection frequencies below 10 percent making the potential Site-related origin unknown. The remaining 14 constituents are plausibly related to Site activity. One of the PAHs (naphthalene) had dietary TRVs developed for birds and mammals.
- Nine are VOCs, which were only sampled for soil in 10 of the 16 PRIs. Two VOCs were designated as unlikely to be related to Site activity, two are unknown, and five are plausibly linked to Site activity; one of these VOCs (m,p-xylene) had dietary TRVs developed for birds and mammals.
- The remaining constituent (perchlorate) was detected in 14 percent of soil/sediment and 74 percent of water samples. Thus, it is plausibly related to Site activity.

In sediment, 39 constituents lack a benchmark:

- Nineteen are VOCs, which were analyzed in sediment in seven of the 16 PRIs. Six VOCs were unlikely related to Site activity, five were unknown, and eight were plausibly linked to Site activity. Of the VOCs detected in at least one PRI, three had dietary wildlife TRVs developed for at least one receptor group (Table 7-4).
- Seventeen are SVOCs, which were sampled for sediment in eight of the 16 PRIs. Eleven SVOCs were unlikely to be related to Site activity, one was unknown and five are plausibly linked to Site activity. Additionally, dietary TRVs were developed for HMW PAHs for both birds and mammals.
- Two metals (beryllium and molybdenum) were designated as a COPEC in PRIs where Site concentrations exceeded background. Based on detection frequencies, the two metals are plausibly linked to Site activity. Beryllium dietary TRVs were developed for mammals, leaving uncertainty associated with a lack of benchmarks/TRVs to birds, plants, and invertebrates. Dietary TRVs for molybdenum were developed for both birds and mammals, as well as direct contact benchmarks for plants. Uncertainty associated with a lack of benchmarks for molybdenum is limited to invertebrates.
- The remaining constituent (perchlorate) was sampled for sediment in eight PRIs and was plausibly linked to Site activity.

In surface water, 46 constituents lack a benchmark/TRV:

Commented [EPA11]: It is likely that iron would be detected in 100% of background samples too, so this logic is pretty weak. The real reason for considering it site-related is that it is higher than bkg. Recommend delete this statement.

Commented [EPA12]: As above, the link between DF and source (site vs non-site) is such that a low DF is not strong evidence it is not site related, and a high DF is not strong evidence it is site related. Better to think about things like "Is it higher than bkg?" and "Is this chemical known or potentially generated in and released by site operations?' In this regard, EPA thinks all chlorinated organics observed in site samples have a good probability of being site related, regardless of DF. In this paragraph and below, use comparison to background and chemical nature as the main way to judge if something might be site related. Probably best not to use DF as a line of logic at all.

- Sixteen are SVOCs, with ten unlikely to be related to Site activity, one unknown, and five plausibly linked to Site activity. Additionally, dietary TRVs were developed for HMW PAHs for both birds and mammals.
- Seventeen are VOCs, with six unlikely to be related to Site activity, five unknown, and six plausibly linked to Site activity. Additionally, two of the VOCs designated as plausible had dietary TRVs developed for mammals.
- Five are HAAs, which are plausibly linked to Site activities, as they are process byproducts.
- Perchlorate was designated as plausible.
- The remaining seven analytes are conventional water quality parameters and anions that are frequently detected, as they are present in GSL water.

Overall, the constituents lacking a benchmark/TRV are present in a limited number of PRIs, and a significant portion are NDs. A majority of the constituents are also VOCs or SVOCs. Absence of toxicity values for these analytes could result in an underestimate of risk. However, given the relatively low detection frequency of these chemicals and that they are generally not bioaccumulative, it is likely these chemicals do not contribute a level of risk that would approach the risks that have been identified for well characterized COPECs. Consequently, they are not considered a significant source of uncertainty in the risk characterization of the Site.

7.1.2.4 Lack of Toxicity Reference Values for Amphibians and Reptiles

Given the hypersaline conditions, amphibians are not observed living in the GSL. In addition, the lack of freshwater aquatic habitat further limits amphibians in the Site. Moreover, consistent with the likely limited occurrence, amphibians are generally considered to play a relatively minor ecological role in arid/playa habitats (Heatwole 1982). Accordingly, a quantitative risk assessment was not conducted for amphibians. ~~The omission of a quantitative evaluation of potential risk for amphibians may result in underestimates of potential overall risk to aquatic community; however, this omission is considered likely to have a negligible effect on overall risk characterizations reported in this BERA~~This is not considered to be a significant source of uncertainty in the overall evaluation of ecological risks at the Site.~~.~~

Quantitative evaluations of potential risk were also not performed for reptiles due to the lack of data on exposure and toxicity. The lack of TRVs for reptiles is considered a data gap in this BERA. However, there is no clear reason to suspect that the level of risk to reptiles~~amphibians~~ would exceed those identified for other ~~aquatic and semi-aquatic~~ receptors that are evaluated. Consequently, this data gap is not likely to be a significant limitation to risk management decision-making at the Site.

7.1.2.5 Threatened and Endangered Species

The American kestrel was used as a surrogate for the golden eagle, which is a special status species that nests in the PRI 16 mountains. ~~In this exposure unit, only TEQ Category 1 NOAEL HQs were greater than 1 only for the horned lark and tree swallow (Section~~ **Error! Hyperlink reference not valid.** ~~and none of the LOAEL-based HQs exceeded 1 for any avian receptor~~. Given that neither NOAEL-based nor LOAEL-based HQs for the American kestrel exceed 1 in this PRI, the golden eagle is not considered to be at risk from Site-related COPECs and this is not a significant source of uncertainty in the BERA.

7.1.2.6 Cumulative Effects Due to Exposure to Multiple COPECs

Receptors are expected to be exposed to chemical mixtures at the Site. However, TRVs and benchmarks used to calculate HQs are nearly always based on exposure to single chemicals. Therefore, single-chemical HQs do not account for potential changes in toxicity due to the presence of chemical mixtures~~, rather than single chemicals,~~ at the Site (Burton et al. 2002). Some chemicals are known to have toxicological interactions (e.g., additive, antagonistic, synergistic, or potentiating), which makes the single-chemical HQ an oversimplification.

For this BERA, cumulative effects of multiple COPECs were assessed for chemicals that were chemically related or are known to have the same mode of action,[18] as per standard practice in ERA (USEPA 2003a). The COPECs for which cumulative effects of similar-acting constituents were assessed are total PCBs, D/F and HCB (using TEQs), and HMW/LMW PAHs. In the case of D/F, TEFs not only accounted for cumulative effects, but also the relative difference in toxicity among congeners.

For all other COPECs, where the chemicals are not related or there is no known similar mode of action, HQs were calculated for each chemical singularly. It is unknown whether this strategy might result in an over-estimate or underestimate of total risk, ~~I~~but this is not considered to be a substantial source of uncertainty in this risk assessment.~~n the absence of a known toxicological interaction that is well characterized across a range of concentrations, attempting to calculate a cumulative effects HQ would increase, rather than decrease, uncertainty~~.

~~18~~15 Frequently, on the same target organ.

7.2 Site-Specific Toxicity Studies Line of Evidence Uncertainties

Uncertainties associated with the Site-specific toxicity studies LOE are described below, for both exposure- and effects-related uncertainties.

7.2.1 Exposure-Related Uncertainties

For both the Parametrix (2004) and Hooper et al. (2008) studies, one sample each of acidic wastewater was collected from the Site and used for the toxicity studies. It is unknown how representative these single samples may be of conditions in the waste ponds across all seasons, as both water levels and freshwater inputs fluctuate seasonally. The measured pH of the samples for both studies was approximately 1, which is typical of the measured range of pH in PRIs 5 and 6 (see Section 2.2.1.3). Thus, the samples used for the Site-specific toxicity studies are considered representative of highly acidic wastewater in the CWP/OWP.

For both studies, ~~pH was measured in the sample, but most~~ other COPECs were not analyzed (see Section 3.2.3). Thus, it is uncertain whether results seen in the toxicity studies were due entirely to pH or may have been partially due to other, unmeasured COPECs. This uncertainty is mitigated by the fact that negligible toxic responses were observed in the studies, thus neither pH nor other COPECs in acidic wastewater are expected to lead to acute adverse effects in birds with avoidance behaviors.

Exposure conditions in both studies were unrealistic, representing a “worst-case” acute exposure. Dehydrated and fasted birds in cages were offered acidic wastewater, whereas at the Site, birds have the freedom to forage and drink from other, more palatable sources. With a 2-hour constant exposure, the dermal (eye, skin, and foot) exposures were also unrealistic. Birds that experience discomfort,

such as the tearing observed in the study, would be expected to avoid the source of that discomfort. The egg dermal exposure is relevant to birds at the Site, as “belly-soaking” behavior in adult nesting birds directly exposes eggs to water and is performed during incubation by two shoreline species observed at the Site (snowy plover and American avocet). However, the exposure regime (1-minute immersion, followed by 20 minutes of drying, up to four times) may not be realistic for eggs in nests at the Site.

One of the Hooper et al. (2008) experiments used wild-caught house finches as test subjects. The previous exposures and life histories of these finches were unknown. This introduces potential for confounding, due to unknown prior injuries, diseases, or susceptibilities that may have been present in the test subjects before the experiment.

Overall, these exposure-related uncertainties are more likely to overestimate than underestimate the potential for adverse effects from acute oral and dermal exposure of birds to acidic pond water. Since effects were minimal, this is not a significant source of uncertainty in the BERA.

7.2.2 Effects-Related Uncertainties

The main effects-related uncertainty for the Site-specific toxicity studies LOE is the limited number of test species and test subjects utilized. The two studies used two bird species (mallard duck and house finch) to assess acute oral exposures, and two bird species (mallard ducks and Japanese quail eggs) to assess dermal exposures. The mallard duck was selected as they are the USEPA’s preferred species to assess the toxicity of a test substance to waterfowl. Finches are present in Utah statewide and have bioenergetics similar to other smaller birds potentially exposed at the Site. Japanese quail have little relevance to the Site, but their eggs have speckling similar to that observed in other species. Thus, the test species have relevance to birds that utilize lakebed habitats at the Site, but may not represent all the variable responses that might be seen in bird species at the Site. In addition, sample sizes for the different experiments were as low as n = 4, which decreases the statistical power for detecting statistically significant differences between treatment groups and the control group.

While house finch treatment groups ingested significantly less water within the first hour compared to the control, no differences in water ingestion were observed between any study group for the remainder of the study. Based on the findings of the study, finches demonstrate limited avoidance behaviors toward acidic pond water compared to mallards, potentially related to needs associated with increased bioenergetics. Birds with similar bioenergetics as house finches may also display limited avoidance behaviors at the Site, and it is uncertain the degree to which limited avoidance behaviors may increase exposure to acidic wastewater.

Overall, these effects-related uncertainties may over- or underestimate the potential for adverse effects, but the negative findings of these studies still provide good evidence that concerns for acute exposure are minimal.

Commented [EPA13]: EPA does not see much of a relevant point here. Granted that some avoidance was observed, are you trying to say you don't think that same avoidance behavior would be seen at the site? EPA has no reason to doubt that birds at the site will seek to minimize ingestion of acid water. EPA recommends deletion of this paragraph. If not, make your point more clearly.

7.3 Ecological Field Surveys Line of Evidence Uncertainties

The exposure-related and effects-related uncertainties associated with the ecological field surveys LOEs are described below. Studies that form the ecological field surveys LOEs fall into one of two broad categories: those that performed a quantitative comparison between the Site and an appropriate reference, and those that quantitatively compared Site conditions against an expected normal or typical condition for that species. Of the available studies, only Cavitt (2008, 2010) performed a quantitative comparison to reference, which increases the usefulness of this evidence. The remaining studies (Thompson 1983; Glover 1983; Halford et al. 1999; BIO-Logic 2006; and

Beltman and Stackhouse 2007) provide and qualitative assessments of condition. In the following uncertainty discussion, the qualitative surveys are discussed first as a group, followed by a more detailed analysis of the quantitative Cavitt (2008, 2010) studies.

7.3.1 Exposure-Related Uncertainties

Uncertainty as to the degree of exposure for plants, invertebrates, and small home range receptors such as mice and rats is low for the surveys that qualitatively noted the condition of biota at the Site compared to a normal condition. For these biota, it is likely that they have had continuous exposure to Site COPECs and conditions throughout their lifespan. For wildlife with larger home ranges, such as migratory birds and larger mammals, there is higher uncertainty as to their use of habitat at the Site. The observed wildlife during these surveys may have been local residents with intense Site use, may have been transients moving through the Site, or may have short intense periods of Site use during the breeding season. Thus, there is higher confidence that observations of healthy or robust body condition represent actual Site exposures for plants, invertebrates, and small mammals, rather than for birds or larger mammals. In addition, these surveys were each representative of a snapshot in time. However, this uncertainty is not expected to be substantial, as the numerous surveys provide documentation of biota across the Site across approximately three decades, at different times of the year, and during different times of the day.

7.3.1.1 Cavitt 2008, 2010

The Cavitt (2008, 2010) studies monitored nests in portions of PRIs 5, 6, 7, 13, and 14, as well as an area east of PRIs 13 and 14 beyond the Site boundary. Results from all the Site nests were pooled before statistical comparisons against reference. This method introduces uncertainties as to the relevance of the results across the entirety of each exposure units, and also introduces potential confounding from the area east of PRIs 13 and 14 that is not part of the Site. This uncertainty is mitigated by a scrutiny of the nest success in each of the exposure units; nests in PRIs 6, 7, and 14 all performed better than the nests in the area east of PRIs 13 and 14. Therefore, the nests outside the Site boundary are not masking poor performance of nests at the Site. In addition, only one nest each was monitored in PRIs 5, 6, and 13. It is uncertain how applicable the results of the ecological field surveys LOE are to PRIs 5, 6, and 13.

Commented [EPA14]: Kind of hard to tell what point you are trying to make here. It sems like you are asserting that it is tough to use the results to draw conclusions about risks on a PRI by PRI basis. EPA agrees, but the better reason for this conclusion is discussed in the following paragraph. EPA suggests trying to shorten and simplify the point id the first paragraph and emphasize the importance of the second paragraph.

An additional uncertainty is the location of the exposure for the breeding adults of the above nests. The study author notes that foraging distance varied for the adults, with an average distance of 47 meters or 192 meters, and a maximum of 689 meters away from the nest. Home ranges, calculated in 2010, averaged 0.83 ha with a maximum of 3.1 ha. Thus, most exposures are expected to occur within 200 meters of the nest. For many of the nests surveyed by Cavitt, exposures may have been from the neighboring PRI(s), rather than just the PRI in which the nest was located. For example, nests along the northern border of PRI 14 may represent breeding adult exposures from PRIs 5 and 7.

Another limitation to ~~Interpreting the results of~~ the Cavitt (2008, 2010) studies is that ~~challenging because of the lack of COPEC chemistry measurements in abiotic (solids or water) or biotic (breeding adults or eggs) media during the study. N~~no chemical analysis was performed on the eggs or adults monitored in the study, which means that any correlations between specific COPECs and measured endpoints cannot be determined. The reference areas also may have had non-Site-related sources of chemical stressors that may have impacted nesting success (see Section 3.2.4.1).

Three species were monitored during the Cavitt (2008, 2010) studies: American avocet, snowy plover, and horned lark. Two of these species, the avocet and the snowy plover, are migratory, and

the horned lark is a year-round resident. Results from these three species were applied to all avian receptors, as a reasonable representation of exposures at the Site for all locally breeding avian species.

Overall, the exposure-related uncertainties associated with the ecological field surveys LOE may under- or overestimate the potential for adverse effects.

7.3.2 Effects-Related Uncertainties

The major uncertainty with the surveys that qualitatively documented body condition is the lack of a quantitative comparison between the Site and an appropriate reference condition. Without such a comparison, the true measure of effects at the Site is unknown, particularly for chronic effects. Thus, these surveys do not specifically answer the question as to whether COPECs at the Site are impacting individual biota, populations, or communities at the Site.

7.3.2.1 Cavitt 2008, 2010

The Cavitt (2008, 2010) studies represent a snapshot in time of the reproductive success at the Site during the breeding seasons of 2008 and 2010. If high annual variability in reproductive success exists for these species, the results from these 2 years may not be representative of reproductive success across multiple years.

The only measured endpoints analyzed using statistical tests were for reproductive success (e.g., hatchability, daily survival rate) and adult size (e.g., mass, wing length). Both of these endpoint types are susceptible to natural variability, from causes such as predation, disease, and weather. Predation was the primary cause of nest failure, for both Site and reference area nests. Weather, disease, and other non- measured biotic or abiotic stressors may also have impacted reproductive success or adult size.

- **Reproductive Success**. There were no statistically significantly different measures of reproductive success in 2008, and in 2010 only hatchability was close to statistical significance ($p = 0.07$). It is uncertain why hatchability varied between the two study years, with a hatchability of 0.95 ± 0.13 (standard error) in 2008 and 0.75 ± 0.12 in 2010. In contrast, hatchability within reference areas ranged from 0.94 to 1 (± 0 to 0.18) in 2008 and 0.93 to 0.98 (± 0.02 to 0.03) in 2010. The study author notes that a number of factors may influence hatchability, including: (1) toxic effects of contaminants, (2) age or experience of breeding adults, (3) parental condition, and (4) high ambient temperatures. The co-occurrence of smaller adults and low hatchability in 2010 suggests that the low hatchability may have been due to the inexperienced breeding adults or adults in poor body condition (see below). In addition, the survey area that presumably has the highest contamination, PRI 7, had the highest hatchability at the Site for both years, suggesting that contamination was not the cause of the low hatchability at the Site. However, the possibility that low hatchability in 2010 may have been due to contamination from COPECs at the Site cannot be ruled out. While hatchability was low in 2010, the mean number of young produced per successful nest was comparable between Site and reference areas, with 2.57 ± 0.20 (standard error) at the Site and reference areas ranging from 2.61 to 2.87 (± 0.09 to 0.14) in 2010. Thus, the number of young produced at the Site did not appear to be impacted by the low hatchability in 2010.
- **Adult Size**. Adults at the Site were the same as at reference areas in 2008, but significantly smaller in 2010. Adults may have been smaller due to several reasons, including (1) selection of the Site's poorer quality nesting habitat (see Section 2.2.1.4) by younger, inexperienced breeders or breeders in poor body condition; (2) natural variability; (3) later arrival by breeders

with more strenuous migratory routes with higher energetic costs; or (4) exposure to COPECs at the Site while foraging. The most logical interpretation is that the Site is poor quality nesting habitat for these birds (see Section 2.2.1.4), which means it is likely that younger, inexperienced breeding adults or adults in poor body condition selected the Site for their nests. However, there is uncertainty in this interpretation.

~~Overall, the effects-related uncertainty associated with the ecological field surveys LOE may under- or overestimate the potential for adverse effects.~~

Commented [EPA15]: Nearly all of this is just a repeated presentation of what was observed, not a discussion of whether or not any aspects of the study provide a basis for doubting the results. EPA suggests all of this should be replaced with a discussion something similar to the following:

The effects monitored in the Cavitt (2008, 2010) studies were all relevant indicators of reproductive success, and each endpoint was compared between the Site and 3 reasonable reference areas. Consequently, the observations are considered to be highly informative. Although there was variability between sites and between years, the majority of the results indicated there was no clear decrement in reproductive success at the Site. The only significant source of uncertainty in this conclusion stems from the fact that a substantial decrease in hatching success was noted in one year (2010) but not the other (2008). The calculated statistical significance value was 0.07. If this effect is real (as opposed to simple random variability), the cause of the difference would be consistent with what is expected based on the dose-based and tissue-based HQs. However, there are a number of other plausible explanations, and in the absence of actual exposure measurements, no firm conclusions about cause can be drawn. This uncertainty leaves open the possibility that reproductive effects in the area of the waste ponds may be observable in the field.

8. CONCLUSIONS

The BERA presents results for up to five LOEs for birds, mammals, terrestrial plants, soil invertebrates, benthic invertebrates, and aquatic biota. The LOEs were integrated into a WOE analysis for each ecological receptor resulting in a determination of potential risk for each exposure unit at the Site. A summary of the COPECs that may potentially result in risk for each receptor and exposure unit is presented in Table 8-1 and described below.

In summary, the WOE analysis finds that risks to birds and mammals are mostly due to intake of TEQ, although two bioaccumulatives (HCB and total PCBs) may also ~~present potential~~contribute to risk. The upland habitats of PRIs 5, 6, and 8, which are in the areas surrounding the waste ponds, may present risk to individual birds from exposure to bioaccumulative COPECs. Birds in lakebed habitats of PRIs 7 and 14, also located around the waste ponds, may also be at risk of potential adverse effects due to intake of TEQ. Risk to mammals is limited to the upland habitat in PRIs 5, 6, and 8 and the lakebed habitat in PRI 7 from exposure of TEQ. The WOE analysis finds no conclusive evidence for risks to plants or invertebrates, except possibly for effects of chlorine on aquatic receptors that might be present in PRIs 7 and 14.

The above areas may pose a risk to individual birds, which may be of concern for the snowy plover in ~~lakebed habitats of PRIs 7 and 14~~around the waste ponds since the snowy plover is a species of Utah Greatest Conservation Need. For other birds and mammals, it is unclear whether these risks for individual organisms may be of sufficient severity and magnitude to lead to population-level impacts. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Moreover, each of the above areas with potential risk is composed of relatively poor quality habitat that is unlikely to support the minimum number of individuals necessary to sustain a population. Thus, it is considered unlikely that impacts to individuals in these areas would elicit ecologically significant changes in the populations utilizing habitat at the Site. ~~Additionally, the prediction of risks to birds and mammals is likely overestimated due to the conservative assumptions used to calculate the HQ LOEs.~~

~~Based on these findings, it is concluded that ecological risks are not of significant concern to plants or invertebrates and are unlikely to be of concern to the majority of bird and mammal populations, although individual organisms, such as snowy plover, may be impacted.~~ These conclusions are applicable to current and future conditions of all exposure units with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP.

Commented [EPA16]: Risks to mammals are of potential concern for TEQ in PRI 6

Commented [EPA17]: You don't need to summarize a summary.

Table ES-1

Summary of Risk Findings US Magnesium LLC Tooele County, Utah

Exposure Area	PRI 2	PRI 4	PRI 5		PRI 6		PRI 7	PRI 8		PRI 9	PRI 10	PRI 12	PRI 13	PRI 14		PRI 15	PRI 16	GSLIC	SVDD
Habitat	Upland	Upland	Upland	Lakebed	Upland	Lakebed	Lakebed	Upland	Lakebed	Upland	Upland	Upland	Lakebed	Upland	Lakebed	Upland	Upland	Lakebed	Lakebed
Birds	-	-	TEQ, HCB, Total PCBs	-	TEQ, HCB, Total PCBs	-	TEQ	TEQ	-	-	-	-	-	-	TEQ	-	-	-	-
Mammals	-	-	TEQ	-	-	-	TEQ	TEQ	-	-	-	-	-	-	-	-	-	-	-
Plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Invertebrates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benthic Invertebrates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aquatic Biota	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

EPA Changes (in Yellow)

Exposure Area	PRI 2	PRI 4	PRI 5		PRI 6		PRI 7	PRI 8		PRI 9	PRI 10	PRI 12	PRI 13	PRI 14		PRI 15	PRI 16	GSLIC	SVDD
Habitat	Upland	Upland	Upland	Lakebed	Upland	Lakebed	Lakebed	Upland	Lakebed	Upland	Upland	Upland	Lakebed	Upland	Lakebed	Upland	Upland	Lakebed	Lakebed
Birds	-	-	TEQ, HCB, Total PCBs	-	TEQ	-	TEQ	TEQ, HCB	-	-	-	TEQ	TEQ	TEQ	TEQ	TEQ	-	TEQ	-
Mammals	-	-	TEQ	-	-	-	TEQ	TEQ	-	-	-	-	-	-	-	-	-	-	-
Plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Invertebrates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benthic Invertebrates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aquatic Biota	-	-	-	-	-	-	Chlorine	-	-	-	-	-	-	-	Chlorine	-	-	-	-

Prepared for:

US Magnesium LLC

Final OU-1 Baseline Ecological Risk Assessment Report

US Magnesium LLC Site, Rowley, Utah

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The business of sustainability

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Final OU-1 Baseline Ecological Risk Assessment Report

US Magnesium LLC Site, Rowley, Utah

David Abranovic, PE
Partner
Project Coordinator

Jennifer Holder, PhD
Partner
Risk Assessment Lead

ERM-West, Inc.
7272 E Indian School Road
Suite 108
Scottsdale, AZ 85251

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EXECUTIVE SUMMARY

The purpose of this Baseline Ecological Risk Assessment (BERA) is to provide a description of the nature and likelihood of adverse effects that might occur in ecological receptors as a result of exposure to chemicals in the soil, sediment, and water at the US Magnesium LLC (USM) Site. The Site is located 15 miles north of Interstate 80 in Rowley, Utah, in northern Tooele County, along the southwestern shore of the Great Salt Lake. USM is a commercial producer of primary magnesium metal, magnesium alloys, chlorine, hydrochloric acid, and lithium carbonate. Releases of chemicals from the facility may result in exposure of ecological receptors that utilize habitats around the facility.

Site Description

The Site is located in the Lakeside Valley, a north-south-trending valley bordered by the Great Salt Lake and solar evaporation ponds to the east and the Lakeside Mountains to the west. The Site is defined as the area within a 5-mile radius centered on USM's Main Stack, excluding the magnesium production facility itself. The facility has been in operation since 1972. Magnesium is refined from brine obtained from the Great Salt Lake. The facility includes employee offices and process buildings and other ancillary structures and facilities. Surrounding the process buildings are a series of evaporation ponds, a concentrated brine pond, a landfill, electrolytic salt ("smut") storage areas, and a calcium sulfate (gypsum) disposal area. A series of earthen, open-air ditches formerly conveyed liquid waste from the process facility to earthen wastewater evaporation ponds. Currently, liquid wastes are conveyed via piping to the wastewater evaporation ponds. An engineered disposal site for cast house residues containing barium sulfate is located northwest of the facility.

The Site was divided into two Operable Units (OUs), each covering a 5-mile radius from the main magnesium production facility. Operable Unit 1 (OU-1) includes areas of soil, sediment, groundwater/surface water, and wastewater that may be affected by waste streams. For the purpose of assessing the likelihood of adverse ecological effects, OU-1 was divided into 16 Preliminary Remedial Investigation (PRI) areas, the Skull Valley Diversion Ditch (SVDD), and the Great Salt Lake Intake Canal (GSLIC). PRIs 1 through 10, a portion of PRI 11, and PRI 12 are located on the USM property and are actively used by USM, while all other PRIs extend outside the property boundaries and represent areas where material from the USM operations may have migrated. As part of the Resource Conservation and Recovery Act (RCRA) activities, PRI 1 and PRI 3 were remediated. Additionally, PRIs 5, 6, and 7 will be merged to create a retrofitted waste pond (RWP). The RWP will receive the current wastewater stream that includes wastewater from the new lithium facility constructed to reprocess smut material in PRI 9. It is anticipated that little of the upland area currently present in PRIs 5 and 6 will remain due to operation of the RWP, but actual water levels and the extent of sediment inundation are not known with certainty. PRI 4 currently receives a slurry of gypsum and will remain in use during future facility operations; however, under future conditions the gypsum will no longer contain elevated levels of bioaccumulative compounds. Additionally, the entire length of the SVDD adjacent to PRI 5 is inside the RWP 7 and the portion of the SVDD adjacent to PRI 7 has been filled and covered by an earthen dike as part of the RWP construction.

BERA Purpose and Approach

The purpose of this BERA is to provide a description of the nature and likelihood of potential adverse effects that might occur in ecological receptors as a result of exposure to chemicals in soil, sediment, water, and biota in the area surrounding the Site. The BERA follows standard United States Environmental Protection Agency (USEPA) risk assessment procedures and is consistent with State of Utah guidance, and the Administrative Settlement Agreement and Order on Consent (AOC) (USEPA 2011).

The final BERA dataset included abiotic and biotic data collected in support of the remedial investigation and feasibility study (RI/FS) program, biotic data (egg tissue) from USEPA, two Site-specific toxicity studies, and 12 ecological field studies. Chemicals of potential ecological concern (COPECs) were identified in a screening assessment, where bioaccumulative compounds were carried through as COPECs unless concentrations were below background. These compounds include Avian Toxicity Equivalency (TEQ) (a sum of dioxins, furans, polychlorinated biphenyls [PCBs], and hexachlorobenzene [HCB]), Mammalian TEQ (a sum of dioxins, furans, and PCBs), total PCBs, HCB, mercury, hexachlorobutadiene, 1,2,4,5-tetrachlorobenzene, and pentachlorobenzene.

Avian TEQ and Mammalian TEQ were calculated using toxicity equivalency factors (TEFs) that are based on the relative toxicity to tetrachlorodibenzo-p-dioxin (TCDD) for birds and mammals, respectively. HCB was also included in the summation for Avian TEQ, since HCB was found to have dioxin-like toxicities for birds. Avian species sensitivity to TCDD is grouped into three categories, where Avian TEQ Category 1 birds are most sensitive to TCDD and Avian TEQ Category 3 birds are least sensitive to TCDD. All three Avian TEQ categories were evaluated in the BERA.

Environmental Setting

The environmental setting for the Site is characterized by a semi-arid climate. Surface water has been or may be present in various areas with salinity levels that are mostly hypersaline (> 35 parts per thousand salinity). For the BERA, land covers/habitats within the Site were categorized into “upland” and “lakebed” for purposes of evaluating the different biota types found within these habitats. The upland category represents terrestrial habitat that supports soil invertebrates, plants, birds, and mammal. The lakebed category represents wetland/playa habitat that may support aquatic/benthic invertebrates (e.g., brine shrimp and brine flies), plants, and “shoreline” wildlife (i.e., birds and mammals).

Much of the upland habitat at the Site does not support terrestrial plant communities and/or has plants that are ruderal, sparse, patchily distributed, short in stature, and do not provide suitable refuge or foraging habitat for wildlife. In the lakebed habitat, salinity levels are mostly hypersaline, thus no fish are present in the Site and aquatic organisms in surface water are limited to brine shrimp, brine flies (brine fly larvae are considered to be benthic invertebrates in the BERA), and aquatic plants. Past studies reported that shorebirds at waste ponds (PRIs 5, 6, 7) are generally observed less frequently, and when observed, are restricted to short visits before flying off (BIO-Logic 2002, 2003). In general, PRIs within the facility boundary tend to have less bird usage due to disturbed habitat and/or ongoing physical disturbances. Trails of large mammal prints in lakebed habitat suggest these animals are likely to be transient visitors. Currently, facility waste ponds support little or no emergent vegetation. Adult and larval brine flies have been observed in aquatic habitats within the lakebed habitat, excluding the acidic waste ponds; however, the brine flies may have blown in from another location since brine fly casts have been rarely observed.

Conceptual Site Model

The Conceptual Site Model considers the Site setting in an ecological context, presents schematically the relationship between chemical sources and organisms at the Site, and identifies exposure pathways for ecological receptors (USEPA 1992a). The chemical sources include: (1) gases and fine particulate materials released to air; (2) solid materials placed in piles on the ground or released from USM facility buildings as fugitive dusts that fall to the ground; and (3) liquid wastes and slurries discharged historically through ditches (now closed and capped) and currently conveyed through pipes into waste impoundments (waste ponds) and the gypsum pile. These processes have led to the presence of Site-related chemical contaminants in air, soil, waste piles, surface water, sediments, and groundwater.

The USM facility is currently active. Its land is zoned as industrial and is anticipated to be industrial for the foreseeable future. Currently, PRIs within the facility boundaries (PRIs 2 through 12) support an industrial

use that is characterized by frequent physical anthropomorphic disturbance and/or management of waste streams from the active facility. As a result, much of the upland and lakebed habitat within the facility boundaries does not support prey items for birds and mammals, which results in an acute exposure to soil or sediment.

Exposure Pathways and Representative Species

A chemical exposure pathway is deemed "potentially complete and potentially significant" if that pathway is reasonable for a receptor given its habitat and dietary preferences. Exposure routes evaluated in the BERA include:

- Direct contact/uptake of constituents in surface water by aquatic invertebrates (brine shrimp) and aquatic plants (including algae)
- Direct contact/uptake of constituents in sediment by benthic invertebrates (brine fly larvae)
- Direct contact/root uptake of constituents in soil by terrestrial plants
- Direct contact/uptake of constituents in soil by soil invertebrates
- Incidental ingestion of constituents in soil by wildlife
- Ingestion of constituents in surface water by wildlife
- Ingestion of constituents in food items (i.e., plant, invertebrate, or small mammal) by wildlife

Representative wildlife species selected for use in the BERA are as follows:

- Gleaning invertivorous bird (upland habitat only) – horned lark (*Eremophila alpestris*)
- Aerial invertivorous bird (upland and lakebed habitat) – tree swallow (*Tachycineta bicolor*)
- Probing invertivorous bird (lakebed habitat only) – snowy plover (*Charadrius nivosus*) and American avocet (*Recurvirostra americana*)
- Herbivorous bird (upland and lakebed habitat) – mourning dove (*Zenaida macroura*)
- Carnivorous bird (upland and lakebed habitat) – American kestrel (*Falco sparverius*). The American kestrel was used as a surrogate for the golden eagle, which has been observed nesting in the Lakeside Mountains in PRI 16 and is protected at the individual level due to the Bald and Golden Eagle Protection Act.
- Invertivorous mammal (upland and lakebed habitat) – grasshopper mouse (*Onychomys arenicola*)
- Herbivorous mammal (upland and lakebed habitat) – Ord's kangaroo rat (*Dipodomys ordii*)
- Carnivorous mammal (upland and lakebed habitat) – badger (*Taxidea taxus*)
- Large herbivorous mammal (upland habitat only) – pronghorn antelope (*Antilocapra americana*). Large herbivorous mammals are only expected to occur in the buffer areas (PRIs 14, 15, and 16).

Exposure and Effects Estimation

Exposure and effects to receptors and representative species were estimated using five lines of evidence (LOEs) within a weight of evidence (WOE) process, which are briefly described below.

Hazard Quotients Lines of Evidence (Direct Contact, Dietary Dose, Tissue)

Hazard quotients (HQs) are comparisons of Site-specific exposure measures to toxicity benchmarks or toxicity reference values (TRVs). Benchmarks and TRVs were based on no observed adverse effect

levels (NOAELs) and lowest observed adverse effect levels (LOAELs), which resulted in NOAEL HQs and LOAEL HQs. A NOAEL HQ less than or equal to 1 suggests that adverse effects at the organism level are unlikely. A LOAEL HQ greater than 1 indicates that potential adverse effects at the organism level cannot be ruled out. The three types of HQ LOEs calculated for the BERA include:

- Direct contact HQs – HQs were developed for terrestrial plants, soil invertebrates, benthic invertebrates, and aquatic biota using measured concentrations in soil/sediment or water compared to benchmarks.
- Dietary dose HQs – HQs were developed for birds and mammals using a modeled daily dose from oral ingestion of food, solids, and/or water compared to acute, chronic, or intermittent longer-term dietary TRVs. An intermittent longer-term scenario was evaluated for probing birds (snowy plover, American avocet) in the acidic waste ponds where a conservative estimate of exposure for probing birds in the waste ponds was assumed to be one visit a month, based on survey data for American avocets.
- Tissue HQs – HQs were developed for measured concentrations of bird eggs compared to chronic tissue benchmarks. HQs were also developed for modeled concentrations in biotic tissue (small mammal whole carcass, plant tissue, or invertebrate tissue) compared to chronic tissue benchmarks.

Site-Specific Toxicity Studies Line of Evidence

The Site-specific toxicity studies LOE was only applicable to birds since it is based on two studies on the palatability and toxicity of acidic waste pond water to birds (Parametrix 2004; Hooper et al. 2008).

Ecological Field Surveys Line of Evidence

The ecological field surveys LOE is derived from studies on the reproductive success of birds near the Old Waste Pond (PRI 7 and nearby areas), as well as a number of surveys reporting the comparisons of organism health at the Site to organism health under normal conditions for vegetation, benthic invertebrates, birds, and mammals.

Weight of Evidence

A WOE process was used to evaluate and integrate the different LOEs described above. The approach for the BERA is a narrative WOE. First, the results of the different LOEs are considered together. If the LOE results are consistent with each other (or if there is only one LOE), the risk conclusions are derived and the WOE concludes the findings. However, if the LOEs do not have results consistent with each other, then the LOEs are evaluated narratively for strength, reliability, and relevance. The LOE(s) with the highest weight (strongest, most reliable, and most relevant) then drive the risk conclusion. Conclusive results and key uncertainties are emphasized as appropriate.

Risk Assessment Findings

A summary of the WOE findings is presented below for each ecological receptor followed by summaries by exposure unit and media. As described previously, all results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP.

BERA Findings for Birds

Four LOEs were used to characterize risk to birds, resulting in the following main findings:

1. Dietary dose HQs are highest due to chronic intake of TEQ with the highest values generally for probing birds (American avocet, snowy plover) in lakebed habitats and for gleaning/aerial invertivores (horned lark, tree swallow) and carnivores (American kestrel) in upland habitats. LOAEL HQs for single or repeated acute exposures are low in magnitude and frequency.
2. Tissue HQs for bird eggs showed elevated levels of TEQ and PCBs in eggs around the waste ponds.
3. Site-specific toxicity studies indicate that (1) most birds preferentially avoid acidic wastewater, even when dehydrated, (2) consumption of acidic wastewater is not acutely toxic to mallards or finches, (3) birds that have acute exposures to acidic wastewater readily recover any lost body weight from reduced water and feed consumption after the exposure ends, and (4) dermal exposure of acidic wastewater to eggs does not result in weight loss but may alter egg camouflage characteristics. The logical interpretation of this information is that acute exposures to acidic wastewater are unlikely to result in adverse effects to bird populations at the Site.
4. Ecological field surveys found no statistically significant differences in reproductive success at the Site compared to the reference areas, although nest hatchability at the Site for snowy plover was lower in one of the study years. The author also notes that the Site is likely poor quality breeding habitat, due to low food availability, higher thermal and osmotic stress, increased distance to freshwater, and higher predator density. The poorer condition of both the breeding habitat and the breeding adults may lead to lower hatchability or higher seasonal variation. Additionally, the bird observation studies clearly indicate that birds are present at the Site, and that their use of the Current Waste Pond and Old Waste Pond is substantially less than other areas of the Site.

These four LOEs were integrated into the WOE finding that risks for individual birds are unlikely across much of the spatial area of the Site, including PRIs 2, 4, 9, 10, 12, 13, the portion of PRI 14 south or east of the P-11 canal, 15, 16, the GSLIC, and the SVDD. Acute risks to individual birds in the lakebed habitats of PRIs 5, 6, and 7 are also unlikely, due to limited exposure as most birds are expected to avoid the acidic waste pond water. However, COPECs in the following areas may represent a cause for concern:

- **Upland Habitats of PRIs 5 and 6** – Adverse effects are possible for individual birds, particularly due to TEQ, PCBs, and HCB.
- **Lakebed Habitats of PRI 7 and PRI 14 (north of the P-11 canal)** – Adverse effects due to chronic exposure to TEQ are possible for individual birds in PRI 7 and the portion of PRI 14 north of the P-11 canal.
- **Upland Habitat of PRI 8** – Risks to individual birds are possible in the upland habitats of PRI 8, due to TEQ.

While the above areas may pose a risk to individual birds, which may be of concern for the snowy plover, which is a species of Utah Greatest Conservation Need. For other species, it is unclear whether these risks for individual birds may be of sufficient severity and magnitude to lead to population-level impacts. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Moreover, each of the above areas with potential risk to individual birds is noted to be small in size, ranging from 28 to 340 hectares (ha) large, and also composed of poor quality habitat. This represents a fraction of bird populations. Thus, it is considered unlikely that decreased reproductive success in the limited number of nests present in the above areas would elicit changes in the populations of bird species utilizing habitat at the Site.

BERA Findings for Mammals

Three LOEs (dietary dose HQs, tissue HQs, and ecological field surveys) were available to characterize risk to mammals. The main findings for each LOE are listed below.

1. Dietary dose HQs indicate that HQs are highest due to chronic intake of TEQ. The most sensitive mammals are the grasshopper mouse in upland habitats and the badger in lakebed habitat. Single acute exposures result in no LOAEL HQs above 1.
2. No tissue HQs were above 1 for the bioaccumulative COPECs.
3. Ecological field survey results report the presence of mammals with robust body condition, which suggests that overt toxicity is not occurring in PRIs 2 to 10, 12, and 15 due to COPECs, but cannot be used as a conclusive evaluation for chronic adverse effects.

WOE findings are that risks are unlikely for individual mammals for all areas of the Site, except:

- **PRI 5 (Upland Habitat), PRI 7, and PRI 8 (Upland Habitat)** – Mammalian TEQ may pose a risk to individual mammals within the upland habitat of PRI 5, the lakebed habitat of PRI 7, and the upland habitat of PRI 8. However, these exposure areas are small in size (68, 339, and 67 ha, respectively) and support a maximum of approximately 200 individual mammals per species. This represents a fraction of the population; thus, it is unlikely that any adverse effects on individual mammals in the above areas would translate to population-level effect. Therefore, risks to mammal populations are considered unlikely.

BERA Findings for Terrestrial Plants

The three LOEs used for evaluating plants were: direct contact HQs, tissue HQs, and ecological field surveys. The main findings for each LOE are:

1. Direct contact HQs above 1 are limited to inorganics, which are also consistent with background HQs. Thus, inorganic HQs are due to naturally occurring concentrations in the soil.
2. No tissue HQs were above 1 for the bioaccumulative COPECs.
3. Ecological field surveys report dead vegetation in PRIs 6, 7, and 8, which is ascribed to physical soil conditions and/or water levels. Report of healthy vegetation in other PRIs suggest that adverse effects on plants are not occurring in those areas of the Site, but cannot be used as a conclusive evaluation for chronic adverse effects from soil COPECs.

The LOEs were combined to generate a WOE finding that risks to the terrestrial plant community at the Site are unlikely, for all evaluated upland habitat areas.

BERA Findings for Invertebrates

Two LOEs were used to evaluate soil invertebrates, benthic invertebrates, and aquatic biota. Main findings are listed below.

1. Direct contact HQs for soil invertebrates are all either consistent with background inorganic HQs or are below 1. HQs for benthic invertebrates are above 1 for total PCBs, phenol, carbon disulfide, and inorganics. Of these COPECs, only total PCBs could reach a level of concern for benthic invertebrates, which may occur in PRI 7 if the sediment is not flooded with acidic wastewater. For aquatic biota, direct contact HQs above 1 in surface water are highest in frequency and magnitude for total PCBs, chlorine, aluminum, and iron. However, benchmarks for these COPECs have low relevance to Site conditions, thus are likely overestimating risks to aquatic invertebrates.

2. Tissue LOAEL HQs above 1 are low in magnitude and frequency for soil invertebrates. No tissue LOAEL HQs are above 1 for aquatic invertebrates.

The WOE integrated the results of two LOEs (direct contact HQs and tissue HQs) into the following findings:

- **Soil invertebrates** – There is compelling evidence that risks to the soil invertebrate community in the upland habitats of PRIs 5, 6, 8, 10, 12, 14, 15, and 16 are unlikely.
- **Benthic invertebrates** – Benthic invertebrate community risk is low for the lakebed habitats of PRIs 7, 8, 13, 14, the GSLIC, and the SVDD. In the active ponds (PRIs 5 and 6), the acidic water precludes presence of benthic invertebrates. PRI 7 is intermittently acidic, so even though there may be some risk from total PCBs in PRI 7, growth of benthic invertebrates in this PRI is likely to be limited.
- **Aquatic biota** – Due to a number of uncertainties leading to overestimations of risk, interpretation of the results for aquatic biota are challenging. However, the evidence suggests that overall risks to the aquatic biota community in the surface waters of PRI 7, 8, 14, and the SVDD are probably low.

Uncertainties

In general, assumptions used in this BERA were intended to overestimate (rather than underestimate) characterizations of potential ecological risk. The following sources of uncertainties associated with the LOEs resulted in an overestimation of potential ecological risk:

- HQ LOEs
  - Representative Species
  - Site Use Factors
  - Bioaccessibility
  - Intermittent Longer-term Dose Estimation
  - Chronic NOAEL-equivalent TRVs
  - Species-to Species Extrapolations
  - Unbounded NOAEL Effects Levels
- Site-Specific Toxicity Studies LOE
  - Representativeness of Single Wastewater Sample
  - Unrealistic Exposure Conditions
- Ecological Field Surveys LOE
  - Variable Applicability across Spatial Areas

The following assumptions used in the BERA were likely to have a negligible influence on the potential for adverse effects or were likely to have an unidentified (direction and/or magnitude) influence on the potential for adverse effects:

- HQ LOEs
  - Bioaccumulation Models (particularly TEQ Models for Brine Fly)
  - Avian TEQ Concentrations
  - Scenarios Not Evaluated (Inhalation Pathway, Dermal Contact Pathway)

- Uncertain COPECs Not Quantitatively Evaluated
- Threatened and Endangered Species
- Cumulative Effects Due to Exposure to Multiple COPECs

- Site-Specific Toxicity Studies LOE
  - Lack of Analysis for other COPECs
  - Wild-Caught Test Subjects
  - Limited Number of Test Species and Small Sample Sizes
  - Temporal Variability in House Finch Responses
- Ecological Field Surveys LOE
  - Species Applicability
  - Interpretation of Adult Body Mass Endpoint

Conclusions

The BERA presents results for up to five LOEs for birds, mammals, terrestrial plants, soil invertebrates, benthic invertebrates, and aquatic biota. The LOEs were integrated into a WOE analysis for each ecological receptor resulting in a determination of potential risk for each exposure unit at the Site. A summary of the COPECs that may potentially result in risk for each receptor and exposure unit is presented in Table ES-1 and described below.

In summary, the WOE analysis finds that risks to birds and mammals are mostly due to intake of TEQ, although two bioaccumulatives (HCB and total PCBs) may also present potential risk. The upland habitats of PRIs 5, 6, and 8, which are in the areas surrounding the waste ponds, may present risk to individual birds from exposure to bioaccumulative COPECs (PRIs 5, 6, and 8) and vanadium (PRI 8 only). Birds in lakebed habitats of PRIs 7, 8, and 14, also located around the waste ponds, may be at risk of potential adverse effects due to intake of TEQ (PRIs 7, 8, and 14) and vanadium (PRI 8 only). Risk to mammals is limited to the upland habitat in PRI 5 and the lakebed habitat in PRI 7 from exposure of TEQ. The WOE analysis finds no conclusive evidence for risks to plants or invertebrates.

The above areas may pose a risk to individual birds, which may be of concern for the snowy plover in lakebed habitats of PRIs 7 and 14 since the snowy plover is a species of Utah Greatest Conservation Need. For other birds and mammals, it is unclear whether these risks for individual organisms may be of sufficient severity and magnitude to lead to population-level impacts. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Moreover, each of the above areas with potential risk is composed of poor quality habitat that is unlikely to support the minimum number of individuals necessary to sustain a population. Thus, it is considered unlikely that impacts to individuals in these areas would elicit changes in the populations utilizing habitat at the Site. Additionally, the prediction of risks to birds and mammals is likely overestimated due to the conservative assumptions used to calculate the HQ LOEs.

Based on these findings, it is concluded that ecological risks are not of significant concern to plants or invertebrates and are unlikely to be of concern to the majority of bird and mammal populations, although individual organisms, such as snowy plover, may be impacted. These conclusions are applicable to current and future conditions of all exposure units with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future

scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP.

CONTENTS

EXECUTIVE SUMMARY ES-1

Site Description ES-1
BERA Purpose and Approach ES-1
Environmental Setting ES-2
Conceptual Site Model ES-2
Exposure Pathways and Representative Species ES-3
Exposure and Effects Estimation ES-3
Risk Assessment Findings ES-4
BERA Findings for Birds ES-4
BERA Findings for Mammals ES-6
BERA Findings for Terrestrial Plants ES-6
BERA Findings for Invertebrates ES-6
Uncertainties ES-7
Conclusions ES-8

1. INTRODUCTION 1

1.1 Purpose and Organization 1
1.2 Site Description and Background 1
1.3 BERA Organization 3

2. BERA APPROACH 5

2.1 BERA Dataset 5
2.1.1 Data Usability Assessment 5
2.1.2 Data Adequacy 14
2.1.3 Final BERA Datasets 14
2.1.4 Chemistry Data Management and Treatment 15
2.2 Problem Formulation 18
2.2.1 Environmental Setting 19
2.2.2 Constituents of Potential Ecological Concern 35
2.2.3 Exposure Pathways/Refined Conceptual Site Models 36
2.2.4 Management Goals, Assessment Endpoints, and Measurement Endpoints/Lines of Evidence 40
2.2.5 Representative Wildlife Receptors 42
2.3 Exposure Assessment 44
2.3.1 Direct Contact Hazard Quotient Line of Evidence 44
2.3.2 Dietary Dose Hazard Quotient Line of Evidence 45
2.3.3 Tissue Hazard Quotient Line of Evidence 51
2.3.4 Site-Specific Toxicity Studies Line of Evidence 52
2.3.5 Ecological Field Surveys Line of Evidence 52
2.4 Effects Assessment 53
2.4.1 Hazard Quotients 53
2.4.2 Site-Specific Toxicity Studies Line of Evidence 55
2.4.3 Ecological Field Surveys Line of Evidence 55
2.5 Risk Characterization 56
2.5.1 Hazard Quotients 56
2.5.2 Site-Specific Toxicity Studies Line of Evidence 58
2.5.3 Ecological Field Surveys Line of Evidence 58
2.5.4 Weight of Evidence 58

2.5.5 Inferring Effects for Wildlife Populations within an Exposure Unit 61

3. RISK EVALUATION FOR BIRDS 63

3.1 Bird Usage of the Site 63
3.2 Risk Estimates 63
3.2.1 Dietary Dose Hazard Quotient Line of Evidence 63
3.2.2 Egg Tissue Hazard Quotient Line of Evidence 66
3.2.3 Site-Specific Toxicity Studies Line of Evidence 67
3.2.4 Ecological Field Surveys Line of Evidence 70
3.3 Weight of Evidence 74
3.3.1 Acute Exposures 74
3.3.2 Chronic Exposures 76
3.4 Summary of Findings for Birds 79

4. RISK EVALUATION FOR MAMMALS 81

4.1 Mammal Usage of the Site 81
4.2 Risk Estimates 81
4.2.1 Dietary Dose Hazard Quotient Line of Evidence 81
4.2.2 Tissue Hazard Quotient Line of Evidence 83
4.2.3 Site-Specific Toxicity Studies Line of Evidence 83
4.2.4 Ecological Field Surveys Line of Evidence 83
4.3 Weight of Evidence 84
4.3.1 Acute Exposures 84
4.3.2 Chronic Exposures 84
4.4 Summary of Findings for Mammals 86

5. RISK EVALUATION FOR PLANT COMMUNITIES 87

5.1 Plant Occurrences at the Site 87
5.2 Risk Estimates 87
5.2.1 Direct Contact Hazard Quotient Line of Evidence 87
5.2.2 Tissue Hazard Quotient Line of Evidence 88
5.2.3 Site-Specific Toxicity Studies Line of Evidence 88
5.2.4 Ecological Field Surveys Line of Evidence 88
5.3 Weight of Evidence 89
5.4 Summary of Findings for Plants 90

6. RISK EVALUATION FOR INVERTEBRATES AND AQUATIC BIOTA 91

6.1 Invertebrate Occurrences at the Site 91
6.2 Risk Estimates 91
6.2.1 Direct Contact Hazard Quotient Line of Evidence for Soil Invertebrates with Upland Soil 91
6.2.2 Direct Contact Hazard Quotient Line of Evidence for Benthic Invertebrates with Sediment 92
6.2.3 Direct Contact Hazard Quotient Line of Evidence for Aquatic Invertebrates with Surface Water 93
6.2.4 Soil Invertebrate Tissue Hazard Quotient Line of Evidence 94
6.2.5 Aquatic Invertebrate Tissue Hazard Quotient Line of Evidence 95
6.2.6 Site-Specific Toxicity Studies Line of Evidence 95
6.2.7 Ecological Field Surveys Line of Evidence 95
6.3 Weight of Evidence 96
6.3.1 Soil Invertebrates 96

6.3.2 Benthic Invertebrates 96
6.3.3 Aquatic Biota 96
6.4 Summary of Findings for Invertebrates and Aquatic Biota 96
7. UNCERTAINTY ANALYSIS 98
7.1 Uncertainties for Lines of Evidence based on Hazard Quotients 98
7.1.1 Exposure-Related Uncertainties 98
7.1.2 Effects-Related Uncertainties 104
7.2 Site-Specific Toxicity Studies Line of Evidence Uncertainties 113
7.2.1 Exposure-Related Uncertainties 113
7.2.2 Effects-Related Uncertainties 113
7.3 Ecological Field Surveys Line of Evidence Uncertainties 114
7.3.1 Exposure-Related Uncertainties 114
7.3.2 Effects-Related Uncertainties 115
8. CONCLUSIONS 117
9. REFERENCES 118

APPENDIX A COMPREHENSIVE SPECIES LIST
APPENDIX B PROCESS FOR CALCULATING SURFACE-WEIGHTED AVERAGE CONCENTRATIONS USING ACCESSIBLE SAMPLES IN PRI 5 AND PRI 6 LAKEBED SEDIMENT
APPENDIX C BENCHMARK AND TRV SELECTION
APPENDIX D RETROFITTED WASTE POND HYPOTHETICAL RISK RESULTS OUTPUT
APPENDIX E COMPREHENSIVE RISK TABLES AND RISK WORKBOOK
APPENDIX F PROUCL OUTPUT FOR CALCULATION OF 95UCLS

List of Tables

Executive Summary
Table ES-1 Summary of Risk Findings

Section 2
Table 2-1 Data Quality Criteria for Biotic Chemistry, Ecological Field Survey, and Laboratory Toxicity Data
Table 2-2 PRI 8 Dataset Selection for BERA
Table 2-3 Data Suitability Criteria for Laboratory Toxicity Data
Table 2-4 Data Suitability Criteria for Ecological Field Survey Data
Table 2-5 Sample Numbers per PRI
Table 2-6 Modifications to Sample Exposure Unit Designation
Table 2-7 Summary Statistics of Solid and Water COPECs
Table 2-8a Threatened and Endangered Species
Table 2-8b Species of Concern
Table 2-9 Land Use Scenarios
Table 2-10 Summary of Solid Media COPECs
Table 2-11 Summary of Water COPECs
Table 2-12 Assessment and Measurement Endpoints per PRI
Table 2-13 Representative Wildlife Receptors of Concern
Table 2-14 Comparisons among Herbivore, Invertivore, and Omnivore - Example Calculation for Copper
Table 2-15 Exposure Point Concentration Types for Direct Contact Exposures
Table 2-16 Exposure Point Concentration Types for Daily Dose Exposures
Table 2-17 SWAC EPCs for Intermittent Longer-Term Exposure
Table 2-18 Wildlife Exposure Factors
Table 2-19 Site Use Factors
Table 2-20 Uptake Model Parameters for Modeled Prey Item Tissue
Table 2-21 Uptake Models and Abiotic Media Used in Dose Models
Table 2-22 Exposure Point Concentration Types for Tissue Body Burden
Table 2-23 Direct Contact Benchmarks for Aquatic Biota
Table 2-24 Direct Contact Benchmarks for Saltwater Benthic Invertebrates
Table 2-25 Direct Contact Benchmarks for Terrestrial Plants
Table 2-26 Direct Contact Benchmarks for Soil Invertebrates
Table 2-27 Avian Toxicity Reference Values
Table 2-28 Mammalian Toxicity Reference Values
Table 2-29 Tissue Benchmarks

Section 3
Table 3-1 Avian Chronic Dietary Dose HQs in Upland Habitat
Table 3-2 Summary of Avian Acute Dietary Dose HQs in Upland Habitat
Table 3-3 Avian Chronic Dietary Dose HQs in Lakebed Habitat
Table 3-4 Summary of Avian Acute Dietary Dose HQs in Lakebed Habitat
Table 3-5 Avian Intermittent Longer-Term HQs using SWAC EPCs
Table 3-6 Dose Contribution for all Avian Chronic HQs Above One
Table 3-7 Egg Tissue HQs
Table 3-8 PRI 14 Hazard Quotient Comparisons

Section 4
Table 4-1 Large Mammal Chronic Dietary Dose HQs in Upland Habitat
Table 4-2 Summary of Large Mammal Acute and Small Mammal Acute and Chronic Dietary Dose HQs in Upland Habitat
Table 4-3 Large Mammal Chronic Dietary Dose HQs in Lakebed Habitat
Table 4-4 Summary of Large Mammal Acute and Small Mammal Acute and Chronic Dietary Dose HQs in Lakebed Habitat
Table 4-5 Dose Contribution for all Mammal Chronic HQs Above One

Section 5
Table 5-1 Summary of Terrestrial Plant Chronic Direct Contact HQs in Upland Habitat

Section 6
Table 6-1 Summary of Soil Invertebrate Chronic Direct Contact HQs in Upland Habitat
Table 6-2 Summary of Benthic Invertebrate Chronic Direct Contact HQs in Lakebed Habitat
Table 6-3 Summary of Aquatic Biota Chronic Direct Contact HQs in Surface Water
Table 6-4 Summary of Tissue HQs for Soil Invertebrates
Table 6-5 Summary of Tissue HQs for Aquatic Invertebrates

Section 7
Table 7-1 Uncertainty Summary by LOE
Table 7-2 Avian Intermittent Longer-Term HQs using 95UCL EPCs
Table 7-3 Chemicals with Nondetects and Maximum Detection Limits Greater than the RBESL
Table 7-4 Chemicals Lacking Screening Values by Media

Section 8
Table 8-1 Summary of Risk Findings

List of Figures

Section 1
Figure 1-1 Site Location Map
Figure 1-2 Revised Preliminary Remedial Investigation Areas

Section 2
Figure 2-1 Surface Geology Map
Figure 2-2 General Soil Class Map
Figure 2-3 Site Map with Selected Hydrologic Features
Figure 2-4 Modified SWReGAP Land Cover
Figure 2-5 Avian Egg Sampling and Nest Locations 2004 to 2016
Figure 2-6 Habitat Categories
Figure 2-7 RCRA Carve-Out Cleanup Project
Figure 2-8 Retrofitted Waste Pond
Figure 2-9 Conceptual Site Model for PRI 2, Current and Future Land Use Scenarios
Figure 2-10 Conceptual Site Model for PRI 4, Current Land Use Scenario
Figure 2-11 Conceptual Site Model for PRI 5, Current Land Use Scenario
Figure 2-12 Conceptual Site Model for PRI 6, Current Land Use Scenario
Figure 2-13 Conceptual Site Model for PRI 7, Current Land Use Scenario
Figure 2-14 Conceptual Site Model for PRI 8, Current and Future Land Use Scenarios

Figure 2-15 Conceptual Site Model for PRI 9, Current and Future Land Use Scenarios
Figure 2-16 Conceptual Site Model for PRI 10, Current and Future Land Use Scenarios
Figure 2-17 Conceptual Site Model for PRI 12, Current and Future Land Use Scenarios
Figure 2-18 Conceptual Site Model for PRI 13, Current and Future Land Use Scenarios
Figure 2-19 Conceptual Site Model for PRI 14, Current and Future Land Use Scenarios
Figure 2-20 Conceptual Site Model for PRI 15, Current and Future Land Use Scenarios
Figure 2-21 Conceptual Site Model for PRI 16, Current and Future Land Use Scenarios
Figure 2-22 Conceptual Site Model for Skull Valley Diversion Ditch, Current Land Use Scenario
Figure 2-23 Conceptual Site Model for Great Salt Lake Intake Canal, Current and Future Land Use Scenarios
Figure 2-24 Tissue Versus Soil/Sediment Concentrations for Brine Flies and Brine Shrimp

Section 3

Figure 3-1a Avian Chronic Dietary Dose HQs in Upland Habitat, Avian TEQ Category 1 ND=1/2DL
Figure 3-1b Avian Chronic Dietary Dose HQs in Upland Habitat, Avian TEQ Category 2 ND=1/2DL
Figure 3-1c Avian Chronic Dietary Dose HQs in Upland Habitat, Avian TEQ Category 3 ND=1/2DL
Figure 3-1d Avian Chronic Dietary Dose HQs in Upland Habitat, Total PCBs
Figure 3-1e Avian Chronic Dietary Dose HQs in Upland Habitat, Aluminum
Figure 3-1f Avian Chronic Dietary Dose HQs in Upland Habitat, Vanadium
Figure 3-1g Avian Chronic Dietary Dose HQs in Upland Habitat, Hexachlorobenzene
Figure 3-1h Avian Chronic Dietary Dose HQs in Upland Habitat, Total Cyanide
Figure 3-2a Avian Acute Dietary Dose HQs in Upland Habitat, Avian TEQ Category 1 ND=1/2DL
Figure 3-2b Avian Acute Dietary Dose HQs in Upland Habitat, Avian TEQ Category 3 ND=1/2DL
Figure 3-3a Avian Chronic Dietary Dose HQs in Lakebed Habitat, Avian TEQ Category 1 ND=1/2DL
Figure 3-3b Avian Chronic Dietary Dose HQs in Lakebed Habitat, Avian TEQ Category 2 ND=1/2DL
Figure 3-3c Avian Chronic Dietary Dose HQs in Lakebed Habitat, Avian TEQ Category 3 ND=1/2DL
Figure 3-3d Avian Chronic Dietary Dose HQs in Lakebed Habitat, Aluminum
Figure 3-3e Avian Chronic Dietary Dose HQs in Lakebed Habitat, Iron
Figure 3-3f Avian Chronic Dietary Dose HQs in Lakebed Habitat, Vanadium
Figure 3-3g Avian Chronic Dietary Dose HQs in Lakebed Habitat, Hexachlorobenzene
Figure 3-3h Avian Chronic Dietary Dose HQs in Lakebed Habitat, Total Cyanide
Figure 3-4a Avian Acute Dietary Dose HQs in Lakebed Habitat, Avian TEQ Category 1 ND=1/2DL
Figure 3-4b Avian Acute Dietary Dose HQs in Lakebed Habitat, Avian TEQ Category 2 ND=1/2DL
Figure 3-4c Avian Acute Dietary Dose HQs in Lakebed Habitat, Avian TEQ Category 3 ND=1/2DL
Figure 3-4d Avian Acute Dietary Dose HQs in Lakebed Habitat, Hexachlorobenzene
Figure 3-5a Avian Intermittent Longer-Term HQs in Lakebed Habitat, Avian TEQ Category 1, ND= 1/2DL
Figure 3-5b Avian Intermittent Longer-Term HQs in Lakebed Habitat, Avian TEQ Category 2, ND= 1/2DL
Figure 3-5c Avian Intermittent Longer-Term HQs in Lakebed Habitat, Avian TEQ Category 3, ND= 1/2DL
Figure 3-6a Tissue HQs for Avian Eggs, Avian TEQ Category 1, ND=0
Figure 3-6b Tissue HQs for Avian Eggs, Avian TEQ Category 1, ND=1/2DL
Figure 3-6c Tissue HQs for Avian Eggs, Avian TEQ Category 2, ND=0
Figure 3-6d Tissue HQs for Avian Eggs, Avian TEQ Category 2, ND=1/2DL
Figure 3-6e Tissue HQs for Avian Eggs, Avian TEQ Category 3, ND=0
Figure 3-6f Tissue HQs for Avian Eggs, Avian TEQ Category 3, ND=1/2DL
Figure 3-6g Tissue HQs for Avian Eggs, Total PCBs
Figure 3-6h Tissue HQs for Avian Eggs, Hexachlorobenzene

Figure 3-7 Detection Limits: Historical Egg Tissue Samples vs. Phase 2A Tissue Samples
Figure 3-8a Bird Egg LOAEL Hazard Quotients ND=0, Background Area
Figure 3-8b Bird Egg LOAEL Hazard Quotients ND=0, Study Area
Figure 3-8c Bird Egg LOAEL Hazard Quotients ND = 1/2DL, Background Area
Figure 3-8d Bird Egg LOAEL Hazard Quotients ND = 1/2DL, Study Area

Section 4
Figure 4-1a Large Mammal Chronic Dietary Dose HQs in Upland Habitat, Mammalian TEQ, ND=1/2DL
Figure 4-1b Large Mammal Chronic Dietary Dose HQs in Upland Habitat, Aluminum
Figure 4-2a Small Mammal Chronic Dietary Dose HQs in Upland Habitat, Mammalian TEQ, ND=1/2DL
Figure 4-2b Small Mammal Chronic Dietary Dose HQs in Upland Habitat, Total PCBs
Figure 4-2c Small Mammal Chronic Dietary Dose HQs in Upland Habitat, Aluminum
Figure 4-2d Small Mammal Chronic Dietary Dose HQs in Upland Habitat, Hexachlorobenzene
Figure 4-3a Large Mammal Chronic Dietary Dose HQs in Lakebed Habitat, Mammalian TEQ, ND=1/2DL
Figure 4-3b Large Mammal Chronic Dietary Dose HQs in Lakebed Habitat, Aluminum
Figure 4-4a Large and Small Mammal Acute Dietary Dose HQs in Lakebed Habitat, Mammalian TEQ, ND=1/2DL
Figure 4-4b Small Mammal Chronic Dietary Dose HQs in Lakebed Habitat, Mammalian TEQ, ND=1/2DL
Figure 4-4c Small Mammal Chronic Dietary Dose HQs in Lakebed Habitat, Aluminum
Figure 4-4d Small Mammal Chronic Dietary Dose HQs in Lakebed Habitat, Iron

Section 5
Figure 5-1a Terrestrial Plant Direct Contact HQs in Upland Habitat, Aluminum
Figure 5-1b Terrestrial Plant Direct Contact HQs in Upland Habitat, Antimony
Figure 5-1c Terrestrial Plant Direct Contact HQs in Upland Habitat, Barium
Figure 5-1d Terrestrial Plant Direct Contact HQs in Upland Habitat, Chromium
Figure 5-1e Terrestrial Plant Direct Contact HQs in Upland Habitat, Molybdenum
Figure 5-1f Terrestrial Plant Direct Contact HQs in Upland Habitat, Manganese
Figure 5-1g Terrestrial Plant Direct Contact HQs in Upland Habitat, Selenium
Figure 5-1h Terrestrial Plant Direct Contact HQs in Upland Habitat, Vanadium
Figure 5-1i Terrestrial Plant Direct Contact HQs in Upland Habitat, Pentachlorophenol

Section 6
Figure 6-1a Soil Invertebrate Direct Contact HQs in Upland Habitat, Barium
Figure 6-1b Soil Invertebrate Direct Contact HQs in Upland Habitat, Chromium
Figure 6-1c Soil Invertebrate Direct Contact HQs in Upland Habitat, Mercury
Figure 6-2a Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Total PCBs
Figure 6-2b Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Arsenic
Figure 6-2c Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Barium
Figure 6-2d Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Iron
Figure 6-2e Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Manganese
Figure 6-2f Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Hexachlorobenzene
Figure 6-2g Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Pentachlorobenzene
Figure 6-2h Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Phenol
Figure 6-2i Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, 1,1-Dichloroethane

Figure 6-2j Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, 1,2,4-Trichlorobenzene
Figure 6-2k Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, 2-Butanone
Figure 6-2l Benthic Invertebrate Direct Contact HQs in Lakebed Habitat, Carbon Disulfide
Figure 6-3a Aquatic Biota Direct Contact HQs in Lakebed Habitat, Total PCBs
Figure 6-3b Aquatic Biota Direct Contact HQs in Lakebed Habitat, Aluminum
Figure 6-3c Aquatic Biota Direct Contact HQs in Lakebed Habitat, Barium
Figure 6-3d Aquatic Biota Direct Contact HQs in Lakebed Habitat, Beryllium
Figure 6-3e Aquatic Biota Direct Contact HQs in Lakebed Habitat, Cadmium
Figure 6-3f Aquatic Biota Direct Contact HQs in Lakebed Habitat, Chromium
Figure 6-3g Aquatic Biota Direct Contact HQs in Lakebed Habitat, Cobalt
Figure 6-3h Aquatic Biota Direct Contact HQs in Lakebed Habitat, Copper
Figure 6-3i Aquatic Biota Direct Contact HQs in Lakebed Habitat, Iron
Figure 6-3j Aquatic Biota Direct Contact HQs in Lakebed Habitat, Lead
Figure 6-3k Aquatic Biota Direct Contact HQs in Lakebed Habitat, Manganese
Figure 6-3l Aquatic Biota Direct Contact HQs in Lakebed Habitat, Mercury
Figure 6-3m Aquatic Biota Direct Contact HQs in Lakebed Habitat, Nickel
Figure 6-3n Aquatic Biota Direct Contact HQs in Lakebed Habitat, Selenium
Figure 6-3o Aquatic Biota Direct Contact HQs in Lakebed Habitat, Silver
Figure 6-3p Aquatic Biota Direct Contact HQs in Lakebed Habitat, Thallium
Figure 6-3q Aquatic Biota Direct Contact HQs in Lakebed Habitat, Vanadium
Figure 6-3r Aquatic Biota Direct Contact HQs in Lakebed Habitat, Zinc
Figure 6-3s Aquatic Biota Direct Contact HQs in Lakebed Habitat, Pentachlorophenol
Figure 6-3t Aquatic Biota Direct Contact HQs in Lakebed Habitat, Carbon Disulfide
Figure 6-3u Aquatic Biota Direct Contact HQs in Lakebed Habitat, Chloroform
Figure 6-3v Aquatic Biota Direct Contact HQs in Lakebed Habitat, Total Cyanide
Figure 6-3w Aquatic Biota Direct Contact HQs in Lakebed Habitat, Chlorine
Figure 6-4 Modeled Tissue HQs for Soil Invertebrates, Total PCBs
Figure 6-5 Modeled Tissue HQs for Aquatic Invertebrates, Hexachlorobenzene

Section 7

Figure 7-1 COPEC Concentration Variability in Site Surface Water
Figure 7-2 Comparison of PCB Mixtures

Acronyms and Abbreviations

Name	Definition
95UCL	95 percent upper confidence limit of the mean
µg/L	Micrograms per liter
AE	Assessment endpoint
AhR	Aryl hydrocarbon receptor
AHUF	Acid habitat utilization factor
AOC	Administrative Settlement Agreement and Order on Consent
AQUIRE	AQUatic toxicity Information REtrieval
ATI	ATI Titanium, LLC
BAF	Bioaccumulation factor
BERA	Baseline ecological risk assessment
bgs	Below ground surface
BTAG	Biological Technical Assistance Group
BW	Body weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHC	Chlorinated hydrocarbon
Cmax	Maximum detected concentration in a dataset
COPEC	Constituent of potential ecological concern
CSM	Conceptual Site Model
CWP	Current Waste Pond
D/F	Dioxins/furans
DL	Detection limit
DLC	Dioxin-like compound
DMA	Demonstration of Methods Applicability
DNR	Division of Natural Resources
DOC	Dissolved organic carbon
DQA	Data Quality Assessment
DUA	Data Usability Assessment
dw	Dry weight
DWQ	Division of Water Quality
EC20	20 percent effect concentration
EcoSurvey	5-Day ecological survey
EPC	Exposure point concentration
ERA	Ecological risk assessment
ERM	ERM-West, Inc.
EROD	7-Ethoxyresorufin-O-deethylase
FS	Feasibility study
GSL	Great Salt Lake
GSLIC	Great Salt Lake Intake Canal
GWDP	Ground Water Discharge Permit
ha	Hectare
HAA	Haloacetic acids
HCB	Hexachlorobenzene
HMW	High molecular weight
HQ	Hazard quotient
IMB	Inter-Mountain Basin
kg	Kilogram
L	Liter

LMW	Low molecular weight
LOAEL	Lowest observed adverse effect level
LOE	Line of evidence
MATC	Maximum Allowable Threshold Concentration
ME	Measurement endpoint
mg	Milligram
MVP	Minimum viable population
NAWQC	National Ambient Water Quality Criteria
ND	Nondetect
NOAEL	No observed adverse effect level
NOEC	No observed effect concentration
OCDD	Octachlorodibenzodioxin
OCDF	Octachlorodibenzofuran
OU	Operable Unit
OU-1	Operable Unit 1
OU-2	Operable Unit 2
OWP	Old Waste Pond
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PeCDF	2,3,4,7,8-Pentachlorodibenzofuran
ppt	Parts per thousand
PRI	Preliminary Remedial Investigation
RBESL	Risk-based ecological screening level
RCRA	Resource Conservation and Recovery Act
ReP	Relative potency
RWP	Retrofitted Waste Pond
RI	Remedial investigation
SAP	Sampling and Analysis Plan
SAP Mod	Sampling and Analysis Plan Modification
SLERA	Screening-level ecological risk assessment
SUF	Site use factor
SVDD	Skull Valley Diversion Ditch
SVOC	Semivolatile organic compound
SWAC	Surface-weighted average concentration
SWReGAP	Southwest Regional Gap Analysis Project
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TCDF	2,3,7,8-Tetrachlorodibenzofuran
TDS	Total dissolved solids
TEF	Toxicity equivalency factor
TEQ	Toxicity equivalency
TOC	Total organic carbon
TRV	Toxicity reference value
UCL	Upper confidence limit of the mean
UDEQ	Utah Department of Environmental Quality
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USM	US Magnesium LLC
VOC	Volatile organic compound
WOE	Weight of evidence

1. INTRODUCTION

US Magnesium LLC (USM) is a commercial producer of magnesium, magnesium alloys, chlorine, hydrochloric acid, and lithium carbonate that operates a facility in Rowley, Tooele County, Utah (Site; Figure 1-1). ERM-West, Inc. (ERM) has been retained by USM to perform remedial investigation and feasibility study (RI/FS) services at the Site. This Baseline Ecological Risk Assessment (BERA) has been prepared in accordance with the requirements of the Administrative Settlement Agreement and Order on Consent (AOC), which governs the performance of the RI/FS (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. CERCLA-08-2011-0013, effective 4 August 2011). This BERA has been prepared in consultation with the United States Environmental Protection Agency (USEPA) Region 8 Biological Technical Assistance Group (BTAG).

1.1 Purpose and Organization

This report presents the BERA conducted in support of the USM RI/FS. The primary objectives are to: (1) describe the methodology used to evaluate baseline ecological risks at the Site; and (2) present the findings of the BERA evaluations.

1.2 Site Description and Background

The Site includes an active primary magnesium production facility, which has been in operation since 1972. Magnesium is refined from brine obtained from the Great Salt Lake (GSL). The facility includes employee offices, process buildings, and other ancillary structures and facilities. Surrounding the process buildings are a series of evaporation ponds, a concentrated brine pond, a landfill, electrolytic salt (“smut”) storage piles, and a calcium sulfate (gypsum) disposal area. A series of earthen, open-air ditches formerly conveyed liquid waste from the process facility to earthen wastewater evaporation ponds. Currently, liquid wastes are conveyed via piping to the wastewater evaporation ponds. An engineered disposal site for cast house residues containing barium sulfate is present northwest of the facility.

The investigation history for the Site dates back to 1969 and the early 1970s, when investigations were conducted to collect geotechnical data for facility design and to evaluate background groundwater conditions. Between 1972 and 2001, several investigations were performed by National Lead, AMAX, and MagCorp (previous owners of the facility); USEPA; and the Utah Division of Air Quality, which included collection of samples from process streams and wastes, soil, and sediment for analysis of contaminants including hexachlorobenzene (HCB) and other semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and dibenzofurans, metals, and/or volatile organic compounds (VOCs). Between 2001 and 2006, multiple investigations were performed by USEPA and USM in association with a Resource Conservation and Recovery Act (RCRA) complaint filed by the U.S. Department of Justice on behalf of USEPA.

On 4 August 2011, the AOC for an RI/FS under CERCLA was entered into by USM and USEPA Region 8. The AOC defines the roles, responsibilities, schedule, and administration of the RI/FS to be performed. For project planning purposes, the Site was defined in the AOC as the area within a 5-mile radius centered on USM’s Main Stack, excluding the magnesium plant. The Site is located in Lakeside Valley, a north-south-trending valley bordered by the GSL and solar evaporation ponds to the east and the Lakeside Mountains to the west. Note that the Site encompasses the active magnesium production facility, but the active magnesium production facility itself is not included in the RI/FS.

Additionally, the USEPA divided the Site into two Operable Units (OUs), each covering a 5-mile radius from the main magnesium production facility. Operable Unit 1 (OU-1) includes areas of soil, sediment, groundwater/surface water, and wastewater that may be affected by waste streams. Operable Unit 2 (OU-2) includes ambient air, specifically, air contaminants potentially present in stack and fugitive

emissions from the Site. OU-1 is the subject of this BERA. Risks to humans from exposures in OU-1 are evaluated in a separate report.

The BERA for chlorine and hydrogen chloride in ambient air (OU-2) is evaluated in a separate report (*Final OU-2 Human Health and Ecological Baseline Risk Assessment Report* [ERM 2022]). Chronic air toxicants (i.e., toxicants other than chlorine and hydrogen chloride) were assumed to deposit in soil/sediment/surface water, thus exposure to chronic air toxicant contaminants released by stack and fugitive emissions are evaluated in this BERA through contact with soil, sediment, and groundwater/surface water.

To support initial planning phases of the RI, USEPA Region 8 divided the Site into 18 Preliminary Remedial Investigation (PRI) areas, which are considered as exposure units for the BERA. Site-wide ambient air (OU-2, formerly referred to as PRI 18) was evaluated independently as described above. In later planning phases of the ecological risk assessment (ERA), USEPA Region 8 further delineated Skull Valley Diversion Ditch (SVDD) and Great Salt Lake Intake Canal (GSLIC) as additional exposure units for the BERA. PRIs 1 through 10, a portion of PRI 11, and PRI 12 are located on the USM property and actively used by USM, while all other PRIs are outside the property boundaries and represent areas where material from the USM operations may have migrated. The exposure units are listed below and shown on Figure 1-2.

- PRI 1: Former Ditches
- PRI 2: Landfill
- PRI 3: Sanitary Lagoon
- PRI 4: Gypsum Pile
- PRI 5: Southeast Ponded Waste Lagoon (Current Waste Pond [CWP])
- PRI 6: Northwest Ponded Waste Lagoon (CWP)
- PRI 7: Northeast Ponded Waste Lagoon (Old Waste Pond [OWP])
- PRI 8: Northwest Lagoon Overflow
- PRI 9: Smut Area
- PRI 10: Barium Sulfate Disposal Area
- PRI 11: ATI Titanium, LLC (ATI) and USM Parking Lots
- PRI 12: Ancillary Worker Exposure Area
- PRI 13: Buffer Area Northeast
- PRI 14: Buffer Area Southeast
- PRI 15: Buffer Area Alluvial Upland
- PRI 16: Buffer Area Lakeside Mountains
- PRI 17: Site-Wide Surface Water and Groundwater
- SVDD
- GSLIC

These PRIs provide the decision units evaluated in the RI/FS. PRI 17 is Site-wide surface water and groundwater. However, for the BERA, to support decision-making in the RI/FS, surface water was

evaluated within each exposure unit rather than Site-wide (see Section 2.3). Groundwater is not evaluated in this BERA as it is not an exposure medium to ecological receptors.

PRIs 1 and 3 have already undergone remedial actions. Most of the wastewater ditches that made up PRI 1 were filled and capped in 2020 as part of the RCRA activities occurring under the RCRA AOC (USEPA 2016a) and are therefore not evaluated in this BERA. Similarly, solids in PRI 3 have been addressed under the RCRA AOC, and only surface water and ambient air exposures are evaluated in this BERA.

Pursuant to Utah Department of Environmental Quality (UDEQ), Division of Water Quality (DWQ) Ground Water Discharge Permit (GWDP) No. UGW450012, effective 19 December 2018 and the Consent Decree (Case No. 2:01CV0040B) lodged by the United States in the United States District Court, District of Utah on 19 January 2021, PRIs 5, 6, and 7 will be merged to create a retrofitted waste pond (RWP). The RWP will receive the current wastewater stream that includes wastewater from the new lithium facility constructed to reprocess smut material in PRI 9. The projected final elevation of wastewater within the RWP has been evaluated as part of the engineering design process. Based on the dynamic water balance modeling, little of the upland area currently present in PRI 5 and PRI 6 will remain due to operation of the RWP, but actual water levels and the extent of sediment inundation are not known with certainty, and are expected to vary as a function of both weather conditions and USM facility production rates. As part of the RCRA activities, PRI 4, which currently receives a slurry of gypsum, will remain in use during future facility operations; however, after the construction and operation of a filtration treatment system (Filtration System), the gypsum being disposed of at PRI 4 will no longer contain elevated levels of chlorinated hydrocarbons, such as PCBs, HCB, and dioxins/furans (D/F). Additionally, USM permanently ceased use of the section of the SVDD adjacent to PRIs 5 and 6 and an alternative alignment for the SVDD was developed to route Skull Valley surface water discharge farther away from the waste ponds. The entire length of the SVDD within PRI 5 is inside the RWP and the portion of the SVDD that is adjacent to PRI 7 has been filled and covered by an earthen dike as part of the RWP construction. Thus, the SVDD will cease to exist after the RWP construction.

For PRIs included in the RWP Area (PRIs 4, 5, 6, and 7), potential risks under current conditions are described in the main body of the BERA. Potential risks included in the RWP Area under future conditions are presented in Appendix C of the BERA. Management of potential ecological risks under current and future conditions for PRIs within the RWP Area will be addressed pursuant to the Consent Decree. If USEPA determines there are Site conditions that pose a significant risk to birds in the RWP Area, Appendix 9 (Avian Risk Mitigation Plan) of Consent Decree (Case No. 2:01CV0040B) provides the framework for managing these risks.

1.3 BERA Organization

Following the Site description and background in this section, this BERA contains the following sections:

- Section 2: BERA Approach
- Section 3: Risk Evaluation for Birds
- Section 4: Risk Evaluation for Mammals
- Section 5: Risk Evaluation for Plant Communities
- Section 6: Risk Evaluation for Invertebrates and Aquatic Biota
- Section 7: Uncertainty Analysis
- Section 8: Conclusions
- Section 9: References

Figures and tables follow the report text. Appendices with supporting information are as follows:

- Appendix A: Comprehensive Species List
- Appendix B: Process for Calculating Surface-Weighted Average Concentrations Using Accessible Samples in PRI 5 and PRI 6 Lakebed Sediment
- Appendix C: Benchmark and TRV Selection
- Appendix D: Retrofitted Waste Pond Hypothetical Risk Results Output
- Appendix E: Comprehensive Risk Tables and Risk Workbook
- Appendix F: ProUCL Output for Calculation of 95UCLs

2. BERA APPROACH

The risk assessment process is used to systematically evaluate and organize data, assumptions, and uncertainties to help understand and predict the relationships between stressors and receptors in a way that is useful for environmental decision-making (USEPA 1998). The risk assessment in support of the USM RI/FS is consistent with USEPA and State of Utah guidance, and the AOC (USEPA 2011).

The first step of the process is the screening-level ecological risk assessment (SLERA). The SLERA for USM has been completed and is detailed in ERM 2017b. The assumptions used in the OU-1 SLERA to model risk were by design highly conservative with the objective of identifying constituents of potential ecological concern (COPECs). The COPECs selected do not necessarily signify a risk, but rather are merely chemicals that have been identified for advancement to further analyses.

The next step in the process is the BERA, in which COPECs carried through from the SLERA have been evaluated in a focused and refined assessment of ecological risk (i.e., the BERA), using more realistic and Site-specific assumptions. The final BERA step was completed after the Site assessment activities were completed and has been conducted in accordance with USEPA (1997) guidance as described below.

The approach used in this BERA follows a process that is consistent with USEPA guidance:

- **BERA Dataset** – Establishes the list of studies used for the BERA and their adequacy through a four-step data usability assessment and subsequent data adequacy evaluation
- **Problem Formulation** – Establishes the scope of the BERA, identifies the major factors to be considered, and ensures that exposure scenarios most likely to contribute to ecological risk are evaluated
- **Exposure Assessment** – Establishes the information necessary to determine or predict ecological exposures to COPECs under exposure scenarios of interest
- **Effects Assessment** – Establishes concentrations in media or doses of COPECs that pose an unacceptable potential for adverse effects to receptors of concern
- **Risk Characterization** – Integrates the results of the exposure and effects assessments to evaluate the likelihood of adverse ecological impacts associated with exposure to COPECs

2.1 BERA Dataset

This section identifies the procedures used to evaluate the usability, quality, and suitability of the historical and newly collected data for the purposes of supporting a BERA.

2.1.1 Data Usability Assessment

A data usability assessment (DUA) was conducted to support the BERA. The DUA is a critical step that should be performed prior to conducting analyses for ERAs (USEPA 1998). This section presents the approach and findings of the DUA for OU-1 and establishes chemical and biological data that are of acceptable quality and considered suitable for use in conducting this BERA.

2.1.1.1 Approach

Chemical and biological data collected as part of the RI and in other studies were reviewed using a four-step process, consistent with approaches presented in USEPA's Guidance for Data Usability in Risk Assessment (USEPA 1992b), to assess data usability for the BERA. These four steps are:

- **Step 1 – Data inventory.** Identify all studies conducted within the RI with data potentially relevant for use in the BERA.
- **Step 2 – Data quality assessment.** Assess whether data identified in Step 1 are of acceptable quality for use in the BERA.
- **Step 3 – Data suitability assessment.** Assess the relevance of data for each assessment type in the BERA.
- **Step 4 – Data comparability assessment.** Determine whether data collected from different studies or using different methods can be combined for specific evaluations (e.g., combining chemical data prior to calculating exposure point concentrations).

2.1.1.2 Step 1. Data Inventory

Existing data were compiled for potential inclusion in the BERA. Inventoried data include chemistry (e.g., abiotic chemistry [solids and water] and biotic chemistry [e.g., tissue]) data, Site-specific toxicity studies, and ecological field survey data.

Chemistry Data

Several sampling events for evaluating contamination have occurred at the Site since 1972. For abiotic chemistry data, only studies conducted within the RI/FS are considered for this data inventory. For biotic chemistry data, all studies (both collected outside the RI/FS and as part of the RI/FS) are described here.

Abiotic Chemistry Data

Sampling and analysis activities completed under USEPA-issued or USEPA-approved work plans for the RI/FS began in 2012 and have included the sampling events listed below. Note that throughout the RI/FS activities, the term “solids” has been used to refer to solid-matrix samples comprising soil, sediment, or solid waste.

- **Phase 1A Demonstration of Methods Applicability Study (ERM 2013a) –** Surface soil/sediment/ solid waste, wastewater, and surface water samples were collected from PRIs 1, 4, 5, 6, 7, 9, 14, and 15 in 2012 as part of the Phase 1A Demonstration of Methods Applicability (DMA) study that was completed as proof of sampling and analysis methodology that could be used for all subsequent RI studies in preparation for the first phase of sampling for the RI. A draft technical memorandum summarizes results and data quality (ERM 2013a).
- **Phase 1A Study for PRIs 2 and 8 through 17 (USEPA 2013a; ERM 2016a) –** Surface and subsurface soil/sediment/solid waste, surface water, wastewater, and groundwater samples were collected from PRIs 2 and 8 through 17 in 2013 to 2015 during the Phase 1A RI, and the SVDD through a Sampling and Analysis Plan (SAP) modification, to identify chemicals of potential concern for human and ecological receptors. Surface sample locations were selected using systematic grid and judgmental sampling strategies. Solids samples were collected from 0 to 6 inches using a hand auger or flat-bottom scoop at PRIs 2, 8, 9, 10, 12, and 14. In PRIs where areal deposition was the only suspected contaminant transport mechanism, samples were collected from 0 to 2 inches using a flat-bottom scoop. Subsurface solids samples were collected from 10 sampling locations within PRI 2, PRI 8, PRI 10, and PRI 14 using a core with samples taken at specific depth intervals. Groundwater samples were collected from 30 groundwater monitoring wells while grab surface water samples were collected from 16 locations in ponded waste lagoons and in ditches. Samples were analyzed using standard analytical methods appropriate for ERA. Solids samples were analyzed for PCBs, D/F, SVOCs, polycyclic aromatic hydrocarbons (PAHs), metals, cyanide, total organic carbon (TOC), perchlorate, and pH. Subsurface solids and select surface solids samples were also analyzed

for VOCs. Groundwater and surface water samples were analyzed for PCBs, D/F, SVOCs, PAHs, pH, chlorine, metals (total/unfiltered and dissolved/filtered), cyanide, TOC, VOCs, haloacetic acids (HAAs), perchlorate, major anions, alkalinity, total dissolved solids (TDS), and hexavalent chromium. Results and data quality are summarized in ERM 2016a.

- **Phase 1A-B Remedial Investigation Study (ERM 2015a, 2016c) –** Surface and subsurface soil/sediment/solid waste samples were collected from PRIs 1 and 3 through 7 and from upland and lakebed background areas in 2015 for the Phase 1A-B RI to identify chemicals of potential concern, and perform preliminary Site characterization mapping of PRIs 1 and 3 through 7. Surface and subsurface soil/sediment samples were also collected outside the 5-mile RI/FS area radius at six candidate background areas and one contingency area at the Bear River Migratory Bird Refuge and for background chemical assessments and identification of biotic reference areas. Surface solids samples were collected from 0 to 6 inches below ground surface (bgs) using a hand auger, ponar, or flat-bottom scoop, while subsurface solids samples were collected from up to 10 feet bgs. At background locations, samples were collected from 0 to 2 inches, and at a subset of locations, a subsurface sample was collected from 2 to 36 inches bgs. Samples were analyzed using standard analytical methods appropriate for ERA. Samples were analyzed for PCBs, D/F, SVOCs, PAHs, metals, cyanide, TOC, perchlorate, and pH. Results and data quality are summarized in ERM 2016c.
- **Phase 2A Remedial Investigation Study (ERM 2016b, 2017c, 2018a) –** Co-located surface soil/ sediment/solid waste and biotic tissue samples were collected from upland and shoreline habitats in PRIs 1, 4 through 8, and 13 through 15 (including SVDD and GSLIC), and a reference area in Lakeside Valley south of the Site in 2016 for the Phase 2A RI. The objective of the sampling effort was to characterize COPEC concentrations in substrate and in biotic tissue to determine the relationship between COPEC concentrations in co-located soils/sediment and representative prey tissues and development of bioaccumulation models. In total, 36 locations were sampled for surface solids at depths of 0 to 6 inches. Samples were analyzed using standard analytical methods appropriate for ERA. Abiotic solids samples were analyzed for PCBs, D/F, HCB, metals, and TOC. Results and data quality are summarized in ERM 2018a.
- **Phase 2B Hydrology Remedial Investigation (ERM 2018b, 2020b) –** Surface water and groundwater samples were collected quarterly for four quarters in 2018 to 2019 for the Phase 2B Hydrology RI. One objective of the Phase 2B Hydrology RI was to spatially and temporally characterize the nature and extent of COPECs in surface water from either groundwater discharges or discharges/releases of facility wastewater; other objectives were associated with refining the hydrologic Conceptual Site Model (CSM) for groundwater and surface water. Groundwater samples were collected from monitoring wells using low-flow sampling methods, while surface water samples were collected using a peristaltic pump. Samples were analyzed using standard analytical methods appropriate for ERA. Samples were analyzed for major anions, TDS, alkalinity, metals, VOCs, HAAs, density, D/F, SVOCs, cyanide, PCBs, pH, chlorine, and hexavalent chromium. Select water samples were also analyzed for stable and radiogenic isotopes. Results and data quality are summarized in the *Draft Phase 2B Hydro Remedial Investigation Data Report* (ERM 2020b).
- **Phase 1A-B Remedial Investigation SAP Modifications (ERM 2021) –** Surface soil/sediment/solid waste samples were collected from various PRIs in 2019 and 2020 under a series of Phase 1A-B RI SAP Modifications (SAP Mods). Results and data quality are summarized in the Final Phase 1A-B RI SAP Modifications Data Report (ERM 2021). Samples collected under these SAP Mods were analyzed for lists of COPECs specific to each PRI, as identified by the SLERA. These Phase 1A-B SAP Mods were as follows:
  - SAP Mod 4, which included collection of surface soil/sediment/solid waste samples in PRIs 5, 7, and 14 in 2019 and 2020 to characterize concentrations of COPECs and waste thickness, and in

PRI 8 to evaluate whether wastewater releases that occurred after the 2014 Phase 1A RI sampling have resulted in significantly changed concentrations of COPECs.

- SAP Mod 5, which included collection of surface soil/sediment/solid waste samples in PRIs 8, 13, and 14 (including SVDD and GSLIC) to fill data gaps for the BERA and provide additional information on contaminant nature and extent for the RI.
- SAP Mods 6 and 7, which included collection of surface soil/sediment/solid waste samples in PRI 8 to evaluate changed conditions in the PRI as a result of the placement of gypsum material to construct of truck turnarounds or as a result of inundation of the area by wastewater releases that occurred after the Phase 1A sampling.

Biotic Chemistry Data

Historical studies conducted outside the RI/FS include:

- **MagCorp 2000 –** Brine flies and brine shrimp were collected near the facility in November 1999 by MagCorp for chemical analysis. One sample was collected for each tissue type. Available documentation for these samples does not state the sample location.
- **Parametrix 2004 –** Biotic tissue, including small mammals, plants, soil invertebrates, and brine flies, was collected for chemical analysis in 2003 and 2004 (often with co-located with abiotic samples) to support the Focused ERA. Multiple samples were collected where tissue mass allowed. Samples were collected in PRIs 3, 5, 6, 7, and 15, and in aquatic and terrestrial reference areas.
- **USEPA 2004, 2005a, 2006 –** Bird eggs were collected from the Site and from reference areas during the 2004, 2005, and 2006 nesting seasons to determine if there were elevated concentrations of metals, PCBs, D/F, and HCB in eggs collected at the Site compared to eggs collected in reference areas. The object of these studies was to collect egg tissue to assess the risks and embryological effects of contaminants from the Site to shorebirds.

Sampling and analysis activities completed under USEPA-issued or USEPA-approved work plans for the RI/FS began in 2012 and included the following sampling event:

- **Phase 2A Remedial Investigation Study (ERM 2016b, 2017c, 2018a) –** Tissue samples (plants, small mammals, soil invertebrates, brine flies, and/or brine shrimp) were collected for COPEC analysis from upland and shoreline habitats in PRIs 1, 4 through 8, and 13 through 15 in 2016 and 2017 and a background area in 2016 and 2017 for the Phase 2A RI. Tissue samples were collected with co-located substrate samples at 36 locations to support development of bioaccumulation models. Biotic tissue samples were analyzed for PCBs, D/F, HCB, metals, and lipids, depending on the collected biomass. Refer to the abiotic chemistry data inventory for discussion of abiotic samples collected for this study.

Site-Specific Toxicity Studies

Avian toxicity studies using USM process wastewater as a test substance have been conducted prior to the RI/FS. These studies include:

- **Parametrix 2004 –** Parametrix (Appendix K of Parametrix 2004) collected USM facility process wastewater from the active pond on 17 March 2003 to test the effects of its ingestion on aquatic birds and migrating shorebirds.
- **Hooper et al. 2008 –** Hooper et al. conducted five experiments to assess potential adverse health effects of acidic pond water on birds by means of its consumption and contact to the birds and their eggs.

Ecological Field Survey Data

A number of field surveys have been performed to provide information on the status of ecological receptors (birds, mammals, plants, invertebrates) in the vicinity of the USM facility. These studies are listed below.

- **Thompson 1983 –** The study by Thompson (1983) reported the findings of a vegetation survey conducted on 25 October 1983, at sites within 3 miles of the facility. The objective of the survey by Thompson (1983) was to determine if any major changes in plant species composition had occurred after 12 years of production.
- **Glover 1983 –** The study by Glover (1983) presented the findings of a reconnaissance survey conducted on 27 October 1983, on and near the USM property to determine if indigenous plants and animals had experienced environmental stress.
- **Halford et al. 1999 –** A specialized use survey was conducted to determine species of plants and animals using or potentially using areas likely impacted by facility operations. Visible observations of plants, wildlife, and wildlife signs were made in 10 locations. Small mammals were identified and inventoried by placing overnight trapping transects in four selected areas within the Site.
- **USFWS 1998a, 1998b, 1998c –** Airborne surveillance and Site visits were conducted by United States Fish and Wildlife Service (USFWS) representatives on four separate days. The objectives of these activities were to tour the Site, observe solids and water sample collection, and observe birds within close proximity to the OWP, active wastewater ponds, wastewater conveyance ditches, and evaporation ponds.
- **BIO-Logic 2002 –** Field observations were made at the wastewater areas near the magnesium facility to investigate use of the wastewater in the active ponds (PRIs 5 and 6) by birds.
- **BIO-Logic 2003 –** Bird exposure to the active wastewater pond (PRIs 5 and 6) at the USM facility was assessed primarily based on analysis of bird observation data (BIO-Logic 2002); analyses involved basic calculations that utilized time intervals of bird water contact and total observation times to estimate mean monthly exposures.
- **BIO-Logic 2004 –** BIO-Logic Environmental conducted a benthic invertebrate survey at the OWP (PRI 7) and Borrow Pit (PRI 6)[1] to determine whether overwintering brine fly larvae or other benthic macroinvertebrates were present.
- **BIO-Logic 2006 –** Bird presence and relative abundance during the 2006 breeding season (May to June) was studied. Relative abundance was compared between the OWP (PRI 7) and other adjacent habitats of saline mudflats and manmade dikes.
- **Beltman and Stackhouse 2007 –** Beltman and Stackhouse (2007) detail the results of a 2002 bird survey (concurrent with BIO-Logic 2002) conducted at the Site to qualitatively characterize bird use in the wastewater ditches and ponds.
- **Cavitt 2008, 2010 –** Cavitt (2008, 2010) reported on avian utilization and reproductive success for nests located in PRIs 5, 6, 7, 14, and several reference areas. Information was collected on three species (American avocet [*Recurvirostra americana*], snowy plover [*Charadrius nivosus*], and horned lark [*Eremophila alpestris*]) regarding behavioral activity, nesting locations, hatchability of eggs, and nesting success. These metrics were compared between the Site nests and the selected reference areas.

[1] The Borrow Pit described in BIO-Logic 2004 is referred to as the Barrow Pits in Parametrix 2004. This ditch feature was located at the northwestern boundary of PRI 6 adjacent to PRI 10. The ditch feature is now continuous with the acidic wastewater in PRI 6, thus does not support brine fly larvae.

Ecological field survey data collected for the RI/FS has included the following events:

- **2014 Habitat and Wildlife Survey (ERM 2013b, 2014a) –** A visual survey of habitat and wildlife was conducted for 5 days in June 2013 (ERM 2013b, 2014a). This survey (EcoSurvey) was designed to identify and map dominant or conspicuous habitat types and wildlife in PRIs 1 through 10 and 12 at 24 locations approved by agency representatives in the field.
- **2015 Reconnaissance of Candidate Background Sampling Area (ERM 2015b) –** A 4-day habitat and wildlife survey was conducted by ERM between 1 and 4 June 2015 to identify reference areas outside the Site representative of upland and lakebed habitats found at the Site. Fifteen areas were surveyed to identify suitable sampling locations for background information with regard to environmental and biological samples.

2.1.1.3 Step 2. Data Quality Assessment

The data quality assessment (DQA) is the scientific and statistical evaluation of data to determine if data are of the type, quality, and quantity to support their intended use (USEPA 2000). Specific procedures and assumptions for the DQA follow this USEPA (2000) guidance.

Chemistry Data

Data quality is assessed separately for abiotic and biotic chemistry data.

Abiotic Chemistry Data

For each sample collection effort conducted within the RI/FS, third-party data validation and DQAs were conducted and reported in data summary reports (see Section 2.1.1.2). RI/FS studies were designed to collect a representative set of samples from each medium of potential concern in each exposure area, and subsequent data adequacy evaluations (ERM 2019 and Section 2.1.2) have found these data to be sufficient[2] for this BERA. All data were deemed appropriate for use in ERA, with the following exceptions:

- Analytical methods for water were substantially refined after the DMA study, thus surface water samples from the DMA study were excluded from the dataset.
- Three background samples for molybdenum (LBB-09, LBSE-10, and UPN-10) were identified as outliers, and were thus excluded from the background dataset. Additionally, background sample LBSE-07 was identified as an outlier due to elevated concentrations of organics, and all results from this sample location were excluded from the background dataset.
- Reference area solids samples collected as part of Phase 2A were not intended for use as part of the background dataset, and thus were excluded.
- Two values were reported for field-measured chlorine in a Phase 1A water sample from sample location PRI5-017. Only the higher of the two values was retained for use in the BERA.

Biotic Tissue Chemistry Data

Four biotic tissue sampling studies have been conducted at the Site (see Section 2.1.1.2). Table 2-1 presents the criteria for and the results of the DQA for biotic tissue chemistry data. Three studies are of conditionally acceptable or acceptable quality for use in the BERA (Parametrix 2004; USEPA 2004, 2005a, 2006; and ERM 2018a).

[2] ERM (2019) recommended that additional sampling and/or revisions of PRI boundaries could be warranted for lakebed habitat within PRI 8 and upland habitat within PRI 14. Additional sampling within these areas was performed as part of SAP modifications to Phase 1A-B.

Site-Specific Toxicity Studies

Two Site-specific toxicity studies have been conducted using USM-specific media (see Section 2.1.1.2). Table 2-1 presents the criteria for and the results of the DQA for Site-specific toxicity data. Both studies (Parametrix 2004 and Hooper et al. 2008) are deemed acceptable for use in the BERA.

Ecological Field Survey Data

Numerous ecological field surveys have been conducted at the Site (see Section 2.1.1.2), but with varying study designs, durations, and objectives. Table 2-1 presents the criteria for and the results of the DQA for field survey data. Three studies are not acceptable for use in the BERA, due to a lack of methodological information or because the survey results could not be associated with a specific exposure area (USFWS 1998a, 1998b, and 1998c). Two studies are of conditionally acceptable quality due to insufficient location information such that survey or sample locations could not be associated with a specific exposure area (Thompson 1983 and Glover 1983). Three additional studies (BIO-Logic 2004; BIO-Logic 2006; and Beltman and Stackhouse 2007) are of conditionally acceptable quality due to a lack of supporting documentation, such as field notebooks or photographs, which may decrease the reliability of these studies. Finally, six studies are of acceptable quality (Halford et al. 1999; BIO-Logic 2002; BIO-Logic 2003; Cavitt 2008, 2010; ERM 2013b, 2014a; and ERM 2015a), three of which were conducted as part of the RI/FS process. Studies conducted for an RI/FS are expected to have increased rigor, documentation, and critical review by relevant parties, which increases the reliability of these data.

2.1.1.4 Step 3. Data Suitability

The *Final Problem Formulation and Baseline Ecological Risk Assessment Technical Memorandum* (ERM 2020a) and subsequent discussions with USEPA (USEPA 2020b) outline exposure and effects-based assessments to be performed in this BERA (refer to Sections 2.3 and 2.4 of this BERA). These intended data use form the factual basis for the data suitability assessment. For each media type, data of sufficient quality (Section 2.1.1.3) are evaluated below for the following data uses:

- Development of exposure point concentrations (EPCs) that adequately represent current conditions at each exposure unit at the Site for use in hazard quotients (HQs) (abiotic chemistry data and biotic egg tissue data)
- Development of bioaccumulation models to estimate tissue body burdens to support dietary modeling for use in HQs and to develop EPCs for tissue HQs for invertebrates, plants, birds, and small mammals (co-located abiotic and biotic chemistry data)
- Assessment of toxicity of Site-specific media to relevant species compared to appropriate controls (Site-specific toxicity studies)
- Assessment of ecological metrics (e.g., avian reproductive success) at the Site compared to reference (ecological field surveys)

Chemistry Data

Data suitability is assessed separately for abiotic and biotic chemistry data.

Abiotic Chemistry Data

All chemistry data deemed appropriate for ERA in the DQA (Section 2.1.1.3) are considered suitable for all data uses in the BERA with the following exceptions:

- Only solids (soil and sediment) and surface water were considered suitable for assessing risk to ecological receptors. Groundwater samples were collected from monitoring wells that extend to

depths greater than those considered to be biologically relevant for use in this risk assessment (i.e., 6 inches). Therefore, all groundwater samples are excluded as they are not relevant to the ecological receptors evaluated in the BERA.

- For soil and sediment, only surface samples collected from 0 to 6 inches bgs, inclusive of samples collected to shallower final depths were considered relevant for assessing risk to ecological receptors, as this is the soil horizon that ecological receptors are expected to contact. All samples collected deeper than 6 inches bgs were excluded.
- Cyanide in water was analyzed in RI/FS studies using different methods and different fractions. Only unfiltered total cyanide data were considered suitable for ERA; amenable cyanide and filtered total cyanide results were excluded.
- Solids samples were collected from PRI 8 during Phase 1A in 2013 and 2014 and during Phase 2A in 2016. A portion of PRI 8 was inundated by wastewater overflow during the winters of 2015/16 and 2016/17. During the Phase 1A-B SAP Mod 4, 5, and 6/7 sampling, several of the Phase 1A locations in the area of inundation were resampled, and some new locations were sampled because some previous sampling locations were inaccessible due to the inundation. In addition, samples were collected from locations where a truck turnaround berm had been constructed of gypsum and then removed. Table 2-2 provides a list of samples collected in PRI 8 during all phases and indicates which samples are included and which are excluded from the BERA PRI 8 dataset.
- Water samples were collected from the SVDD as part of the Phase 1A SAP Mod in 2015 and 2016. After those samples were collected, USM rerouted the SVDD to no longer use the ditch running along the southern boundary of PRI 5 and installed an overflow pipe from the Current Waste Pond (CWP) (PRIs 5 and 6) to the OWP (PRI 7) to reduce water levels in PRI 5 during the wet season, thus eliminating seepage into the former SVDD. Therefore, only water samples from the 2018 to 2019 Phase 2B RI sampling effort are considered representative of current conditions, and are included in the BERA dataset. Earlier water samples in the SVDD are excluded.
- PRIs 1 and 3 are not evaluated in the BERA, as these areas have already undergone remedial actions as part of the RCRA Carve-Out AOC (USEPA 2016a). The majority of samples collected in PRIs 1 and 3 are thus excluded from the BERA dataset, with the exception of three solids sample locations from PRI 1 (samples 1-11, 1-12, and 1-13). Analytical chemistry results from these samples, which are outside the bounds of the PRI 1 remedy, were added into the PRI 5 data because these sample locations are representative of the USM waste stream entering PRI 5.
- The SLERA identified COPECs based on the presence of samples with detected concentrations of analytes for each PRI and did not consider lakebed and upland habitats within a PRI. The inclusion of habitat type in this BERA results in some analytes that have no detected samples for specific habitats in a PRI. Therefore, consistent with the SLERA, analytes with no detected concentrations in any sample for a given exposure area and habitat combination are removed from the BERA dataset.
- In water, metals were analyzed using both total and dissolved fractions. Results for total metals are appropriate for use for dietary dose calculations, as metals sorbed to particulates in the water may desorb in the acidic environment of an animal's gut. Results for dissolved metals were not used in dietary exposure calculations for water.

Biotic Chemistry Data

All egg tissue chemistry data found to be of sufficient quality (Section 2.1.1.3) are deemed suitable for use in the development of EPCs for use in HQs except for one background sample (06SPEG1R0105) that has an anomalously high HCB concentration, and four Site samples (06SPEG1S0506, 06SPEG1S0607, 06SPEG1S0708, and 06SPEG1S0809) that are located close to the 5-mile Site

boundary and appear to have contaminant levels that are intermediate between Site and background levels (USEPA 2020a).

While tissue data from Parametrix (2004) and USEPA (2004, 2005a, and 2006) are of sufficient quality, data from these studies cannot be used to accurately characterize the relationship between prey tissue burdens and soil concentrations based on evaluations performed as part of the Phase 2A Final Work Plan (ERM 2016b). In brief, the historical data was determined to be incomplete (e.g., only included a subset of PCB congeners), and the sample sizes and frequency of detects were considered limited in providing adequate power for comparisons between Site and reference areas that would be needed to confidently identify target analytes (ERM 2016b). Therefore, these data are not suitable for the development of bioaccumulation models. The *Phase 2A Representative Prey Investigation Data Report* (ERM 2018a) was designed to collect representative prey tissues to develop Site-specific bioaccumulation models for use in ERA. The study was conducted within the RI/FS, and tissue and soil samples were co-located. All tissue data found to be of sufficient quality (Section 2.1.1.3) are deemed suitable for use in the development of bioaccumulation models for use in this BERA.

Site-Specific Toxicity Studies

Of the two Site-specific toxicity studies deemed acceptable for use in the BERA in the DQA (see Section 2.1.1.3), both are appropriate for use (see Table 2-3). These studies, Parametrix 2004 and Hooper et al. 2008, assessed the acute effects of acidic wastewater on avian receptors and utilized appropriate controls. The results from these studies are appropriate to assess the toxicity of acidic wastewater to avian receptors.

Ecological Field Survey Data

Eleven ecological field surveys were deemed acceptable or conditionally acceptable for use in the BERA in the DQA (see Section 2.1.1.3). Of the 11 studies, 10 are appropriate for use in the Problem Formulation to identify receptors and exposure pathways, and four are appropriate for use interpreting avian use results for avian receptors (see Table 2-4). Two studies (Cavitt 2008, 2010) had a study design that compared avian reproductive success at the Site against an appropriate reference, which allows this data to be used to assess ecological metrics at the Site compared to an appropriate reference. While the Cavitt (2008, 2010) studies also collected data on aquatic invertebrates, the author only made statistical comparisons between Site and reference areas for avian species (e.g., comparisons between avian reproductive success at the Site against reference). Three studies (Glover 1983; Thompson 1983; Halford et al. 1999) compared plant health at the Site to plant health under normal conditions. Halford et al. (1999) also made observations on birds and mammal body condition. The studies that made comparisons, qualitative or quantitative, of Site data against reference and/or normal conditions are suitable for use assessing ecological metrics at the Site.

2.1.1.5 Step 4. Data Comparability

All suitable abiotic chemistry data collected from RI/FS sampling efforts were collected using similar methods for each media type and analyzed using similar analytical methods appropriate for use in ERA. Therefore, these data are comparable and can be combined for the purposes of calculating values such as EPCs and upper confidence limits of the mean (UCLs) for use in this BERA. Likewise, biotic egg tissue chemistry data obtained by USEPA (2004, 2005a, 2006) were all analyzed using the same methods, so all of the data from these three studies may be combined and compared.

Data from the two suitable Site-specific toxicity studies (Parametrix 2004 and Hooper et al. 2008) can be used in this BERA. However, these studies are not comparable due to differences in study design (exposure water, exposed species, exposure durations).

For birds, two ecological field surveys (Cavitt 2008, 2010) were found to be suitable for use in the ecological field survey line of evidence (LOE) (Table 2-4; Section 2.5.4). Because the two surveys were performed in the same areas using the same methods, data from the two surveys may be combined and compared.

For mammals and plants, respectively, two and three ecological field surveys were suitable for use as an LOE (Table 2-4; Section 2.5.4). These studies were performed using different methods during different seasons, and thus these studies are not comparable.

2.1.2 Data Adequacy

A data adequacy assessment for abiotic chemistry data was conducted in consultation with USEPA Region 8 BTAG (ERM 2019). The objective of the data adequacy assessment was to evaluate whether sufficient data had been collected to characterize exposure in the BERA. Recommendations from the data adequacy assessment were that: (1) no additional sampling was recommended for PRIs 1 through 7, upland habitat in PRI 8, PRIs 8 through 13, lakebed habitat in PRI 14, or PRIs 15 and 16; and (2) additional sampling or a PRI boundary revision may be warranted for lakebed habitat in PRI 8 and upland habitat in PRI 14. Because of these recommendations, additional data were collected as part of the Phase 1A-B SAP Mods (see Section 2.1.1.3). With the additional data, the BERA abiotic chemistry dataset is considered adequate for characterizing risk in all exposure areas.

2.1.3 Final BERA Datasets

This section summarizes studies for each data type (abiotic chemistry data, biotic chemistry data, Site-specific toxicity data, and ecological field survey data) found to be of sufficient quality and suitability for uses in this BERA (Section 2.1.1).

2.1.3.1 Chemistry Data

Summaries of the BERA datasets for abiotic and biotic chemistry are presented separately.

Abiotic Chemistry Data

A summary of the BERA dataset samples by exposure area, habitat, and media is presented in Table 2-5. The applicable habitat type (lakebed and upland) has been assigned to each sample location. Surface water samples and corresponding EPCs were assigned to the PRI within which they were collected. Sample locations within the GSLIC and the SVDD were designated as the GSLIC or the SVDD, respectively, rather than the larger PRI area (Table 2-6). The final BERA dataset source datasets for the BERA consist of the following:

- Surface soil/sediment/solid waste samples collected from PRIs 1, 3, 4, 5, 6, 7, 9, 14, and 15 in 2012 as part of a DMA study
- Surface soil/sediment/solid waste, surface water, and wastewater samples collected from PRIs 2 and 8 through 17 in 2013 to 2015 during the Phase 1A RI
- Surface soil/sediment/solid waste samples collected from PRIs 1, 3, and 4 through 7 (including the SVDD), and from upland and lakebed background areas in 2015 for the Phase 1A-B RI
- Surface soil/sediment/solid waste and surface water samples from the SVDD collected under Phase 1A SAP Mods in 2016
- Surface soil/sediment/solid waste samples collected from upland and shoreline habitats in PRIs 1, 4 through 8, and 13 through 15 (including the SVDD and GSLIC) in 2016 for the Phase 2A RI

- Surface soil/sediment/solid waste samples from upland and shoreline habitats in PRIs 5, 7, 8, 13, and 14 (including the SVDD and GSLIC) collected under Phase 1A-B SAP Mods in 2019 to 2020
- Surface water samples collected in PRIs 5 through 8, 14, and the SVDD in 2018 and 2019 for the Phase 2B Hydro RI

Biotic Chemistry Data

A summary of the BERA dataset used for the development of tissue EPCs by exposure area, habitat, and media is presented in Table 2-5 and comprises samples from USEPA's 2004 to 2006 field survey efforts. The applicable habitat type (lakebed and upland) has been assigned to each sample location based on species information (e.g., if a horned lark, habitat is upland). Egg tissue data samples collected from PRIs 5, 7, 13, 14, and background areas are used.

- American avocet and snowy plover eggs, representing lakebed habitats based on their nesting behaviors, were collected from PRIs 5, 7, 13, 14, and background.
- Horned lark and sage thrasher eggs, representing upland habitats based on their nesting behaviors, were collected from PRIs 5, 14, and background.

2.1.3.2 Site-Specific Toxicity Study Data

Site-specific toxicity data for the BERA were from Parametrix (2004) and Hooper et al. (2008). The Parametrix (2004) study evaluated the palatability and acute oral toxicity of facility process wastewater on mallards. The Hooper et al. (2008) study included five experiments, assessing the palatability, acute oral toxicity, and acute dermal toxicity of acidic pond water on adult mallard ducks, adult house finches, and Japanese quail eggs. The BERA dataset included toxicity data from all experiments from the above studies. For the BERA, study conclusions were taken directly from the reports without any additional statistical analysis of the raw data.

2.1.3.3 Ecological Field Survey Data

Ecological field survey data for the BERA are from numerous studies. Species presence/absence data from Thompson (1983); Glover (1983); Halford et al. (1999); BIO-Logic (2002, 2003, 2004); Parametrix (2004); USEPA (2004, 2005a, 2006); Beltman and Stackhouse (2007); Cavitt (2008, 2010); and ERM (2013b, 2014a, 2018a) were included in the BERA to inform the Problem Formulation (Section 2.2). Data on the presence/absence of mammals and live vegetation and visual assessment of plant condition and species composition from Thompson (1983), Glover (1983), and Halford et al. (1999) are included in the BERA for mammals and plants. Data on the number of birds and/or amount of time in contact with waste pond water from BIO-Logic (2002, 2003), Beltman and Stackhouse (2007), and ERM (2013b, 2014a) were included in the BERA to inform the interpretation of avian use results for avian receptors. Data on avian reproductive success (e.g., hatchability, adult mass) at the Site and reference areas from Cavitt (2008, 2010) were included in the BERA, as well as the limited qualitative notes on bird condition from Glover (1983), Halford et al. (1999), BIO-Logic (2006), and Beltman and Stackhouse (2007). For the BERA, study conclusions were taken directly from the reports without any additional statistical analysis of the raw data.

2.1.4 Chemistry Data Management and Treatment

This section describes data management and data treatment steps performed on the final BERA chemistry dataset.

2.1.4.1 Sample Types and Usage

Within the final BERA dataset, several different types of samples were collected. A description of each type and how they are handled is provided below.

- **Split Samples –** Split samples are used to check analytical techniques and comprise two or more parts of a homogeneous sample that are analyzed for the same parameters by different laboratories. Only the parent samples are used in this BERA.
- **Laboratory Replicate Samples –** Laboratory replicates are used to assess analytical variability. Only the parent sample results are used in this BERA.
- **Field Duplicates –** Field duplicates are used to assess sampling technique. Field duplicates are samples collected at the same time and location, are sampled using the same sampling procedure, and are analyzed by the same laboratory. Only the primary samples are used in this BERA.
- **Multiple Analytical Methods –** Some constituents were reported by more than one analytical method in the same sample. If the analyte was detected by both methods, the result from the method with the lower method detection limit (DL) was used. If the analyte was detected by one method, but not the other, the detected result was used. If the analyte was not detected by either method, the lower DL of the two results was used.

2.1.4.2 Qualified and Censored Data Handling

- **Nondetect Values –** Nondetect values (NDs) were designated as either “U” or “UJ” by the data validator and reported as the DL in the BERA dataset. NDs are assessed at ND = ½ DL for analytes evaluated on a sample-by-sample basis, and at the full DL for entry into ProUCL for calculation of the 95 percent upper confidence limit of the mean (95UCL). NDs for COPECs evaluated as summed values are described below in Section 2.1.4.4.
- **Rejected Data –** Data that failed quality assurance checks are qualified as “R” for rejected data and are excluded from the BERA.

2.1.4.3 Calculated Values

Calculated values including summations of COPECs with similar mechanisms of action and 95UCLs are used in this BERA. Methods used to calculate these values are provided below.

2.1.4.4 Summations

Some COPECs act using similar physiological mechanisms and are best evaluated as a group to account for additive toxicological effects. In this BERA, the following compounds have been evaluated by summing the results from individual compounds within the chemical class, including:

- 2,3,7,8-Tetrachlorodibenzo-p-dioxin toxicity equivalence concentration (TCDD TEQ) for D/F, dioxin-like coplanar PCB congeners, and HCB (HCB included in Avian TEQ only)
- Total low molecular weight/total high molecular weight (LMW/HMW) PAHs
- Total PCBs

The methodology used to calculate the sums and address ND constituents is described below for each class.

- The TCDD TEQ is calculated using concentrations for D/F congeners, and coplanar PCBs; the TCDD TEQ calculated for birds also includes HCB. Toxicity equivalency factors (TEFs) express the toxicity

of related chemicals (e.g., congeners) in terms of the most toxic form (2,3,7,8-TCDD). For D/F and coplanar PCBs, the World Health Organization TEFs have been applied as follows:

$$\text{TCDD TEQ} = \Sigma\ TEF_i \times C_i \qquad \text{Eqn 2-1}$$

Where:

C_i is the concentration of the ith dioxin congener, furan congener, coplanar PCB congener, or HCB (for Avian TEQ only).

- Mammalian TEFs from Van den Berg et al. (2006) were used to calculate mammal TEQs for the BERA. Two TEQ values were calculated for the Mammalian TEQ:
  1. ND results were excluded from the TCDD TEQ calculations (ND = 0); or
  2. ND results were incorporated by using one-half of the detection limit (ND = ½ DL). This approach was used to gauge the influence of DL sensitivity on calculated TEQ values.
- Avian TEFs for D/F and coplanar PCBs and for HCB were used to calculate Avian TEQs in soil, sediment, and water for the BERA.
  - Avian TEFs for D/F and coplanar PCBs were based on Van den Berg et al. (1998). More recent literature has shown that variability in the sequence of the aryl hydrocarbon receptor (AhR) ligand-binding domain influences the between-species relative sensitivity to TCDD (Herve et al. 2010a; Farmahin et al. 2013b; Wei et al. 2016). However, since there are no studies reporting the species-specific TEFs for all of the avian receptors in the Site, TEFs were based on the historically used values for D/F and coplanar PCBs from Van den Berg et al. (1998). The uncertainty in these TEFs is discussed in the BERA Uncertainty Analysis (Section 7.1.1.5).
  - Avian TEFs for HCB were based on Mundy (2011) and Mundy et al. (2012). Mundy found there was a range of TEFs for HCB (0.01–0.0001) based on species sensitivity to TCDD. Since species sensitivity to TCDD is grouped into three categories (which is discussed in more detail in Section 7.1.1.5), separate Avian TEQs were calculated using either 0.01 TEF, 0.001 TEF, or 0.0001 TEF for HCB.
    - Six Avian TEQ values were calculated to gauge the influence of TEF and DL sensitivity on calculated TEQ values:
      1. Avian TEQ with 0.01 HCB TEF and ND = 0
      2. Avian TEQ with 0.01 HCB TEF and ND = ½ DL
      3. Avian TEQ with 0.001 HCB TEF and ND = 0
      4. Avian TEQ with 0.001 HCB TEF and ND = ½ DL
      5. Avian TEQ with 0.0001 HCB TEF and ND = 0
      6. Avian TEQ with 0.0001 HCB TEF and ND = ½ DL
        - Avian TEQ in modeled tissue were calculated as follows:
          - Avian TEQs in soil/sediment were calculated excluding HCB for application in the tissue uptake model using ND = ½ DL;
          - HCB in soil/sediment were applied to its tissue uptake model using ND = ½ DL;
          - The three TEFs were then applied to the tissue HCB concentration from the uptake model to yield three HCB tissue concentrations; and

- The three alternative HCB concentrations were each summed with the Avian TEQ concentration (that excluded HCB) to yield three Avian TEQs for evaluation in the BERA with their corresponding toxicity reference value (TRV) category (1, 2, or 3) (detailed further in Section 7.1.1.5).

- Total LMW/HMW PAHs were calculated based on the approach presented in (USEPA 2005b) using concentrations as follows:

$$\text{Total LMW PAHs} = \Sigma\, C_{jlow} \qquad \text{Eqn 2-2}$$

$$\text{Total HMW PAHs} = \Sigma\, C_{jhigh} \qquad \text{Eqn 2-3}$$

Where:

C_{jlow} is the concentration of the jth less-than-4-ring PAH, C_{jhigh} is the concentration of the jth 4-or-more-ring PAH. NDs are assigned the surrogate value of one-half of the detection limit (½ DL).

- Total PCB was calculated and reported by the analytical laboratories using concentrations for 10 PCB homologues as follows:

$$\text{Total PCBs} = \Sigma\, C_j \qquad \text{Eqn 2-4}$$

Where:

C_j is the concentration of the jth PCB homologue. NDs are assigned the value of zero.

2.1.4.5 95UCLs

The 95UCL was calculated for each analyte, exposure area, and habitat. Calculations were performed using USEPA's ProUCL software, version 5.1 (USEPA 2016b). All calculation methods (normal, gamma, lognormal, and non-parametric) were run using both detected and ND values. The software's recommended 95UCL was selected for use in the majority of cases. The maximum value was selected for use in cases where the 95UCL could not be calculated by the software or where the 95UCL was higher than the maximum value. The selected values for 95UCLs are presented in Table 2-7, and the ProUCL output files are presented in Appendix F.

2.2 Problem Formulation

The Problem Formulation defines the goals and objectives (scope) of the ERA, identifies the major factors to be considered, and ensures that ecological receptors likely to be exposed and exposure scenarios most likely to contribute to ecological risk are evaluated. The Problem Formulation typically includes (1) identification of COPECs; (2) development of the CSM, including identification of potentially complete exposure pathways; (3) identification of assessment endpoints (AEs) and measurement endpoints (MEs) that adequately reflect management goals and the ecosystem they represent; and (4) selection of representative receptors. This section provides the same information as presented in the *Final Problem Formulation and Baseline Ecological Risk Assessment Technical Memorandum* (ERM 2020a), with the exception of Section 2.2.4.3, which now includes two additional MEs—Site-specific toxicity studies and field observations. The Problem Formulation sections are organized as follows:

- Section 2.2.1: Environmental Setting
- Section 2.2.2: Constituents of Potential Ecological Concern
- Section 2.2.3: Exposure Pathways/Refined Conceptual Site Models
- Section 2.2.4: Management Goals, Assessment Endpoints, and Measurement Endpoints/Lines of Evidence

- Section 2.2.5: Representative Wildlife Receptors

2.2.1 Environmental Setting

This section describes the environmental setting for the Site, including climate, geology, hydrology, and habitats and wildlife. Additionally, land use scenarios assumed in this BERA are discussed.

2.2.1.1 Climate

The climate at the Site is semi-arid. Average annual precipitation varies with elevation, with the Lakeside Mountains receiving more precipitation than the lower-elevation valley and lakebed. Annual normal precipitation ranges from less than 8 inches at the facility to more than 12 inches at the peaks of the Lakeside Mountains. Air temperatures recorded at stations in Skull Valley, south of Lakeside Valley, range from below zero degrees Fahrenheit during January and February to above 100 degrees Fahrenheit from June to August (Hood and Waddell 1968).

2.2.1.2 Geology and Soils

The Lakeside Mountains are typical of the block-faulted mountains in the Basin and Range province. Rocks in the Lakeside Mountains are of Paleozoic age, spanning the Devonian to Cambrian periods. Quaternary alluvium and colluvium are present within alluvial aprons of the mountains. With the exception of a few outcrops of Cambrian formations west-northwest of the Site, the GSL lakebed, playa, and lowlands and adjacent upland areas are composed of Quaternary mud and salt flat deposits, and Quaternary Lake Bonneville deposits (Hintze et al. 2000). As identified on Figure 2-1, the Site lithology falls into three main categories:

- Ql – Surficial Quaternary Lake Bonneville deposits
- Qs – Surficial Quaternary mud and salt flat deposits, associated with the lakebed of the GSL
- Other – Quaternary alluvium and colluvium (Qa) and consolidated rock in the Lakeside Mountains (units C1, C2, C3, D, O, and S)

Surface soils across the Site are variable; however, soil conditions are generally similar within the three predominant topographic features: (1) the bed of the GSL and lowland mudflats adjacent to the GSL, (2) southeast-trending beach ridges, and (3) upland areas. Within the lowland mudflats, surface soils are composed of silty clays, sandy silts, clayey silts, and fine-to-medium sands. Southeast-trending beach ridges are typically formed of fine-to-medium oolitic sands. In upland areas, surface soils are generally classified as silty fine sands, clayey silts, and silts with fine sand (Dames & Moore 1970). The main soil types at the Site are identified on Figure 2-2 and include:

- Playas-Saltair – Associated with the GSL lakebed
- Amtoft-Rock
- Dynal – Oolitic sand deposits
- Skumpah
- Yenrab
- Other – Checkett, Hiko Peak, Medburn, Puts, and Timpie-Tooele

Background concentrations of naturally occurring metals in soils and sediments are influenced by the underlying soil types and lithology, and understanding the influence of soil and lithology on metals concentrations was a critical aspect in the sample design used to collect background data during the Phase 1A-B RI. Establishing Site-specific background concentrations for each combination of soil and

lithology types listed above could result in an overly complex process, where background populations are so specific that the corresponding Site sample sizes would decrease and result in low statistical power for background comparisons. Therefore, the Phase 1A-B sampling design included the definition of appropriate background soil-lithology population(s) to allow meaningful comparison to Site data.

The degree to which soil types and lithology influence metals concentrations was evaluated using Site data from the Phase 1A DMA and the Phase 1A RI (referred to below as "Phase 1A samples") collected from PRI areas that could be assumed to not be directly impacted by waste releases from the Site, i.e., PRIs 11 through 16. The co-location of soil and lithology units was estimated by tallying the number of Phase 1A samples that were collected in each lithology and soil type across PRIs 11 through 16. As samples were randomly located with respect to any underlying pattern in soil type/lithology, the number of samples serves as a proxy for the prevalence of each soil type and lithology type in areas of interest for risk assessment. The numbers of Phase 1A samples from PRIs 11 through 16 that appear in each soil-lithology type combination were as follows:

	Lithology Type		
Soil Type	**Ql**	**Qs**	**Other**
Amtoft-Rock	2	0	7
Dynal	10	3	0
Playas-Saltair	0	19	0
Yenrab	13	0	0
Other	9	2	1
Skumpah	11	1	0

These tallies show that the Qs geologic type largely comprises the Playas-Saltair soil type and falls primarily into PRIs 13 and 14. These PRI areas are within the "lakebed" setting of the bed of the GSL. The Dynal, Skumpah, and Yenrab soil types fall primarily or entirely within the Ql geologic type, which largely corresponds to PRIs 11, 12, and 15. These PRI areas are considered to be in an "upland" setting, as they are located outside of the bed of the GSL. The "Other" soil and geologic types tend to be associated with the Lakeside Mountains in PRI 16, and are therefore also considered to be in an "upland" setting. Based on these tallies, the distinct lithologic/soil groupings at the Site can be generally divided into two settings, lakebed and upland, with lakebed corresponding to PRIs 13 and 14 and upland corresponding to PRIs 11, 12, 15, and 16. The data quality objectives in the Phase 1A-B RI SAP (ERM 2015a) used multiple lines of evidence including ordinations, multivariate tests, and pair-wise test, to confirm that the upland and lakebed sample populations differ significantly enough in soil type, lithology composition, and geochemistry to be considered two independent soil-lithology populations for purposes of developing background datasets to support comparisons to Site soils.

2.2.1.3 Hydrology

Site descriptions of surface water and groundwater are presented below.

Surface Water

Surface water has been or may be present at the Site within PRIs 5 and 6 (also referred to as the CWP), PRI 7 (also referred to as the OWP), as intermittent wastewater overflow into PRI 8, in areas of surface expression of groundwater seepage or seepage from wastewater ponds (e.g., the Northwest Barrow Area referred to as the "angel wing" in PRI 8), in non-wastewater earthen ditches (e.g., "barrow ditches," the

SVDD), in the GSL lakebed and playa, in solar evaporation ponds, or as accumulated precipitation in low-lying or excavated areas. The ATI Utah Pollutant Discharge Elimination System outfall formerly discharged non-contact wastewater to the bed of the GSL via an outfall to the SVDD near the northeastern corner of PRI 7; however, discharges from the ATI outfall have ceased due to the shutdown of operations at ATI.

There are no perennial streams in Lakeside Valley that flow through or near the Site. Ephemeral flows of surface water originating from seasonal springs and snowmelt that discharge into canyons along the eastern flank of the Lakeside Mountains either evaporate or infiltrate to groundwater prior to reaching the immediate Site vicinity.

The SVDD seasonally conveyed surface water accumulation from Skull Valley south of Interstate 80 to the GSL. The SVDD was constructed and operated by USM to divert surface water around the solar evaporation ponds located in Stansbury Bay of the GSL. This ditch was historically located along the edge of and generally parallel to the southern and eastern areas of the USM facility and the outer side of the CWP and OWP levees. In 2017, USM permanently ceased use of the SVDD adjacent to the CWP and OWP for conveying surface water diverted from Skull Valley. Flows in the SVDD were entirely controlled by pumping at the P-10 pump station, located approximately 8 miles south of the Site.

Surface water is perennially present in the Northwest Barrow Area in PRI 8. The dates over which soil was removed from this area are not known, but based on the historical photographs included as Appendix C to the OWP/CWP Hydrologic CSM Report (ERM 2017a), this barrow area was undeveloped in 1978 and fully developed in 1985. Surface water in the PRI 8 Northwest Barrow Area appears to be periodically commingled with wastewater, but is primarily a surface expression of groundwater. Intermittent wastewater releases from the CWP have flowed into the PRI 8 Northwest Barrow Area, resulting in temporary acidic conditions in surface water in PRI 8. Wastewater releases from PRI 6 into PRI 8 have not occurred since the installation of an overflow pipe from the CWP (PRIs 5 and 6) into the OWP (PRI 7) in November 2018.

The distance from the GSL open water shoreline to the Site fluctuates as a function of lake elevation. Because of the broad, shallow nature of the GSL, small changes in lake level result in large changes in lake area. The lake typically reaches its highest level between May and June as a result of spring and summer runoff. The annual low lake level typically occurs in October or November, following the high evaporation summer season (Utah DNR 2013). Based on the bathymetric map of the southern portion of the GSL (Baskin and Allen 2005), the distance from the open water shoreline to the northeastern corner of the OWP as a function of lake elevation is as follows:

Lake Elevation	Approximate Distance to GSL Open Water from OWP
4,200 feet	0.5 mile
4,195 feet	1 mile
4,192 feet	2 miles
4,190 feet	2.5 miles

Since 2014, the average lake level has fluctuated between about 4,195 and 4,189 feet, which corresponds to a distance of approximately 1 to over 2.5 miles from the open water shoreline of the GSL to the northeastern corner of the OWP. A permanent connection between the GSL and the Site is maintained via the GSL intake canal, which supplies GSL brine to the USM solar evaporation ponding complex. Salinity levels in surface water are mostly hypersaline (> 35 parts per thousand [ppt] salinity) but there are certain areas that may be considered brackish (3–10 ppt), as reported in ERM 2016a. No

surface water salinity measurements rank as freshwater (< 0.5 ppt salinity), and there are no perennial freshwater expressions at the Site. The salinity measurements in exposure units with surface water were measured in ERM 2013a, 2016a, and 2020b, and are summarized below.

- PRI 1: 10–45 ppt in the Former Ditches
- PRI 3: 2–6 ppt in the Sanitary Lagoon
- PRI 5: 31–69 ppt in the CWP
- PRI 6: 38–81 ppt in the CWP
- PRI 7: 64–300 ppt in the OWP
- PRI 8: 43–140 ppt in the Northwest Ponded Waste Lagoon Overflow
- PRI 14: 64–110 ppt in the Buffer Area South
- SVDD: 10–540 ppt

See Figure 2-3 for locations of the surface hydrologic features described above.

Groundwater

Groundwater in the GSL basin generally occurs within four types of basin-fill aquifers. From deepest to shallowest, these aquifers include (1) a deep, confined aquifer in central valley areas; (2) a deep, unconfined aquifer adjacent to mountain recharge zones; (3) a shallow, unconfined aquifer overlying the deep, confined aquifer; and (4) local perched aquifers (Hely et al. 1971). The shallow unconfined aquifer, which is generally defined as the uppermost saturated permeable unit within the unconsolidated lake sediments, extends across the Site from near the bedrock front of the Lakeside Mountains, eastward into the GSL. In the vicinity of the magnesium facility and wastewater ponds, the shallow aquifer comprises (1) an upper unconfined zone that occurs from near ground surface to about 25 to 35 feet bgs; (2) a 10- to 20-foot-thick silty clay layer[3] separating upper and deeper shallow zones; and (3) a deeper confined or semi-confined zone below about 45 to 50 feet bgs.

The presence of a deep, unconfined aquifer has not been confirmed adjacent to the Lakeside Mountains recharge zone adjacent to the Site and no information is available regarding the presence or extent of the deep confined aquifer in the central valley area. Local perched aquifers at the Site may be present in association with recharge areas in the Lakeside Mountains and adjoining upland areas, or in association with the operating facility. These perched aquifers are expected to occur at shallow depth, generally less than 20 feet bgs west of the magnesium facility and less than 10 feet bgs in the vicinity of the facility and wastewater ponds. The shallow, unconfined aquifer and local perched aquifers at the Site are classified as State of Utah Class IV (or saline) groundwater due to concentrations of greater than 10,000 milligrams per liter of TDS. Because of the upward hydraulic gradient observed at the Site, shallow groundwater may rise to the surface where it supports the ecosystem of the salt flats area, and potentially the GSL. Accordingly, shallow groundwater also qualifies as Class IC, ecologically important groundwater (UDEQ 2018). Class IC groundwater is a source of groundwater discharge important to the continued existence of wildlife habitat (Utah Administrative Code Rule 317-6-3.4).

[3] As described in Section 1.2, an upgrade to the wastewater evaporation ponds will include installation of a vertical hydraulic barrier wall to create an RWP. The barrier wall will be keyed into the silty clay layer, which will minimize downward migration of wastewater into the underlying aquifer.

2.2.1.4 Habitats and Wildlife

The operating facility is in a transition area between Inter-Mountain Basin (IMB) playa adjacent to the GSL and uplands that are dominated by primarily IMB Greasewood Flat to the west (BIO-Logic 2003). The surface water in the playa is hypersaline, thus there are no fish present within the Site and aquatic organisms in surface water are limited to brine shrimp, brine flies (brine fly larvae are considered to be benthic invertebrates in the BERA), and aquatic plants (algae). The IMB Greasewood Flat habitat west of the facility is characterized by arid halophytic shrubs and invasive annual grasses. Other than facility buildings and industrial waste lagoons, much of the open space within the facility property lines is dominated by either (1) barren ground, (2) highly disturbed ruderal vegetation, or (3) moderately to highly disturbed greasewood (*Sarcobatus*) scrub and/or invasive annual grasses. Currently, facility waste lagoons support little or no emergent vegetation.

Land covers/habitat types found in the Site were initially identified based on the Southwest Regional Gap Analysis Project (SWReGAP) database, which was a mapping and biodiversity assessment conducted for the five-state region encompassing Arizona, Colorado, Nevada, New Mexico, and Utah (approximately 500,000 square miles) (USGS 2007). The land cover/habitat types were further refined using observations made during: (1) a 5-day ecological survey (EcoSurvey) (ERM 2014a); (2) the Phase 2A reconnaissance survey (ERM 2017c) and tissue collection field activities (ERM 2018a); and (3) the day-to-day activities at the Site. The modified SWReGAP land cover/habitat types based on observations at the Site are shown on Figure 2-4.

A comprehensive list of wildlife potentially present within the Site was developed as part of the EcoSurvey (ERM 2014a) by reviewing the SWReGAP wildlife-habitat relationship models for vertebrate species that reside, breed, or use habitat for a substantial portion of their life history in the five-state region of Arizona, Colorado, Nevada, New Mexico, and Utah. The SWReGAP provided the most comprehensive species-habitat relationships for vertebrates occurring within the Site and served as the primary source for the species lists developed for the habitats that occur within the Site. The comprehensive species list is presented in Appendix A. However, it is important to recognize that the wildlife species lists developed from the SWReGAP are comprehensive lists of wildlife that are *potentially* associated with specific habitat types and are not necessarily indicative of species that *actually* occur within the Site. Wherever possible, observations of wildlife observed within the Site have been noted. The land cover types and observations of associated wildlife are discussed on an exposure unit basis below.

PRI 1 – Nearly all of the ditches in PRI 1, including the Western Ditch have been filled and capped as part of the activities completed under the RCRA AOC (USEPA 2016a). Therefore, the habitat formerly provided by the Western Ditch has been eliminated. A portion of the Main Ditch remains open where it enters PRI 5.

PRI 2 – The landfill is characterized by physically disturbed, barren ground with patches of sparse “weedy” (ruderal) vegetation, and ongoing human activity and physical disturbance. The EcoSurvey reported flyovers by common ravens and California gulls, and signs of black-tailed jackrabbit, rodent, and coyotes (ERM 2014a). No mammals were directly observed at the landfill during the EcoSurvey. Rodent burrows and scat were observed in small mounds of earth at the periphery of the landfill; while other signs (e.g., scat) of black-tailed jackrabbit and coyotes were observed “outside” active areas of the landfill. Plant communities are absent and those few ruderal patches offer little to no refuge or foraging habitat. Harvester ants, flies, and beetles (e.g., darkling beetles) have been observed in few numbers at this PRI.

Given the level of ongoing disturbance and lack of suitable refuge habitat, this PRI is unlikely to support bird or large mammal populations. Birds and mammals are expected to visit this PRI only briefly and infrequently, with species that are tolerant of human activity (e.g., crow, European starling, coyote) being most common. Due to the ongoing physical disturbance, soil invertebrate communities at PRI 2 are anticipated to be limited in diversity and few in number of individuals.

PRI 3 – In 2018, the Sanitary Lagoon was remediated and refurbished as part of the activities occurring under the RCRA AOC (USEPA 2016a). The excavation removed all vegetation and overlying soil from the lagoon, leaving barren ground. USM manages avian presence at the lagoon through the use of bird hazing (sonic sound broadcasting or nonlethal "screamer" shotgun rounds) in the spring and summer, when birds are attracted to the water and invasive habitat (phragmites) at the lagoon.

PRI 4 – The Gypsum Pile is characterized by barren ground, devoid of vegetation. Substrate in areas of the Gypsum Pile (where dewatering has occurred) appears to be highly compacted. However, the northeastern corner of the Gypsum Pile has a margin of dead, woody vegetation and understory vegetation that extends beyond the front of the gypsum slurry deposition fan. IMB Greasewood Flat habitat and invasive grasses were observed in a small area just "outside" the northwestern border of this PRI (in PRI 6). The marginal vestiges of sparse greasewood scrub appear to be disturbed and offer little refuge or foraging habitat. No birds or signs of birds were observed at the Gypsum Pile, but California gulls were observed flying over this PRI (ERM 2014a, 2018a). Mammalian wildlife was not directly observed during the EcoSurvey or the Phase 2A investigation (ERM 2014a, 2018a), although lagomorph (rabbits/hares) scat and vestiges of old canid (not specified) tracks have been observed in previous surveys (ERM 2014a). Although few in numbers, harvester ants, flies, darkling beetles, and grasshoppers have been observed in invasive grasses / mixed greasewood scrub / ruderal vegetation along the northwest and northern boundary of PRI 4. In remaining portions of PRI 4, few to no invertebrates are observed, except for the occasional flying insect (e.g., grasshopper, fly) that may pass by.

Given the level of ongoing disturbance and lack of suitable refuge habitat, this PRI is unlikely to support any sustaining bird or large mammal populations. Birds and mammals are expected to visit this PRI only briefly and infrequently, with species that are tolerant of human activity (e.g., crow, European starling, coyote) being most common. Given the highly disturbed nature and continual addition of gypsum in the southern portion of PRI 4, soil invertebrate communities at much of PRI 4 are anticipated to be either absent or occurrence is limited in diversity and few in number of individuals.

PRI 5 – This PRI is characterized by open water/wastewater in the CWP (salinity ranging from 31–69 ppt and pH ranging from 0–0.87 [ERM 2016a, 2020b]) that is largely surrounded by terrestrial habitat along the shoreline: disturbed ruderal vegetation (western shore), sparse greasewood/ruderal vegetation and Invasive Annual Grassland (eastern shore), and mixed Invasive Annual Grassland / IMB Greasewood Flat (southeastern shore). No signs of birds or other wildlife were observed in/on the open water of the lagoon during the 2014 survey (ERM 2014a), but historical surveys have reported snowy plover and horned lark nests in upland areas along the eastern boundary of PRI 5, where disturbed ruderal vegetation and scattered greasewood scrub is found (ERM 2014a) (see Figure 2-5). Past studies reported that shorebirds (spotted sandpiper, American avocet) at waste lagoons are generally observed infrequently, and when observed, are restricted to short visits (a few minutes to an hour) before flying off (BIO-Logic 2002, 2003). California gulls and horned larks were observed flying over PRI 5. Passerine birds (unspecified) were also observed flying over the disturbed Invasive Annual Grassland / Ruderal / IMB Greasewood Flat habitat located in the southeastern "corner" of PRI 5. Black-tailed jackrabbits, lagomorph burrows, and coyote scat were also observed in upland habitats in the eastern/southeastern areas of PRI 5 (ERM 2014a). In addition, small mammals (kangaroo rat, desert mouse) were collected in upland areas adjacent to the eastern and western shores of the open water during Phase 2A tissue sample collection (ERM 2018a). Fewer signs of mammals (i.e., burrows of small mammals) were observed in Ruderal / Invasive Grass habitat south of the lagoon in PRI 5 during the EcoSurvey (ERM 2014a). Given the observations, small mammals are anticipated to reside and forage in upland habitats in the southeastern "corner" of this PRI and in the modest upland habitat along the eastern boundary of this PRI. Few small mammals are likely to reside or forage in marginal habitat immediately south of the lagoon at PRI 5. Furthermore, given the lack of refuge habitat at PRI 5, larger mammals (e.g., deer, coyote) are likely to be transient visitors that may occasionally forage at this PRI.

There are few to no plant communities along the shoreline of the open water at PRI 5. Less disturbed upland plant communities are observed in the southeastern "corner" of the PRI and appear to provide suitable refuge and foraging habitat for wildlife. Brine flies were collected in habitat surrounding the lagoon and near the SVDD during Phase 2A tissue sample collection, but no brine fly larvae were observed (ERM 2018a). Since no brine fly larvae were observed in the lagoon and the acidity of the wastewater likely precludes the development of brine fly larvae, it is likely the brine flies collected near the lagoon did not originate from that area. Brine fly casts were observed near the SVDD, which is not acidic, during the Phase 2A reconnaissance survey (ERM 2017c). Harvester ants, darkling beetles, grasshoppers, green darner dragonfly, digger wasp, and tachinid flies were observed in invasive grasses along the eastern boundary and in mixed greasewood scrub / invasive grass / ruderal vegetation in the southeastern portion of PRI 5 (ERM 2014a, 2018a). A few harvester ant burrows, beetles, and tachinid flies were observed soil invertebrates in ruderal vegetation just south of the lagoon at PRI 5.

PRI 6 – This PRI is characterized by open water/wastewater in the CWP (salinity ranging from 38–81 ppt and pH ranging from 0–0.70 [ERM 2016a, 2020b]) that is largely surrounded by terrestrial habitat along the shoreline: barren ground and sparse/dead greasewood (western shore), disturbed ruderal vegetation (northern shore), and Invasive Annual Grassland (eastern shore). No signs of birds or other wildlife were observed in/on the open water of the lagoon during the EcoSurvey, but California gulls, common raven, and horned larks were heard or observed flying over the upland area (ERM 2014a). Historical surveys have reported observations of a snowy plover nest in the upland area along the northeast boundary of PRI 6, where disturbed ruderal vegetation and scattered greasewood scrub are found (ERM 2014a) (Figure 2-5). Past studies reported that shorebirds (spotted sandpipers, American avocet) at waste lagoons are generally observed infrequently, and when observed, are restricted to short visits before flying off (BIO-Logic 2002, 2003).

Coyote scat was observed in the northeastern upland area of PRI 6. Cow scat was also observed in the northeastern upland area of PRI 6, which suggests that this area was once used for cattle grazing. Rodent burrows and lagomorph burrows and scat were observed in upland habitats west and east of the lagoon (ERM 2014a). Furthermore, kangaroo rat and deer mouse were collected at PRI 6 during the Phase 2A investigation (ERM 2018a). A desert horned lizard, rodent burrows, and lagomorph scat were also observed in these upland habitats (ERM 2014a).

There are few to no plant communities along the shoreline of the open water at PRI 6. IMB Greasewood Flat habitat and invasive grasses were observed in a small area in the southwestern "corner" of PRI 6 (bordering the northwest edge of PRI 4). Terrestrial plants (halogeton [*Halogeton glomeratus*], cheatgrass [*Bromus tectorun*], and Indian ricegrass) were collected in upland areas on the eastern and western shores during Phase 2A tissue sample collection (ERM 2018a). Past cattle grazing (as evidenced by cattle scat) may have contributed to the disturbed nature of plant communities (i.e., ruderal and invasive annual grasses) in the northern portion of the "strip" of upland area that borders (just west of the dirt road) the eastern boundary of this PRI. Brine flies were collected in habitat surrounding the lagoon during Phase 2A tissue sample collection (ERM 2018a).

Brine fly larvae were not observed in the acidic wastewater during sample collection, but brine fly casts were seen on the eastern shore near PRI 7 during the Phase 2A reconnaissance survey (ERM 2017c). No brine shrimp or other aquatic invertebrates were observed in the lagoon at PRI 6. Harvester ants, darkling beetles, grasshoppers, wasps (unidentified), and flies were observed and collected in IMB Greasewood Flat habitat in the western portion and in the short-stature invasive grass habitat in the eastern portion of PRI 6 (ERM 2014a, 2018a).

Based on these observations, shorebirds and waterfowl are either likely not to occur, or to be infrequent, transient visitors to the open water at PRI 6, whereas terrestrial birds may find refuge and/or forage in the modest greasewood scrub / invasive grass vegetation in the western and eastern areas of this PRI. Given

the level of disturbance and paucity of suitable refuge habitat, large mammals (i.e., deer, coyote) are likely to be transient visitors to upland areas of PRI 6. However, small mammals are anticipated to reside and forage in upland habitats adjacent to the shoreline of the open water at PRI 6—in particular, in the greasewood scrub to the west and in the annual grassland with sparse greasewood vegetation to the northeast and east of the open water lagoon. Plant communities in upland areas surrounding the open water appear to be disturbed, but may offer suitable marginal refuge and foraging habitat to wildlife.

PRI 7 – This PRI is characterized by IMB Playa and open water/wastewater of the OWP (salinity ranging from 64–300 ppt and pH ranging from 0–6.85 [ERM 2016a, 2020b]). Currently, PRI 7 seasonally has standing water during winter and springtime due to accumulated precipitation and groundwater discharge. The OWP PRI is seasonally flooded by acidic wastewater from the CWP due to the installation of an overflow pipe through the berm separating the OWP and CWP that occurred in November 2018. Since PRI 7 is only acidic on a seasonal basis, it is possible the aquatic prey items may occur in this PRI.

In the southwestern area of PRI 7, a narrow strip of marginal IMB Greasewood Flat habitat exists in the upland area between the lagoon at PRI 7 and the road that runs between PRI 7 and PRI 5. Dikes supporting dirt roads border the entire PRI. There is little emergent shoreline vegetation and mostly barren ground between the road and lagoon. California gulls have been observed flying over and horned larks were heard along the eastern shore of the lagoon during the 2014 survey (ERM 2014a). Historical bird surveys have observed snowy plover nests along the northern and eastern edges of the PRI (Figure 2-5). BIO-Logic (2006) observed horned larks, snowy plovers, American avocets, and western meadowlarks, as well as nests of horned larks and snowy plovers. Rodent burrows and lagomorph scat were observed in mixed IMB Greasewood Flat / Invasive Grassland habitat along the eastern shore of the lagoon. However, there is little to no vegetation to provide refuge cover along the shoreline of the open water at PRI 7.

Brine flies were collected near the Barrow Ditch during Phase 2A tissue sample collection, but brine fly larvae and brine fly casts were not reported during sample collection (ERM 2018a) or the reconnaissance survey (ERM 2017c). BIO-Logic (2004) also found no brine fly larvae or other benthic invertebrates, but did find several cast puparia, which were assumed to have blown in from another location. Since no brine fly larvae were observed in the Barrow Ditch, it is likely the brine flies collected for the Phase 2A tissue sample collection did not originate from that area. No brine shrimp or other aquatic invertebrates were observed in any of these surveys. Few soil invertebrates were observed at PRI 7 during the EcoSurvey (ERM 2014a). Harvester ant burrows and darkling beetles were observed along the road that borders the open water at PRI 7. Although observed, damselflies and tachinid flies were only observed occasionally.

Pursuant to the DWQ GWDP and Consent Decree, PRI 5, 6, and 7 will be merged to create an RWP. This new pond will receive the current wastewater stream as well as wastewater from a new lithium plant constructed to reprocess smut material in PRI 9. The majority of terrestrial habitat is expected to be periodically inundated and submerged annually. However, there is uncertainty that exposure will be completely eliminated since the areal extent and temporal duration that sediment is covered with acidic wastewater are estimated at this time.

PRI 8 – Minimally disturbed IMB Greasewood Flat dominates the western and northern portions of PRI 8. A relatively small pond (open water) was observed in the Northwest Barrow Area (also referred to as the “angel wing”) during the Phase 2A investigation. The open water currently has salinity ranging from 80–140 ppt and pH of 6.00–6.41 (ERM 2020b). Invasive Annual Grassland is observed in the southeastern upland area, just north of the dirt road at this PRI. Sparse/dead greasewood is observed in the southeastern upland area, south of the aforementioned dirt road (northwestern shore of open water at PRI 6).

Several songbirds were observed and heard in the IMB Greasewood Flat habitat including horned lark, Brewer’s sparrow, and sage thrasher, while California gulls were observed flying over but not observed to

land at this PRI (ERM 2014a). Adult and young American avocets were observed in the pond (open water) located in the Northwest Barrow Area (ERM 2014a). Avocet nests were also observed along the shoreline of this pond. Anecdotal information suggests that this pond has historically been ephemeral; however, this pond has been observed on a number of visits to this PRI. When water is present, American avocets and possibly other shorebirds are attracted and exposed to the water. Given these observations, open water at PRI 8 is anticipated to support adult and young American avocet and other shorebirds with suitable refuge and foraging habitat. Terrestrial bird populations are likely to occur in the minimally disturbed upland IMB Greasewood Flat habitat that dominates the western areas of this PRI.

Signs of rodents (burrows), lagomorphs (scat), coyote (scat), and badger (burrows) were observed in both the IMB Greasewood Flat and Invasive Grassland habitats (eastern areas) at PRI 8 (ERM 2014a). Based on mammal signs, terrestrial large and small mammals are anticipated to reside and forage in the IMB Greasewood Flat and Invasive Annual Grassland habitats at this PRI. Tracks of mule deer, pronghorn, bobcat, and coyote were also observed at the water's edge in 2013 (ERM 2014a). However, since the surface water in this area historically had on occasion been flooded with acidic wastewater that migrated under the new northwest berm, the vegetation immediately surrounding the open water has likely been altered since the EcoSurvey.[4]

Plant communities observed in the western and northwestern upland areas of PRI 8 appear to be either undisturbed or minimally disturbed (i.e., comparable to plant communities observed in Buffer Area PRIs) and are considered to provide suitable and attractive refuge and foraging habitat for upland wildlife. Past cattle grazing (as evidenced by cattle scat) may have contributed to plant communities appearing more disturbed in the eastern upland areas, north of the access dirt road at this PRI.

Brine flies were reported near the open water in the central area of the PRI during Phase 2A tissue sample collection (ERM 2018a); however, no brine shrimp or other aquatic invertebrates were observed. The water levels have since been reduced due to the wastewater diversion pipe.[5] Brine flies likely occur when the freshwater pond exists at PRI 8. Harvester ants and their burrows, pallid-winged grasshoppers, bee mimic fly (unidentified), mud dauber wasp, damsel flies, and dragonflies were observed throughout the IMB Greasewood Flat habitat in the western portion of PRI 8. Harvester ant burrows, grasshoppers (unidentified), and tachinid flies were observed in the patchy, short-stature, invasive grasses in the eastern portion of this PRI. Based on these observations, soil invertebrate communities occur in IMB Greasewood Flat and Invasive Grassland habitats throughout PRI 8.

PRI 9 – PRI 9 is characterized by the widespread presence of "smut" (fine, powder-like) substrate that is produced and deposited by the facility—no native soils were observed during the EcoSurvey (ERM 2014a). Based on observations during the Phase 2A investigation and Halford et al. (1999), the barren, powdery smut substrate at PRI 9 is largely devoid of vegetation. Few signs of wildlife have been observed within the smut pile. California gulls were observed flying over and the common raven and horned lark were heard in the Greasewood Flat habitat occurring west of this PRI. However, no birds were observed at PRI 9 during the EcoSurvey. Signs of jackrabbit (scat, tracks) and canid (unspecified, tracks) were also observed, but no mammals or mammal burrows were observed during the EcoSurvey (ERM 2014a).

For the purposes of this BERA, plant communities are absent in the smut piles at PRI 9. Few soil invertebrates were observed at PRI 9 during the EcoSurvey (ERM 2014a). The occasional bottle fly or robber fly (unidentified) was observed flying at this PRI. Ant burrows and darkling beetles, which are typically conspicuous in disturbed habitats within the Site, were not observed at PRI 9. Based on these

[4] Flooding does not occur in the area any more due to a wastewater diversion pipe constructed between PRIs 6 and 7 in 2018 that was designed to reduce PRI 6 water levels and limit further flooding of PRI 8 with acidic wastewater from nearby PRI 6.

[5] The Northwest Barrow Area was monitored quarterly between fourth quarter 2018 and third quarter 2019 as part of the Phase 2B Hydro RI. The barrow area was dry during fourth quarter 2018 and third quarter 2019. Surface water with circum-neutral pH (approximately pH 6) was present in the barrow area during first quarter (March) and second quarter (June) 2019.

observations, although the occasional flying insect may fly through this PRI, soil invertebrate communities do not occur in the smut piles at PRI 9.

USM is operating a lithium production facility that includes accessing the smut piles within the "footprint" of PRI 9 to reprocess the smut material. While over time the soil material covering PRI 9 is expected to change from predominantly smut to more native soils or other stockpiled materials, the area will remain an active industrial area that is not expected to support plant communities or provide significant suitable refuge or foraging habitat for wildlife. Given the level of ongoing disturbance and lack of suitable refuge habitat, this PRI is unlikely to support bird or large mammal populations. Birds and mammals are expected to visit this PRI only briefly and infrequently, with species that are tolerant of human activity (e.g., crow, European starling, coyote) being most common.

PRI 10 – The Barium Sulfate Disposal Area is characterized by barren ground with sparse patches of greasewood/ruderal vegetation. Other features noted at PRI 10 include the predominance of compacted soils and anthropogenic physical disturbance of the substrate. Few signs of wildlife have been observed at PRI 10: California gulls were observed flying over, a horned lark call was heard, and scat from lagomorph and mule deer was observed during the EcoSurvey (ERM 2014a). Based on historical surveys (Halford et al. 1999) and Phase 2A observations, no plant communities are observed at PRI 10. Rather, plants observed at PRI 10 tend to be ruderal, sparse, patchily distributed, short in stature, and do not provide suitable refuge or foraging habitat for wildlife. Few soil invertebrates were observed at PRI 10 during the EcoSurvey (ERM 2014a). The occasional damselfly (unidentified) was observed flying through this PRI. Ant burrows and darkling beetles, which are typically conspicuous in disturbed habitats within the Site, were not observed at PRI 10.

The disturbed habitat provides no refuge habitat for birds or mammals. Based on current understanding, this PRI is unlikely to support any bird or mammal populations. Birds and mammals are expected to visit this PRI only briefly and infrequently, with species that are tolerant of human activity (e.g., crow, European starling, coyote) being most common. Soil invertebrate communities are anticipated to be limited in diversity and few in number of individuals at PRI 10.

PRI 11 – PRI 11 supports buildings, paved parking lots, compacted dirt roads, and other areas actively used for industrial/commercial purposes. Birds and mammals are expected to visit this PRI only briefly and infrequently, with species that are tolerant of human activity (e.g., crow, European starling, coyote) being most common.

PRI 12 – This PRI includes the Hill Brother Chemicals industrial facility immediately south-southeast of the Site. The southern strip of the PRI consists of ruderal habitat. Invasive Annual Grassland and mixed IMB Greasewood Flat/Invasive Annual Grassland dominate the area just north of the dirt road that runs along the southern border of this PRI. Invasive Annual Grassland with sparse patches of greasewood characterizes the area south of this dirt road. The invasive grassland is short in stature and provides modest refuge habitat for small mammal populations. The greasewood scrub provides some additional structure and refuge for small mammals. Horned larks were heard near this PRI during the EcoSurvey. California gull have also been observed flying over, but not landing at this PRI (ERM 2014a). Based on current understanding, this PRI is unlikely to provide suitable refuge habitat of sufficient size to support populations of terrestrial birds, but terrestrial birds are likely to be visitors and forage at this PRI. Rodent scat, but few other notable signs (e.g., large burrows) were observed during the EcoSurvey (ERM 2014a). Based on current understanding, PRI 12 may support small mammal (e.g., rodent) populations; however, large mammals (e.g., deer, coyote) are likely to find more suitable refuge and foraging habitat in nearby Buffer Area PRIs, and are likely to be transient visitors at this PRI.

Based on observations made during the EcoSurvey and Phase 2A investigation, the plant communities appear to be indicative of moderately disturbed habitats. Harvester ant burrows and grasshoppers (unidentified) were conspicuous throughout the short-statured Invasive Annual Grassland habitat in the

western portion of PRI 12. Harvester ant burrows, grasshoppers (unidentified), dragonflies (unidentified), robber flies, and spiders (unidentified) were observed in the mixed grassland and sparse scrub vegetation in the eastern/southeastern portion of this PRI. Based on these observations, soil invertebrate communities occur throughout the moderately disturbed upland habitat at PRI 12.

PRI 13 – This PRI is dominated by IMB Playa. North America Arid West Emergent Marsh has been observed at the former ATI discharge, but the emergent vegetation has died off since the freshwater input has ceased. Much of PRI 13, in particular areas away from the facility, was not surveyed in detail as part of the Phase 2A investigation (ERM 2018a). Remote areas were viewed from afar, primarily from one of the few dirt roads that transverses the PRI. Based on SWReGAP and Phase 2A observations, shorebirds and waterfowl are anticipated to be infrequent transient visitors to unvegetated IMB Playa areas within PRI 13, which, based on aerial photographs, dominate much of this PRI. California gulls have been observed gathering, taking off, and in the water at the former ATI discharge when there was a freshwater source (ERM 2014a). However, given the cessation of water input at the former ATI discharge and return to IMB Playa-like conditions, it is unlikely that gulls would continue congregating at this location. Mammals (e.g., mice, rabbits, badgers [*Taxidea taxus*], coyote, deer) are anticipated to be infrequent transient visitors to unvegetated IMB Playa areas within PRI 13, which dominate much of this PRI.

Little to no vegetation was observed within a short distance from the ATI discharge—the surrounding habitat is IMB Playa. Thus, potential risk to terrestrial plants was not evaluated in PRI 13. Damsel flies, deer flies, long-legged flies, harvester ants, darkling beetles, and spiders (not identified) were observed near the ATI discharge during the EcoSurvey (ERM 2014a). However, given the cessation of water input, soil invertebrate communities are likely to be less diverse and less abundant than observed during the EcoSurvey. Based on these observations, few soil invertebrates occur in the unvegetated IMB Playa habitat that dominates this PRI. Brine flies (and other flying insects) and aquatic invertebrates occur in the portion of PRI 13 where the GSLIC is located (the GSLIC is evaluated separately and discussed below).

PRI 14 – This PRI is primarily IMB Playa with upland areas of mixed IMB Greasewood Flat / Invasive Annual Grassland in the northwestern area of the PRI. Historical bird surveys have observed snowy plover, horned lark, and American avocet nests in the northern edge of the PRI near PRI 5 and along the road that runs east-west, just north of the solar evaporation pond (Figure 2-5). Sandpipers and American avocets were also observed in a perennial groundwater discharge area in the northern portion of PRI 14, just south of the aforementioned road. Based on recent and historical observations, snowy plovers, American avocets, and other shorebirds are anticipated to forage in and along the shoreline of perennial ponded water at PRI 14. No birds were observed in the unvegetated playa habitat in the northern edge of PRI 14 during the Phase 2A investigation (ERM 2018a). Shorebirds and waterfowl are anticipated to be infrequent, transient visitors to unvegetated IMB Playa areas that are observed along the northern boundary of PRI 14 and, based on aerial photographs, dominate much of this PRI. Terrestrial birds (primarily those that are tolerant of human activity) are assumed to be transient visitors, finding temporary refuge and/or forage in the small area of marginal mixed IMB Greasewood Flat / Invasive Annual Grassland in the northwestern area of the PRI.

Signs of small mammals (e.g., burrows) were observed along the road that runs (west-east) along the northern boundary of this PRI. Few signs (e.g., coyote tracks) were observed in the unvegetated playa habitat in the northern edge of PRI 14 during the Phase 2A investigation (ERM 2018a). Terrestrial mammals are expected to be infrequent, transient visitors that do not reside or forage in unvegetated IMB Playa habitat that is observed along the northern boundary of PRI 14 and dominates much of this PRI. The areas of IMB Greasewood Flat habitat in PRI 14 are considered to offer suitable and attractive refuge and/or foraging habitat for wildlife.

Consistent with SWReGAP, plant communities were rarely observed in the IMB Playa during the Phase 2A investigation. For the purposes of this BERA, plant communities are presumed to be absent in IMB

Playa habitat at PRI 14. Areas proximal to the facility (i.e., areas just south of PRIs 12 and 5) were not surveyed in detail, but were viewed during the EcoSurvey and Phase 2A investigation and, for the most part, appear consistent with recent aerial photographs. Areas in PRI 14 that are proximal to the facility (i.e., just south of the road that runs along the northern boundary of PRI 14) primarily support unvegetated IMB Playa habitat.

Soil invertebrate communities are anticipated to be of limited diversity and abundance in unvegetated IMB Playa habitat that dominates much of this PRI. Darkling beetles and harvester ants were conspicuous soil invertebrates observed alongside the road that runs next to northern boundary of this PRI. Adult brine flies were observed near the surface water in Solar Pond 1 West along the northern area of PRI 14 (i.e., areas of groundwater discharge shown on Figure 2-3) during the Phase 2A tissue sample collection (ERM 2018a). Brine fly larvae were not observed in that same area, but brine fly casts were seen during the reconnaissance survey (ERM 2017c). No brine shrimp or other aquatic invertebrates were observed in surface water at PRI 14. Brine flies were observed near areas of groundwater seepage during Phase 2A tissue sample collection (ERM 2017c). Brine fly larvae were not observed in that same area, but brine fly casts were seen during the reconnaissance survey (ERM 2017c). Based on these observations, few soil invertebrates occur in the unvegetated IMB Playa habitat, whereas brine flies occur where ponded water exist—in particular, as seen in the northern area of this PRI.

PRI 15 – This PRI is characterized by IMB Greasewood Flat vegetation. Moderately disturbed IMB Greasewood Flat is observed in areas closest to the USM facility, while less disturbed IMB Greasewood Flat habitat is observed with increasing distance toward the west. The Phase 2A field investigation focused primarily on areas of PRI 15 nearer to the facility (ERM 2018a); accordingly, much of PRI 15 was not surveyed as part of the Phase 2 investigation. During the Phase 2A biotic tissue collection effort, terrestrial fowl (i.e., chukars) and songbirds (e.g., horned larks) were observed and/or heard in this PRI. Small mammal or small mammal signs (scat, burrows) observed at PRI 15 include jackrabbit, desert cottontail, kangaroo rat, white-tailed antelope squirrel, and deer mouse (ERM 2014a, 2018a). Signs of larger mammals including coyote (scat), badger (burrows), and deer (scat) were also observed throughout this PRI during the Phase 2A investigation. Given minimally disturbed IMB Greasewood Flat habitat and other upland habitats observed in areas farther away from the facility, terrestrial birds and mammals are anticipated to reside and forage in the minimally disturbed upland habitat that occurs in this PRI.

Although some areas in PRI 15 support cattle grazing, much of PRI 15 is anticipated to support either “undisturbed” or “minimally disturbed” upland plant communities given the relatively remote nature and limited use by humans. Dominant understory herbaceous plants include halogeton, cheatgrass, and Indian ricegrass (ERM 2018a). Grasshoppers, flies, harvest ants, wasps, and beetles were observed and collected during Phase 2A tissue sample collection (ERM 2018a). Given minimally disturbed IMB Greasewood Flat habitat and other upland habitats observed in areas farther away from the facility, soil invertebrate communities are anticipated to occur in the minimally disturbed upland habitat found throughout this PRI.

PRI 16 – This PRI includes the foothills and Lakeside Mountains. It is a mix primarily of Great Basin Pinyon-Juniper Woodland, Invasive Annual Grassland, IMB Semi-Desert Grassland, and Great Basin Xeric Mixed Sagebrush Shrubland. PRI 16 was not surveyed as part of either the EcoSurvey or the Phase 2 investigation (ERM 2014a, 2018a). Accordingly, there are no recent detailed reports on direct observations of wildlife for this PRI. However, golden eagles have nested in the Lakeside Mountains; if present, nest sites are generally occupied between January and August (USFWS 1999). Given the remoteness and topography of this area, terrestrial birds and mammals are anticipated to reside and forage in the minimally disturbed upland habitat that is noted in aerial photographs of this PRI. Much of PRI 16 is anticipated to support either “undisturbed” or “minimally disturbed” upland plant communities.

Soil invertebrate communities are anticipated to occur throughout the minimally disturbed upland habitat seen in aerial photographs of this PRI.

SVDD – Given the focus on PRIs 1 through 12 (inner PRIs), a survey of the SVDD was not included as part of the scope of the EcoSurvey (ERM 2014a). However, gulls were observed aggregating near the ATI discharge pipe, which emptied into the SVDD (ERM 2014a). Given the cessation of water input at the former ATI discharge and the area's anticipated return to IMB Playa-like conditions, it is unlikely that gulls would continue congregating at this location. The Phase 2A investigation sampled brine flies at two SVDD locations adjacent to PRI 7 (SL-10A, SL-10B) and two locations in the SVDD adjacent to PRI 5 (SM-XA, SM-XB). The portion of the SVDD adjacent to PRI 7 is surrounded by IMB Playa habitat to the east and the OWP to the west, and no anecdotal observations of birds or signs of mammals were reported as part of the Phase 2 sampling effort. American avocets were observed wading in and horned larks were observed and heard along the portion of the SVDD that runs along the southern border of PRIs 5 and 12. Small mammal burrows were observed in upland areas adjacent to the portion of the SVDD that runs along the southern border of PRIs 5 and 12.

For the portion of the SVDD that runs along the southern border of PRIs 5 and 12, emergent vegetation was observed in nearby ponded areas (separated by a berm from the SVDD). Brine flies, but no brine shrimp, were observed and collected (at SL-10A, SL-10B) as part of the Phase 2 investigation in the ditch that runs parallel to the short portion of the SVDD, which itself parallels the northeastern corner of PRI 7. Brine flies, but no brine shrimp, were also observed and collected in the portion of the SVDD that runs along the southern border of PRIs 5 and 12.

Pursuant to the DWQ GWDP and Consent Decree, the entire length of the SVDD within PRI 5 is inside the RWP and the portion of the SVDD that is adjacent to PRI 7 has been filled and covered by an earthen dike as part of the RWP construction.

GSLIC – Historical bird surveys have reported horned lark nests along the GSLIC (Figure 2-5). No other observations on birds in the GSLIC have been noted. Additionally, observations of mammals and vegetation were not noted during the Phase 2 sampling at locations within the GSLIC exposure unit. Brine flies, but not brine shrimp, were observed or collected during the 2016 Phase 2 investigation effort. However, during the supplemental 2017 Phase 2 effort, brine flies and brine shrimp were observed and collected at the two sampling locations in the GSLIC: SL-11A and SL-11B. Based on these limited recent observations, it is concluded that both brine flies and brine shrimp may occur in the GSLIC exposure unit.

2.2.1.5 Upland and Lakebed Habitat Categories

For the BERA, land covers/habitats within the Site were categorized into "upland" and "lakebed" for purposes of evaluating the different biota types found within these habitats. The upland category is intended to represent terrestrial habitat that supports soil invertebrates, plants, and wildlife. The lakebed category is intended to represent wetland/playa habitat that may support aquatic/benthic invertebrates (e.g., brine shrimp and brine flies), plants, and "shoreline" wildlife. The upland and lakebed habitat categories at the Site are shown on Figure 2-6.

The upland habitat category consists of the following habitat types, as defined in SWReGAP (USGS 2007):

- Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
- Great Basin Pinyon-Juniper Woodland
- Great Basin Xeric Mixed Sagebrush Shrubland
- IMB Big Sagebrush Shrubland

- IMB Cliff and Canyon
- IMB Greasewood Flat
- IMB Mixed Salt Desert Scrub
- IMB Montane Sagebrush Steppe
- IMB Semi-Desert Grassland
- IMB Semi-Desert Shrub Steppe
- Invasive Annual and Biennial Forbland
- Invasive Annual Grassland
- Invasive Perennial Grassland
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland
- Developed, Open Space – Low Intensity
- Developed, Medium – High Intensity
- Ruderal

The lakebed habitat category generally consists of the following habitat types, as defined in SWReGAP (USGS 2007):

- IMB Playa
- Open Water
- North American Arid West Emergent Marsh

A third category is shown on Figure 2-6, the “developed” habitat category. For the BERA, all developed habitats except for the operating facility have been evaluated as upland.

Some of the PRIs have small, isolated patches of upland or lakebed habitat category that are surrounded by the other habitat category. Since these patches are not likely to support different receptors than what is found in the surrounding area, these small, isolated areas have been designated as part of the dominant habitat category. For example, according to SWReGAP (USGS 2007), there are isolated patches of IMB Playa in PRI 15 that are surrounded by large areas of IMB Greasewood Flat; these IMB Playa patches have been treated as upland habitat category for this PRI.

2.2.1.6 Species of Special Interest

To support the goals and objectives of the Problem Formulation, species of special interest were identified to (1) provide focus for the BERA, (2) support development of relevant Site-specific AE statements, and (3) assist in identifying appropriate representative species for the exposure assessment. Criteria for identifying species of special interest include:

- **Threatened and endangered species** – federal and state listed species and designated habitats
- **Species of concern** – federal candidate species, Conservation Agreement Species, Bird of Conservation Concern, and Species of Greatest Conservation Need
- **Species of commercial/recreational interest** – species that have an economic or recreational value (e.g., crops, livestock, fisheries, hunted game)

- **Species of ecological interest** – species that play an important role in mediating processes or interactions that affect the structure/function, or biodiversity of native habitats, communities, or ecosystems (e.g., keystone species)

Threatened and Endangered Species/Species of Concern

A review of the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System, Utah Division of Natural Resources (DNR), and USFWS (1999) found no potentially exposed federal and state listed threatened, endangered, and candidate species or USFWS Birds of Conservation Concern in the Site except for the golden eagle (Table 2-8a and Table 2-8b). The golden eagle is a Birds of Conservation Concern that is also protected under the Bald and Golden Eagle Protection Act and has been observed within the Site. The snowy plover is a Utah Species of Greatest Conservation Need and has been observed within the Site.

Species of Commercial/Recreational Interest

There are no crops cultivated within the Site. However, Utah DNR's Division of Wildlife Resources (Utah DNR 2022) lists the following game species hunted within the Site:

- Chukar
- Pronghorn
- Mule deer

Utah DNR maps indicate that these game species may be hunted in PRIs 15 (Lakeside Mountains) and 16 (Buffer Area West).

Species of Ecological Interest

A key strategy to focus the BERA was to organize species into "guilds" of taxonomically and trophically similar organisms. Members of the following guilds were considered to play a key role in maintaining the structure/function of upland and lakebed habitats:

- Primary producers
- Invertebrates
- Gleaning invertivorous birds
- Probing invertivorous birds
- Aerial invertivorous birds
- Herbivorous birds
- Carnivorous birds
- Invertivorous mammals
- Herbivorous mammals
- Carnivorous mammals
- Reptiles

Amphibians were not included as species of ecological interest. Given the hypersaline conditions, amphibians are not observed living in the GSL. In addition, the lack of freshwater aquatic habitat further limits amphibians at the Site. Moreover, consistent with the limited number of species, amphibians are generally considered to play a relatively minor ecological role in arid/playa habitats (Heatwole 1982).

2.2.1.7 Decision Units and Land Use

This BERA provides its findings on a decision-unit-by-decision-unit basis. As described in Section 1.2, the Site has been divided into PRIs, the SVDD, and the GSLIC, which serve as decision units for the RI/FS. The current understanding is that the USM facility will continue to operate, and that land use in the foreseeable future will be similar to current use for many of the PRIs. However, with respect to biota, although some PRIs are characterized by industrial uses that support little to no habitat or biota, other PRIs have or will have changes in Site land use that affect exposures to biota. For example, the PRI 1 (former ditch) closure and capping has resulted in no exposure to biota. Additionally, exposure to wastewater will be eliminated in the future in PRIs 8 and 14 from the construction of the RWP. Site conditions could also change in the future if the facility were to modify operations in a way where the land was allowed to lie fallow (i.e., unused). This fallow scenario is not currently anticipated, but has been evaluated as a possible future scenario for PRI 4, PRI 5, PRI 6, and PRI 7 in Appendix C of the BERA. Descriptions and assumptions for the current and future land use for each PRI are provided in Table 2-9.

RCRA Carve-Out and Facility Operational Changes

AOC RCRA-08-2016-004, proceeding under section 3008(h) of RCRA, was entered by USM and USEPA on 3 August 2016 (USEPA 2016a). The RCRA Carve-Out Cleanup Project Area is shown on Figure 2-7.

Under this AOC, USM was required to implement the RCRA Carve-Out Cleanup Project, which consists of seven elements:

1. Conveying facility wastewater to the current wastewater ponds through pipes in accordance with a wastewater discharge piping plan.
2. Abandoning wastewater ditches in the central ditch network through backfilling and capping of contaminated soils and sediments within or adjacent to the ditches.
3. Excavating contaminated sediments in the outer Main Ditch for consolidation with the contaminated ditch sediments within the central ditch network sediments, unless UDEQ DWQ and USEPA approve a retrofit option for the active wastewater pond.
4. Refurbishing or abandoning the Sanitary Lagoon (PRI 3).
5. Installing a minimum 2-foot cap using clayey soils or other suitable barrier on the closed ditches, and if applicable, on other contaminated areas within the RCRA Carve-Out Project Area, to eliminate burrowing animals. A capping design necessary to minimize water infiltration was required unless UDEQ DWQ and USEPA approve a retrofit option for the active wastewater pond.
6. Developing and implementing a soil vapor assessment, and if necessary, mitigation.
7. Establishing institutional controls and posting suitable warning signs to manage risk within the RCRA Carve-Out Cleanup Project Area.

Retrofitting the active wastewater pond, as contemplated in the RCRA Carve-Out AOC, is being implemented by USM through the construction of an RWP under a GWDP issued by the UDEQ DWQ Groundwater Protection Program and the Consent Decree. The permitted RWP Area is approximately 1,300 acres and covers PRIs 5, 6, and 7 (Figure 2-8). The RWP will be constructed by expanding the CWP eastward into the OWP and utilizing approximately 600 acres of the OWP. The current dike between the CWP and OWP will remain, but may be partially submerged during RWP operation depending on wastewater levels within the RWP. The dike will be breached or large culverts will be installed to allow free communication between the CWP and OWP subareas of the RWP during operations. A hydraulic barrier wall will be installed through the eastern, southern, and northern dikes as shown on Figure 2-8. The existing dikes will be raised and some new sections of embankment will be

constructed from compacted earthen fill. The wall will be installed through the crown of the dikes at an elevation 2 feet higher than the average annual high-water level and will extend approximately 2 feet into the Deeper Silty Clay unit. The western portion of the RWP will remain open and will rely on upgradient groundwater inflow to maintain a hydraulic divide, which will prevent migration of wastewater and impacted groundwater from the RWP footprint to the west.

The RWP will receive the current wastewater stream including wastewater from the lithium facility, which was constructed to process ongoing process generated electrolytic salt and smut material historically stored in PRI 9. The projected final elevation of wastewater within the RWP was evaluated as part of the engineering design process. Little of the upland area currently present in PRIs 5 and 6 is anticipated to remain due to operation of the RWP, but actual water levels and the extent of sediment inundation are not known with certainty, and are expected to vary as a function of both weather conditions and facility production rates. Additionally, the entire length of the SVDD within PRI 5 is inside the RWP and the portion of the SVDD adjacent to PRI 7 has been filled and covered by an earthen dike as part of the RWP construction.

USM will also be designing and constructing the Filtration System to remove chlorinated hydrocarbons (CHCs) from several acidic wastewater streams that originate from the Melt/Reactor and Electrolytic process areas and washdown of those operating areas. As per the Consent Decree, the design will be approved approximately 435 days after the Lodging date of the Decree (19 January 2021). CHCs, consisting of HCB, PCBs, and D/F, are formed in the chlorine-rich off-gas streams from these process areas. Process water used to cool and scrub these off-gas streams is acidified by the absorption of hydrogen chloride gas. Particulate material containing the CHCs is entrained in the cooling/scrubbing liquors. Washdown water from these operating areas could potentially contain CHC-laden dust, and will be filtered prior to discharge to the wastewater pond (USEPA 2021).

Hydrochloric acid is used in the desulfation process, which produces gypsum as a byproduct that is slurried to the PRI 4 Gypsum Pile for disposal.[6] The Gypsum Pile will remain in use during future facility operations; however, after the construction and operation of the Filtration System described above, the gypsum being disposed of at PRI 4 will no longer contain elevated levels of CHCs.

All hypothetical future exposure scenarios for exposure units covered under RCRA (PRIs 4, 5, 6, and 7) are evaluated separately in Appendix C.

2.2.2 Constituents of Potential Ecological Concern

COPECs are Site-related constituents that may adversely affect biota. However, COPECs do not necessarily signify a risk; rather, they are merely constituents that have been identified for further examination. COPEC identification was conducted in the OU-1 SLERA and presented in detail in the OU-1 Screening-Level Risk Assessment Report (ERM 2017b). In summary, COPEC identification consisted of comparing maximum detected concentration in a dataset (C_{max}) to a risk-based ecological screening level (RBESL) and to background concentrations. If C_{max} exceeded the RBESL and was

[6] PRI Area 4, the Gypsum Pile, consists of (1) calcium sulfate (gypsum) removed from the concentrated brine and derived from the desulfation process, where sulfate is removed as gypsum solids (CaSO4) from the concentrated brine via addition of calcium chloride solution; (2) the unreacted calcium carbonate and other solids from calcium chloride production; and (3) raw plant water. In the desulfation process, calcium chloride solution is mixed with concentrated brine to remove sulfur from the brine, producing calcium sulfate (gypsum). After thickening, gypsum filter cake is removed using a drum filter. The calcium chloride used for desulfation is produced onsite via reaction of limestone with hydrochloric acid from the reactor process. The hydrochloric acid feed to the calcium chloride reactor/thickener production process tank comes from several process areas that produce CHCs as byproducts. Unreacted calcium carbonate and other solids from the calcium chloride reactor/thickener are mixed with gypsum filter cake (from the drum filter) and raw plant water (well water from the western foot of the Stansbury Mountain range) and discharged as a slurry to the Gypsum Pile.

greater than background (for those compounds where background was characterized), it was identified as a COPEC. Exceptions to this were:

- Bioaccumulative compounds, which were carried through as COPECs unless concentrations were below background. These compounds include Avian TEQ, Mammalian TEQ, total PCBs, HCB, mercury, hexachlorobutadiene, 1,2,4,5-tetrachlorobenzene, and pentachlorobenzene.
- Essential nutrients, which were excluded from consideration as COPECs. These compounds include calcium, magnesium, potassium, and sodium.

COPECs for soil and sediment identified by the SLERA are presented in Table 2-10. COPECs for water identified by the SLERA are presented in Table 2-11. Hydrogen chloride, as acidic wastewater, was not identified as a surface water COPEC in the SLERA, but has been addressed as a surface water COPEC for avian receptors for evaluation in the BERA (USEPA 2017). Additionally, the SVDD and GSLIC were not assumed to be individual exposure units in the SLERA, but were identified as such for the BERA evaluation. The COPEC lists for the SVDD and GSLIC exposure units were based on the COPECs in the adjacent PRIs (PRIs 7 and 13) (ERM 2021). When finalizing COPEC lists for the BERA, if a COPEC was never detected in a specified medium in a specified habitat of a specified exposure unit, that constituent was removed from the COPEC list for that exposure unit-habitat-media combination. Constituents that were excluded from many exposure unit-habitat-media combinations due to NDs include organics such as 1,2,3,4-tetrachlorobenzene and hexachlorobutadiene, and metals such as silver.

“Uncertain COPECs” were identified in the SLERA as compounds that were either: (1) never detected at the Site and the DL was greater than the RBESL, or (2) there was no RBESL available for comparison. These “uncertain COPECs” were not quantitatively evaluated in the BERA and are discussed in the Uncertainty Analysis (Section 7.1.2.3).

2.2.3 Exposure Pathways/Refined Conceptual Site Models

The CSM considers the Site setting in an ecological context, presents schematically the relationship between chemical sources and classes of receptors at the Site, and identifies potentially complete and significant pathways through which ecological receptors may be exposed to the identified COPECs (USEPA 1992a). A chemical exposure pathway is deemed “potentially complete and potentially significant” if that pathway is reasonable for a receptor given its habitat and dietary preferences. For example, badgers feed on small mammals, so chemical exposure via ingestion of small mammals is considered a complete exposure pathway. One of the potentially complete and potentially significant pathways that cannot be reliably quantitated is toxicity to reptiles, due to a paucity of toxicity data; as a result, only a qualitative evaluation was performed for reptiles. An exposure pathway is deemed “incomplete” if that pathway is highly unlikely for a receptor given its habitat and/or dietary preferences. For example, an American avocet could conceivably ingest soil from PRIs with upland habitat, but this exposure pathway is highly unlikely given that avocets prefer lakebed habitat and predominantly feed from aquatic environments.

Each CSM is intended to identify those exposure scenarios that are most likely to put biotic receptors of concern at risk. Exposure routes considered in the BERA include:

- Direct contact/uptake of constituents in surface water by aquatic invertebrates (brine shrimp) and aquatic plants (including algae)
- Direct contact/uptake of constituents in sediment by benthic invertebrates (brine fly larvae)
- Direct contact/root uptake of constituents in soil by terrestrial plants
- Direct contact/uptake of constituents in soil by soil invertebrates

- Incidental ingestion of constituents in soil by wildlife
- Ingestion of constituents in surface water by wildlife
- Ingestion of constituents in food items (i.e., plant, invertebrate, or small mammal) by wildlife

Dermal absorption by wildlife and inhalation of fugitive dust are considered to be negligible exposure pathways relative to the above pathways because:

- Dense undercoats or down effectively prevent contaminants from reaching the skin of wildlife species and significantly reduce the total surface area of exposed skin (Peterle 1991)
- Results of exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (USEPA 2005b; Peterle 1991)
- Fugitive dust is assumed to be inhaled, the majority of inhaled fugitive dust adheres to mucous, and the mucous is subsequently swallowed (therefore, it is accounted for in the incidental ingestion of soil pathway)

A CSM that identifies and summarizes the sources, mechanisms of transport, media of concern, exposure routes, and receptor groups under the current land use scenario was prepared for each PRI at the Site. PRIs that are anticipated to receive changes to land use/habitats in the future (as described in Section 2.2.1.7) have separate CSMs presented for future land use scenarios. For PRIs in which current and future land use scenarios are expected to remain the same, only one CSM was prepared to represent both of these scenarios. CSMs for all PRIs under the current and future, if applicable, land use scenarios are shown on Figures 2-9 through 2-23 and summarized below.

PRI 1 – All the ditches composing PRI 1 have been filled and capped as part of the RCRA AOC except for the eastern portion of the Main Ditch (USEPA 2016a). Three sediment/soil sample locations in the eastern portion of the Main Ditch are being evaluated in other exposure units as follows: samples 1-11 and 1-12 are evaluated as PRI 5 lakebed, and sample 1-13 is evaluated as PRI 5 upland. One water sample location, PRI1-003, is evaluated as PRI 5 lakebed. No other exposures have been evaluated in the PRI 1 Former Ditches. Because the majority of PRI 1 has been capped and the samples in this short segment of open ditch have been combined with PRI 5, a CSM was not developed for PRI 1.

PRI 2 – Few to no plants or soil invertebrates occupy the landfill due to industrial uses. Birds and mammals may have complete exposure routes via incidental ingestion and direct contact, but these exposures are expected to be infrequent (transitory) and acute in nature (i.e., it is likely that wildlife would not spend much time at these locations given the lack of habitat for cover and lack of food items and frequent industrial use). Given the lack of suitable refuge habitat and the paucity of vegetation and invertebrates at these locations, prey (food) ingestion exposures are expected to be negligible. This CSM reflects current and future land use scenarios. See Figure 2-9.

PRI 3 – The Sanitary Lagoon was remediated in 2018 as part of the RCRA AOC (USEPA 2016a). Therefore, exposure will not be evaluated in PRI 3.

PRI 4 – The Gypsum Pile is a disturbed upland habitat that supports barren ground or minimal vegetation that offers unsuitable refuge habitat. Given the paucity of plants and invertebrates, wildlife is likely limited to acute exposures via direct contact and incidental ingestion. This CSM reflects the current land use scenarios (Figure 2-10). Although unlikely, potential exposure pathways in a future land use scenario were also evaluated assuming the land is fallow. It was conservatively assumed that sufficient amounts of soil would be deposited on top of the gypsum substrate in a future fallow scenario allowing the pile to become vegetated and allowing for potential chronic exposure to plants, invertebrates, and wildlife. This hypothetical exposure occurring under RCRA is presented separately in Appendix C.

PRI 5 – The CWP receives highly acidic surface wastewater from the Main Ditch, which precludes the presence of a suitable environment for aquatic life, thus eliminating an aquatic food source for wildlife species that may be present. Given the acidity, it is unlikely that lakebed wildlife use the inundated lakebed areas and are exposed to COPECs in water or sediment at this PRI. However, since it is possible that wildlife may attempt to forage in the water or sediment, acute exposures were evaluated. Additionally, a repeated acute exposure (termed “intermittent longer-term exposure”) was evaluated for probing birds in the lakebed area of PRI 5 assuming a water and sediment ingestion.

In the upland areas, which include berms surrounding the CWP that are never or very infrequently inundated with the highly acidic wastewater, plants and invertebrates are exposed to soil via direct contact and/or incidental ingestion. Wildlife may forage on these plants and invertebrates. Accordingly, exposure pathways are potentially complete for the upland receptors. The CSM for the current land use scenario is shown on Figure 2-11.

As discussed in Section 2.2.1.7, the future conditions for PRI 5 are based on construction of the RWP. All hypothetical exposures occurring within the RWP are presented separately in Appendix C.

PRI 6 – Exposure pathways for the current and future land use scenarios in PRI 6 are identical to those of the current land use scenario in PRI 5, above, where lakebed exposures were assumed to be acute for lakebed birds and mammals and intermittent longer-term for probing birds. Upland exposures were assumed to be chronic for all upland receptors. See Figure 2-12 for the current use scenario CSM.

As discussed in Section 2.2.1.7, the future conditions for PRI 6 are based on construction of the RWP. All hypothetical exposures occurring within the RWP are presented separately in Appendix C.

PRI 7 – The OWP is composed almost entirely of playa habitat, thus is considered lakebed habitat in the BERA. Under current conditions, aquatic biota are unlikely to persist in the OWP, due to seasonal releases of acidic wastewater into the PRI. Accordingly, the acute and intermittent longer-term exposure pathway (i.e., incidental sediment ingestion) is likely to be complete for lakebed birds and mammals in this area. However, the pH of the wastewater is neutral at times, which could result in potential chronic exposures to lakebed receptors as well. This CSM reflects the current land use scenarios (Figure 2-13).

As discussed in Section 2.2.1.7, the future conditions for PRI 7 are based on the construction of the RWP. All hypothetical exposures occurring within the RWP are presented separately in Appendix C.

PRI 8 – The majority of PRI 8 is upland habitat. However, PRI 8 also contains a depression area with seasonally wetted margin habitat in the playa portions of the PRI where avocets have been observed foraging and possibly nesting. Thus, exposure to lakebed wildlife is assumed to be chronic via direct contact, incidental ingestion, and ingestion of prey items. Terrestrial plants and invertebrates are exposed to soil in the areas of the PRI that are not inundated with water (i.e., the upland habitat). Birds and mammals may forage on upland plants and invertebrates, thus exposure to upland wildlife is assumed to be chronic via direct contact, incidental ingestion, and ingestion of prey items. The CSM for the current land use scenario is shown on Figure 2-14.

PRI 8 no longer receives acidic wastewater due to construction of a wastewater overflow pipe connecting the PRI 5 / PRIs 6 and 7 wastewater evaporation ponds. Quarterly monitoring of the Northwest Barrow Area between fourth quarter 2018 and third quarter 2019 found the area to either be dry or to contain circum-neutral pH (approximately pH 6) surface water. The potential for future releases of wastewater to PRI 8 will be mitigated by construction of the RWP. Therefore, this PRI will become fallow. A future land use scenario would likely result in potentially complete exposure pathways for all lakebed and upland receptors in the PRI since any water in this area would not be acidic. The future land use scenario CSM is consistent with the current land use scenario.

PRI 9 – The Smut Area is disturbed upland habitat with little to no vegetation or suitable refuge habitat. A lithium processing facility is planned for construction in PRI 9, which will reprocess smut material. Thus, this PRI will continue to be an active industrial area. Due to the lack of habitat, wildlife is limited to acute/transient exposure via direct contact and incidental ingestion. This CSM reflects the current and future land use scenarios for PRI 9 (Figure 2-15).

PRI 10 – The Barium Sulfate Disposal Area is disturbed upland habitat with little vegetation or suitable refuge habitat. Chronic exposures are assumed, but likely conservative given the limited suitable habitat in the Barium Sulfate Area. This CSM reflects the current and future land use scenarios for PRI 10 (Figure 2-16).

PRI 11 – PRI 11 supports buildings, paved parking lots, compacted dirt roads, and other areas used for industrial/commercial purposes, as described in the Habitat and Wildlife Survey and Mapping Report (ERM 2014a). As such, there is no attractive refuge or foraging habitat to support biota or wildlife in PRI 11 and, due to the lack of potentially complete exposure pathways, a CSM was not developed.

PRI 12 – The southern area of PRI 12 has upland habitat where terrestrial plants and soil invertebrates may be exposed to COPECs via direct contact and/or incidental ingestion. COPECs that have accumulated in these prey items may be transferred to wildlife through dietary exposure pathways. This CSM reflects the current and future land use scenarios (Figure 2-17).

PRI 13 – The lakebed habitat in PRI 13 does not receive acidic wastewater. Therefore, plants and invertebrates are exposed to neutral pH, high TDS surface water and sediment. Birds and mammals may forage on the plants and invertebrates that reside in the sediment/salt flat, thus exposure to wildlife is assumed to be chronic via direct contact, incidental ingestion, and ingestion of prey items. This CSM reflects the current and future land use scenarios for PRI 13 (Figure 2-18).

PRI 14 – Lakebed plants and invertebrates are exposed to surface water and sediment in the lakebed areas of PRI 14 via storm water runoff and neutral pH, high TDS groundwater seeps. Terrestrial plants and invertebrates are exposed to soil in the areas of the PRI that are upland habitat. Birds and mammals may forage on the plants and invertebrates, thus exposure to wildlife is assumed to be chronic via direct contact, incidental ingestion, and ingestion of prey items. This CSM reflects the current and future land use scenarios (Figure 2-19).

PRIs 15 and 16 – Potentially complete exposure pathways are assumed for terrestrial plants and soil invertebrates via direct contact and/or incidental ingestion. Birds and mammals may forage on the plants and invertebrates, thus exposure to wildlife is assumed to be chronic via direct contact, incidental ingestion, and ingestion of prey items. This CSM reflects the current and future land use scenarios for PRI 15 (Figure 2-20) and PRI 16 (Figure 2-21).

SVDD – The portion of the SVDD (and former SVDD segment) that flows through PRIs 5, 7, 13, 14, and 15 does not have a surface connection to the CWP, but appears to receive seepage from the CWP during late winter to early summer. Surface water in the former SVDD segment in PRI 5 is non-acidic, resulting in complete exposure pathways for aquatic biota and wildlife. The CSM for the current land use scenario is shown on Figure 2-22. Given the ditch will cease to exist after the realignment, a CSM was not developed for the future land use scenario.

GSLIC – The lakebed habitat in the GSLIC does not receive acidic wastewater. Therefore, plants and invertebrates are exposed to neutral pH, high TDS surface water and sediment. Birds and mammals may forage on the plants and invertebrates that reside in the ditch, thus exposure to wildlife is assumed to be chronic via direct contact, incidental ingestion, and ingestion of prey items. This CSM reflects the current and future land use scenarios for GSLIC (Figure 2-23).

2.2.4 Management Goals, Assessment Endpoints, and Measurement Endpoints/Lines of Evidence

The selection of management goals, AEs, and MEs/LOEs is a critical part of the Problem Formulation. These are discussed in more detail in the following sections.

2.2.4.1 Management Goals

Management goals are statements about the desired condition of ecological values of concern (*Guidelines for Ecological Risk Assessment* [USEPA 1998]). These goals may come from the law, interpretations of the law and/or mission statements by regulators/resource managers, desired outcomes voiced by community leaders and the public, and interests expressed by affected parties. Management goals for "places" are typically formed as a consensus based on diverse values reflected in federal, state, and local regulations and on constituency-group and public concerns (USEPA 1998). The USEPA-defined management goal for the Site reflects the over-arching goal of the National Contingency Plan, which is "protection of human health and the environment" (CERCLA/Superfund Amendments and Reauthorization Act).

2.2.4.2 Assessment Endpoints

AEs are an expression of the important ecological values that are to be protected at a site (USEPA 1998). AEs are based on known information concerning the constituents present, the Site, the ecological CSM, and risk hypotheses. There are two components to each AE: an "entity" (e.g., carnivorous bird populations) and an "attribute" of that entity (e.g., persistence and abundance) (USEPA 1998). The AE entities and attributes for the current and future land use scenarios of each PRI were selected based on the following principal criteria:

- Management goals
- Ecological relevance
- Level of biological organization (e.g., community or population level)
- Exposure duration (e.g., acute or chronic)

AEs based on an acute, transient exposure are focused on protection of survival for bird and mammal populations. AEs based on chronic exposures are focused on protection of population-level endpoints (growth, reproduction, and survival) of birds and mammals. Aquatic biota, benthic invertebrates, terrestrial plants, and soil invertebrates are evaluated with AEs based on protection of community structure and function.

The specific AEs evaluated for each PRI are listed in Table 2-12.

2.2.4.3 Measurement Endpoints/Lines of Evidence

MEs are quantifiable ecological characteristics used to evaluate the risk hypotheses for the AEs, and incorporate both measures of exposure and measures of effect (USEPA 1998). These MEs are equivalent to LOEs within the weight of evidence (WOE) process (see Section 2.5.4), and will be referred to as LOEs hereafter.

For the BERA, five LOEs were generated for each of the AEs:

- **Direct contact HQs** – measured concentrations in solids or water compared to chronic benchmarks
- **Dietary dose HQs** – modeled daily dose from oral ingestion of food, solids, and/or water compared to acute, chronic, or intermittent longer-term dietary TRVs

- **Tissue HQs** – measured or modeled concentrations in biotic tissue (eggs, small mammal whole carcass, plant tissue, or invertebrate tissue) compared to chronic tissue benchmarks
- **Site-specific toxicity studies** – results from laboratory toxicity tests using media collected from the Site
- **Ecological field surveys** – field observations of relevant endpoints (e.g., reproductive success, body mass) at the Site compared to reference locations

Three of the five LOEs evaluated in the BERA are based on HQs. An HQ is the ratio of an exposure level at the Site to a "benchmark" exposure level that is associated with a known level of response. These benchmarks may be based on either a no observed adverse effects level (NOAEL) or a lowest observed adverse effects level (LOAEL). The measure of exposure at the Site may be expressed as the concentration in an environmental medium (such as sediment, soil, water, or diet), the concentration in the tissues of an exposed receptor, or the ingested dose for a receptor. Exposure may be directly measured at a site, or may be modeled using relevant uptake models and receptor-specific exposure factors. The benchmark is expressed in the same units as the exposure parameter (either concentration or dose), and may be derived from Site-specific toxicity tests or toxicity information available in the literature. For this report, a concentration-based benchmark value is referred to as a "benchmark" while a dose-based benchmark value is referred to as a "TRV."

The Site-specific toxicity studies LOE uses Site-specific media (e.g., water, solids, or dietary items) to compare the observed response in treatment organisms against that of organisms exposed to control or reference media. Toxicity tests may be performed in the laboratory, which provides better experimental control of potentially confounding variables. The usefulness of the test depends on the experimental methods, including test species, exposure method, duration, minimization of confounding factors, the appropriateness of the reference or control media, and the spatial and temporal representativeness of the sampled media to conditions across the entirety of the Site. For the BERA, the Site-specific toxicity studies LOE is derived from two studies on the palatability and toxicity of acidic waste pond water to birds (Parametrix 2004 and Hooper et al. 2008), which is applicable only to birds, and only to the lakebed habitats of exposure units that may contain acidic wastewater. Information from this LOE is also used to address potential effects from the surface water COPEC, hydrogen chloride as acidic wastewater, to avian receptors.

The ecological field surveys LOE uses field observations of Site ecology, particularly in comparison to an appropriate reference, to provide information on whether actual adverse effects are occurring for receptors at the Site. Depending on the AE, measures such as abundance, production, reproductive success, mortality rates, and species diversity, may be appropriate. The most useful ecology studies compare Site population/community observations against those of an appropriate reference, such as the Site before the presence of COPECs, or a nearby reference area similar in habitat, geology, hydrology, and climate, and adequately address diurnal, seasonal, and annual variability. Studies that merely observe the presence of receptors at a site do not provide useful evidence for addressing population-level effects (Fairbrother 2003). For the BERA, the ecological field surveys LOE is derived from studies by Cavitt (2008, 2010) on the reproductive success of birds near the OWP (PRI 7 and nearby areas). This LOE is applicable only to birds, and only to the habitats and exposure units with monitored bird nests.

The five types of LOEs each have advantages and limitations, thus conclusions based on only one type of LOE may be misleading. The integration of multiple LOEs in a WOE process, which accounts for the relative advantages and limitations, as well as the reliability, relevance, and strength of the individual analyses, generates risk characterizations with higher confidence. The WOE approach for this BERA, including the advantages and disadvantages of the five types of LOEs, is discussed further in Section 2.5.4. Specific LOEs for each AE are outlined in Table 2-12.

2.2.5 Representative Wildlife Receptors

Given the number of species and the complexity of biological communities, not all species present within the Site can be individually assessed. To focus the BERA for OU-1, representative species are used to infer the potential for adverse impacts to members of the guilds of concern identified in AEs (Section 2.4.2). The guilds of concern for birds and mammals include the following consumer types: herbivores (plant-consuming), invertivores (invertebrate-consuming), and carnivores (animal-consuming). This section presents the selection of representative receptors for the BERA.

Representative species were not needed and were not identified for aquatic biota, sediment-dwelling biota, terrestrial plants, and soil invertebrates because exposures and toxicity benchmarks are based on concentrations in media of concern and are appropriate for performing community-based assessments. Representative species for wildlife are needed because exposure and TRVs are dose-based and require the use of representative species-specific wildlife exposure factors.

Members of these guilds that were selected as representative species have attributes (i.e., exposure factors) that maximize exposures/risks, e.g., small body weights, small home ranges.

Representative species for each wildlife AE were identified based on the following selection criteria:

- Taxonomic relatedness to biota of concern
- Similar function/role in the ecosystem
- Known or presumed similarities in physiology and life history
- Presence (known/expected to occur) at/near PRIs
- Biological characteristics that would tend to maximize estimates of exposure (e.g., small body size, small home or foraging ranges, forages on ground surface)
- Availability of wildlife exposure factor data (e.g., ingestion rates)

Representative wildlife species were selected to provide representative estimates of exposure and ensure a conservative assessment of risk that can be related to AEs listed in Section 2.2.4.2. Candidate representative wildlife species were identified by searching the SWReGAP database for relevant species inhabiting the different land cover types found in the upland and lakebed areas of the Site. The upland and lakebed habitats are defined in Section 2.2.1.5 and shown on Figure 2-6. Proposed representative receptors for wildlife species were selected based on the professional judgment and application of selection criteria, as described below. Table 2-13 provides a summary of the representative receptors of concern for each guild of interest and habitat type.

Representative species selected for use in the BERA are summarized below.

Upland Habitat Representative Receptor Species

- Gleaning invertivorous bird – horned lark: This species was selected due to the small home range and presence in the Site.
- Aerial invertivorous bird – tree swallow (*Tachycineta bicolor*): This species was selected due to the small body size, small home range, and preferred habitats.
- Herbivorous bird – mourning dove (*Zenaida macroura*): This species was selected due to the small body size, small home range, and preferred habitats.
- Carnivorous bird – American kestrel (*Falco sparverius*): This species was selected due to the small body size and small home range. The American kestrel was used as a surrogate for the golden

eagle, which has been observed nesting in the Lakeside Mountains in PRI 16 and is protected at the individual level due to the Bald and Golden Eagle Protection Act.

- Invertivorous mammal – grasshopper mouse (*Onychomys arenicola*): This species was selected due to the small body size and presence at the Site.
- Herbivorous mammal – Ord's kangaroo rat (*Dipodomys ordii*): This species was selected due to the small body size, small home range, and preferred habitats.
- Carnivorous mammal – badger: This species was selected because it has been observed at the Site, has a small body weight, has a small home range compared to the red fox and other candidate species, and uses more land cover types within the Site compared to the red fox.
- Large herbivorous mammal – pronghorn antelope (*Antilocapra americana*): This species was selected due to the availability of exposure factors and relevance to the Site; however, large herbivorous mammals are only expected to occur in the buffer areas (PRIs 14, 15, and 16).

Lakebed Habitat Representative Receptor Species

- Probing invertivorous bird – snowy plover and American avocet: The snowy plover was selected as a representative receptor for the BERA for the following reasons: (1) small body size; (2) snowy plovers are gleaners and probers so they will consume brine fly larvae, brine shrimp, and adult brine flies; (3) snowy plover forage within the playa and the shoreline unlike the spotted sandpiper; (4) they nest within the Site boundaries; and (5) have been observed at the Site many times. Additionally, the American avocet was also selected as a representative receptor of invertebrate-consuming birds for the lakebed habitat because this species has different feeding behavior and higher sediment intake than the snowy plover.
- Aerial invertivorous bird – tree swallow: The same selection criteria described above apply to lakebed receptor selection.
- Herbivorous bird – mourning dove: The same selection criteria described above apply to lakebed receptor selection.
- Carnivorous bird – American kestrel: The same selection criteria described above apply to lakebed receptor selection.
- Invertebrate-consuming mammal – grasshopper mouse: The same selection criteria described above apply to lakebed receptor selection.
- Herbivorous mammal – Ord's kangaroo rat: The same selection criteria described above apply to lakebed receptor selection.
- Carnivorous mammal – badger: The same selection criteria described above apply to lakebed receptor selection.

A representative wildlife species was not selected for omnivores because evaluations of the other selected wildlife species include idealized diets (e.g., 100 percent plant diet for representative herbivores, 100 percent invertebrate diet for representative invertivores) that would "bound" the exposure/risk for a representative omnivore since the composition of the diet for an omnivore would be intermediate to these idealized representative species. For example, if an omnivorous representative species had a diet composed of 50 percent plant and 50 percent invertebrates, its exposure/risk lies between exposure/risks for the representative 100 percent herbivore and the representative 100 percent invertivore (Table 2-14).

2.3 Exposure Assessment

The exposure assessment estimates the potential for Site-related exposure by evaluating the co-occurrence of COPECs and the ecological receptors of concern (USEPA 1998). This section presents the approaches used to develop exposure estimates for each receptor.

- The first step in the exposure assessment is to define the area over which exposure to a receptor will be estimated. This area is called an exposure unit.
- The second step in the exposure assessment is to define the EPCs for each medium. An EPC is the representative concentration of a COPEC in an environmental medium (i.e., soil, sediment, water, tissue) that a receptor of concern is likely to contact within the exposure unit.
- The third step in the exposure assessment is to define the methods for quantitatively or qualitatively estimating exposure to the receptors. This is termed the measure of exposure.

This section provides the same information as presented in the *Final Problem Formulation and Baseline Ecological Risk Assessment Technical Memorandum* (ERM 2020a), with the exception of the exposure assessment methodology for the intermittent longer-term exposure, Site-specific toxicity studies LOE, and the ecological field surveys LOE.

The exposure units, EPCs, and measures of exposure are presented below for each LOE where it is applicable. Exposure in background areas was characterized for each LOE, if available. For the HQ LOEs (direct contact, dietary dose, intermittent longer-term), background concentrations in soils/sediments were developed during data collections for the Phase 1A-B field efforts and summarized in the Phase 1A-B data report (ERM 2016c). Background was characterized for inorganics (excluding essential nutrients) and organics at all background locations. While a background comparison was conducted as part of the COPEC selection process, additional background comparisons were evaluated in the BERA to characterize the approximate fraction of the exposure and risk that is attributable to background (as opposed to Site-related) COPEC levels. Background concentrations are presented in Table 2-7. The background dataset was developed as representative of upland and lakebed exposure units.

2.3.1 Direct Contact Hazard Quotient Line of Evidence

The direct contact pathway is the uptake or accumulation of a contaminant from the surrounding physical media into the receptor's tissue, which may result in adverse effects to the receptor. For example, the roots of a plant may accumulate a contaminant that is present in the surrounding soil and this accumulation may result in an effect on growth, reproduction, or survival.

2.3.1.1 Exposure Units

The BERA assumes that the habitat within a PRI equals the exposure unit, where all lakebed habitat within a PRI is an exposure unit for lakebed receptors and all upland habitat within a PRI is an exposure unit for upland receptors (see Section 2.2.1.5 for a description of upland and lakebed habitats). Additionally, the SVDD and GSLIC are each located within PRIs, but are considered separate exposure units.

2.3.1.2 Exposure Point Concentrations

A point-by-point EPC, defined as the concentration of a COPEC at a given sample location, was used to evaluate receptors that are sessile or have very small home ranges. This EPC was selected because variability in exposure among the individual organisms can be evaluated to determine the fraction of the population that may be impacted. The receptors with a direct contact pathway that are sessile or have a small home range include the soil invertebrates, terrestrial plants, aquatic invertebrates, and benthic

invertebrates. The EPC type used for each exposure unit and receptor species evaluated with direct contact exposure is presented in Table 2-15. For water sample locations that had more than one sample result due to repeated sampling events, the maximum detected concentration was selected as the EPC for that sample location. Point-by-point concentrations (i.e., EPCs) for direct contact exposure are within the ranges presented as concentration summary statistics (Table 2-7).

2.3.1.3 Measures of Exposure

The measure of exposure for direct contact exposure was estimated using measured concentrations of Site abiotic media as represented by the EPC. Receptors that were evaluated for exposure via direct contact with COPECs in abiotic media include terrestrial plants, soil invertebrates, aquatic biota, and benthic invertebrates.

The BERA dataset described in Section 2.1.3 was used to estimate direct contact exposures for all current and future land use scenarios. As discussed in Section 2.2.3, exposures for current and future scenarios were assumed to be the same for all exposure units except those in the RCRA Carve-Out Project Area (PRIs 4, 5, 6, and 7).

2.3.2 Dietary Dose Hazard Quotient Line of Evidence

The dietary dose pathway includes the consumption of COPECs in prey tissue and abiotic media (i.e., soil, sediment, and water) through diet and incidental ingestion.

2.3.2.1 Exposure Units

Exposure units are described below for (1) acute and chronic exposures, and (2) intermittent longer-term exposure.

Acute and Chronic Exposure

Exposure units for the dietary dose exposure are the same as those for the direct contact exposure, described above, with the exception of lakebed areas of PRIs 5 and 6 that were evaluated for acute exposures. For purposes of evaluating an acute exposure in acidic wastewater (PRI 5 and PRI 6), only lakebed sediment samples deemed accessible to wildlife were included in the lakebed exposure unit for these PRIs. A sample was determined to be “accessible” if the depth of the water is estimated to be less than 1 foot at the low water level. This depth was selected as a conservative estimate based on the maximum water depth that avocets will probe in (25 centimeters) (Utah Division of Wildlife Resources 2020). Appendix B provides a detailed description of the process used for determining which lakebed samples have an estimated water depth of less than 1 foot.

Intermittent Longer-Term Exposure

The intermittent longer-term exposure scenario was evaluated for probing bird (snowy plover and American avocet) ingestion of COPECs in abiotic media (i.e., sediment and water) through incidental ingestion on an infrequent, repeated occurrence in the acidic waste ponds (PRIs 5, 6, and 7). Exposure units used in the evaluation only included lakebed habitat of PRIs 5, 6, and 7, since this is where the acidic wastewater is located. PRIs 5 and 6 were combined as one exposure unit (the CWP), since there is no physical barrier separating the acidic wastewater of PRIs 5 and 6. Thus, a repeated exposure may occur in any area of the CWP. PRI 7 was evaluated as a separate exposure unit since there is an area of upland habitat that separates the CWP from PRI 7.

Additionally, consistent with the acute dietary dose exposures described above, only lakebed sediment samples deemed accessible to wildlife were included in the lakebed exposure unit for these PRIs.

Appendix B provides a detailed description of the process used for determining which lakebed samples have an estimated water depth of less than 1 foot.

2.3.2.2 Exposure Point Concentrations

EPCs are described below for (1) acute and chronic exposures, and (2) intermittent longer-term exposure.

Acute and Chronic Exposure

Point-by-point EPCs were used to evaluate small mammal receptors that have small home ranges. This EPC was selected because variability in exposure among the individual organisms can be evaluated to determine the fraction of the population that may be impacted. The small mammal receptors with a small home range are the grasshopper mouse and Ord's kangaroo rat.

Solids point-by-point EPCs were used to evaluate all bird and mammal receptors with an acute exposure pathway. Acute exposure pathways were evaluated in PRIs 2, 4, 5 (lakebed only), 6 (lakebed only), 7, and 9. This EPC was selected because an acute exposure is assumed to occur at one sample location rather than at multiple locations within an exposure unit. If the analyte was both a COPEC for solids and water, a 95UCL for surface water in that exposure unit was included as part of the dose calculation.[7]

A 95UCL EPC, defined as the 95th percent UCL on the mean COPEC concentration calculated from samples within a defined exposure unit, was used to evaluate mobile receptors with large home ranges and a chronic exposure pathway. The receptors include horned lark, tree swallow, mourning dove, American kestrel, snowy plover, American avocet, badger, and pronghorn antelope. This EPC was selected because individual receptors with large home ranges are assumed to forage in multiple locations within an exposure unit. 95UCL EPCs were calculated for both solids and water COPECs.

The EPC type used for each exposure unit and receptor species evaluated with daily dose exposures is presented in Table 2-16. EPC values presented as 95UCLs are presented in Table 2-7. EPCs based on individual sample locations are within the ranges presented as concentration summary statistics (Table 2-7).

Intermittent Longer-Term Exposure

A surface-weighted average concentration (SWAC) EPC was used to evaluate probing bird receptors (snowy plover and American avocet) with an assumed intermittent longer-term exposure to accessible areas of the CWP, and to all areas of PRI 7 (all of which is accessible to probing birds). The SWAC is the average concentration weighted by surface area within Thiessen polygons created around individual samples. The SWAC was selected as the EPC for this evaluation, as opposed to the 95UCL, because the SWAC weights the contribution of each sample to the average by the size of the area around the sample location. This means that in high-density sampling areas, concentrations (which can be high or low) apply to smaller areas than in low-density areas.

The SWAC EPC type used for probing birds in PRIs 5, 6, and 7 is shown in Table 2-16. Methods for developing the SWAC concentrations are provided in Appendix B. SWAC concentrations used as EPC values are presented in Table 2-17.

[7] For water sample locations that had more than one sample result due to repeated sampling events, the maximum detected concentration was selected to represent that sample location. The representative concentration for each sample location within an exposure unit was then used to calculate a 95UCL water concentration.

2.3.2.3 Measures of Exposure

Measures of exposure are described below for (1) acute and chronic exposures, and (2) intermittent longer-term exposure.

Acute and Chronic Exposure Model

Exposure to mobile wildlife receptors was evaluated via a dose model that calculates the estimated daily dose of a COPEC. The dose calculation model provides a conservative estimate of food-chain exposure using Site-specific and/or published parameters to estimate the uptake of contaminants via the ingestion of food items, the incidental ingestion of soil or sediment, and the ingestion of water.

The food-chain dose model follows the general equation:

$$Dose = SUF * \left[IR_{food} * \left(C_{plant} * P_{plant} + C_{invert} * P_{invert} + C_{vert} * P_{vert}\right) + IR_s * C_s + IR_w * C_w\right] / BW \quad \text{Eqn 2-5}$$

Where:

Dose	=	estimated daily dose of COPEC from ingestion (milligrams per kilograms body weight per day [mg/kg$_{body\ weight}$/day])
IR_{food}	=	amount of food ingested per day (kilograms dry weight per day [kg dw/day])
IR_s	=	amount of soil/sediment incidentally ingested per day (kg dw/day)
IR_{water}	=	amount of water ingested per day (liters per day [L/day])
BW	=	body weight (kg)
SUF	=	site use factor (unitless)
P_{plant}	=	proportion of diet from plant prey items (unitless)
$P_{invertebrate}$	=	proportion of diet from invertebrate prey items (unitless)
$P_{vertebrate}$	=	proportion of diet from vertebrate prey items (unitless)
C_{plant}	=	concentration of COPEC in plant prey items (mg/kg dw)
$C_{invertebrate}$	=	concentration of COPEC in invertebrate prey items (mg/kg dw)
$C_{vertebrate}$	=	concentration of COPEC in vertebrate prey items (mg/kg dw)
C_s	=	concentration of COPEC in soil/sediment (mg/kg dw)
C_w	=	concentration of COPEC in surface water (milligrams per liter [mg/L])

Calculations of dose and HQ were performed and presented on a medium-by-medium basis, and hazard has been shown at the HQ level by COPEC. For mobile receptors with a chronic pathway, concentrations of soil, sediment, surface water, and prey items were represented by the EPCs for the exposure unit (i.e., 95UCL), as described above. For small mammals with a chronic pathway, concentrations of soil, sediment, surface water, and prey items were represented by the point-by-point EPCs within the exposure unit (i.e., each sample location), as described above. For mobile receptors and small mammals with an acute pathway (i.e., soil/sediment and water ingestion only), concentrations of soil/sediment were represented by the point-by-point EPCs within the exposure unit, but the concentrations of water were represented by the 95UCL EPCs.

Intermittent Longer-Term Exposure Model

The measure of exposure for the intermittent longer-term exposure pathway is the dietary dose model described above with an additional exposure factor, termed the acid habitat utilization factor (AHUF). The

AHUF only applies to an intermittent longer-term exposure to sediment and water ingestion. Food ingestion is not included in this dose equation (similar to the dose model for acute exposure) because there are no food items in the surface water or sediment of the waste ponds due to the high acidity (and due to the lack of observed feeding by probing birds in highly acidic surface waters). The dose model equation for the intermittent longer-term exposure is as follows:

$$Dose = (AHUF * \text{SUF}) * [(IR_s * C_s) + (IR_w * C_w)] / \text{BW} \qquad \text{Eqn 2-6}$$

Where:

Dose	=	estimated daily dose of COPEC from ingestion (milligrams per kilograms body weight per day [mg/kg$_{\text{body weight}}$/day])
AHUF	=	acid habitat utilization factor (unitless)
IR_s	=	amount of soil/sediment incidentally ingested per day (kg dw/day)
IR_{water}	=	amount of water ingested per day (L/day)
BW	=	body weight (kg)
SUF	=	site use factor (unitless)
C_s	=	concentration of COPEC in soil/sediment (mg/kg dw)
C_w	=	concentration of COPEC in surface water (mg/L)

2.3.2.4 Wildlife Exposure Factors

Species-specific exposure factors (food ingestion rate, soil ingestion rate, water ingestion rate, body weight, and home range) were used in the dose model to estimate daily dose. In general, exposure parameters for the selected receptors were obtained from the USEPA's *Wildlife Exposure Factors Handbook* (USEPA 1993) and the Cornell Lab of Ornithology (Cornell 2017). Every effort was made to select ecologically relevant and reasonably conservative ingestion rates, body weights, and dietary compositions. The selected exposure parameters and source for each receptor are summarized in Table 2-18. The site use factor (SUF) for a receptor is a measure of the proportion of time spent in an exposure unit and is typically calculated as a ratio of the exposure unit area (in hectares [ha]) to the receptor's home range (in hectares); if the receptor's home range is smaller than the exposure area, then an SUF of 1 is used. Table 2-18 summarizes home range information for representative receptors. Exposure-unit-specific SUFs were developed using the receptor-specific home ranges and the areas of the exposure units (Table 2-19).

For the intermittent longer-term exposure, an additional exposure factor, termed the AHUF, was included in the dietary dose model. The AHUF is an exposure factor that is unique to this risk assessment. The AHUF is intended to represent the portion of time that a probing bird will utilize highly acidic surface water as compared to the time spent utilizing more optimal habitat. While available data from field observations of bird behavior at the acid ponds do not allow for a robust estimation of PRI and/or species-specific AHUF values, the study by BIO-Logic (2002, 2003) provides sufficient information to derive a conservative estimate. In this study, American avocets were the most commonly observed species in the active ponds as well as the only species to wade and rest in the water for extended periods of time, and the estimated total time at the ponds for all avocets combined was 6 hours per month. If this value is conservatively assumed to be based on one individual avocet (this is not considered likely), and if the average foraging time of avocets in non-acidic water is assumed to be about 6 hours per day (180 hours per month), this would correspond to a maximum AHUF value of 6 / 180 = 0.033, which would correspond to a foraging frequency of about one visit per month. It is suspected that actual AHUF values for avocets and other species of probing birds are likely lower, since the mean monthly exposure estimate by BIO-

Logic (2002, 2003) was based on the total number of avocets (n = 10) rather than an individual avocet. A majority of the other species observed had estimated monthly exposure estimates of less than 1 minute, indicating that this AHUF value is substantially overconservative for most bird species.

2.3.2.5 Bioaccumulation Models

The concentrations of COPECs in prey items used in the dose model for chronic exposure described above were determined using bioaccumulation models that relate tissue burdens to media concentrations. Site-specific bioaccumulation models were developed for the principal bioaccumulative COPECs for the Site (i.e., Avian TEQ, Mammalian TEQ, HCB, total PCBs, and mercury), because literature-based models are less relevant to Site-specific conditions and therefore increase uncertainty. Bioaccumulation models were only used to calculate dietary doses for bioaccumulative COPECs (see Section 2.2.2). Site-specific models and literature-based models are described below.

Site-specific Models

For development of Site-specific bioaccumulation models, tissue concentrations from representative prey items (terrestrial herbaceous plants [i.e., seeds and forbs], soil invertebrates/insects [i.e., crawling insects and flying insects], brine shrimp, brine flies, and small mammals) and co-located abiotic media were collected at the Site and reference areas as part of the Phase 2A study (ERM 2018a). These sample data were used to derive models to predict tissue COPEC concentrations based on the concentration in the abiotic source medium (soil or sediment). Different model forms (linear, plateau, sigmoid, and constant) were tested and final model selection was done in collaboration with BTAG (Appendix G of ERM 2018a). Model equations for each bioaccumulation model are shown below. Table 2-20 presents which of the bioaccumulation models listed below were used in the BERA for each COPEC and prey item. A full description of the methods for model derivation and selection is presented in Appendix G of ERM 2018a.

Linear Model

$$\ln(C_{tissue}) = \text{intercept} + a * \ln(C_{soil}) \qquad \text{Eqn 2-7}$$

Where:

ln(C_{soil}) is the natural log transformed concentration on a dry weight basis of the soil

ln(C_{tissue}) is the natural log transformed concentration on a dry weight basis of the tissue

intercept is where the modeled values intercept the y-axis

a is the slope of the line in log-log space

Plateau Model

$$\ln(C_{tissue}) = a + b \times \left(1 - \frac{1}{e^{(c \times \ln(C_{soil}))}}\right) \qquad \text{Eqn 2-8}$$

Where:

e is Euler's number, a constant approximately equal to 2.71828

ln(C_{soil}) is the natural log transformed concentration on a dry weight basis of the soil

ln(C_{tissue}) is the natural log transformed concentration on a dry weight basis of the tissue

a is the y-intercept

b is the ceiling of the plateau

c determines the rate of increase of the curve

Sigmoid Model

$$\ln(C_{tissue}) = a + \left(\frac{b-a}{1+e^{\left(-d \times (\ln(C_{soil})-c)\right)}}\right) \quad \text{Eqn 2-9}$$

Where:

e is Euler's number

ln(C_{soil}) is the natural log transformed concentration on a dry weight basis of the soil

ln(C_{tissue}) is the natural log transformed concentration on a dry weight basis of the tissue

a is the y-intercept or the lower asymptote

b is the ceiling of the upper asymptote

c is the inflection point of the curve

d is the steepness of the curve

In addition to the model types above, a constant value was used for some analyte-prey tissue combinations (see Table 2-20). A constant value is a stationary tissue concentration over the range of solids concentrations observed at the Site. A constant value was used when no statistically significant linear or nonlinear model could be found (i.e., no relationship between solids and tissue concentrations) using the aforementioned methods. For this study, the constant value used is the mean of the natural log of the concentration observed in prey-specific tissue samples.

Literature-based Models

Literature-based models were used to predict uptake in prey items at the Site and reference areas for hexachlorobutadiene and pentachlorobenzene, which are bioaccumulative COPECs that were not measured in the Site-specific Phase 2A study. The selected literature-based models are presented in Appendix G of ERM 2018a. These literature-based models are based on models for generic organic compounds that use the Log K_{OW} of the compound, and are corrected to dry weight using the mean percent solids for the appropriate prey type as measured in the Phase 2A study (see Table 2-20 for selected values). The equations used as the literature-based models are presented below, with COPEC-specific K_{OW} values presented in Table 2-20.

Bioaccumulation factor (BAF) Model for Organic Compounds for Plant Prey, from Appendix C of USEPA 1999

$$C_{plant} = C_{soil} * 10^{(1.588-1.578* \log K_{OW})} \quad \text{Eqn 2-10}$$

Where:

C_{soil} is the concentration on a dry weight basis of the soil

C_{plant} is the concentration on a dry weight basis of the plant tissue

Log K_{OW} is the log-transformed octanol/water partition coefficient for that chemical

BAF Model for Organic Compounds for Invertebrate Prey, from Appendix C of USEPA 1999

$$C_{invertebrate} = C_{soil} * 10^{(-1.146+0.819* \log K_{OW})} \quad \text{Eqn 2-11}$$

Where:

C_{soil} is the concentration on a dry weight basis of the soil

$C_{invertebrate}$ is the concentration on a dry weight basis of the invertebrate tissue

Log K_{OW} is the log-transformed octanol/water partition coefficient for that chemical

Biotransfer factor (BTF) Model for Organic Compounds for Small Mammal Prey, from Appendix C of USEPA 1999 and Travis and Arms 1988

$$C_{mouse} = \frac{\left(C_{soil} * BAF_{soil-invert} * FIR_{mouse} * 10^{-7.6+\log K_{OW}}\right) + \left(C_{soil} * SIR_{mouse} * 10^{-7.6+\log K_{OW}}\right)}{\%\ solids_{mouse}}$$

Eqn 2-12

Where:

C_{soil} is the natural log transformed concentration on a dry weight basis of the soil

C_{mouse} is the natural log transformed concentration on a dry weight basis of the mouse muscle tissue

$BAF_{soil\text{-}invert}$ is the soil to invertebrate BAF for the same chemical on a dry weight basis

FIR_{mouse} is the food ingestion rate of the grasshopper mouse on a dry weight basis

SIR_{mouse} is the soil ingestion rate of the grasshopper mouse on a dry weight basis

$10^{-7.6+\log K_{OW}}$ is the biotransfer factor from food (in this case, invertebrates, on a dry weight basis) to mouse muscle tissue (on a wet weight basis), sourced from the literature (see ERM 2018a)

Log K_{OW} is the log-transformed octanol/water partition coefficient for that chemical

$\%\ solids_{mouse}$ is the percent solids in mouse tissue

Models Used for Prey Item EPCs

Table 2-21 shows which Site-specific bioaccumulation model and abiotic media was used to calculate prey item EPCs in the dose model, as well as the abiotic media used for incidental ingestion in the dose model. Exposures from ingestion of aquatic invertebrates were based on brine flies since only two samples of brine shrimp were obtained in Phase 2A and these data were not adequate for developing an uptake model. The use of the brine fly model is reasonable as Figure 2-24 demonstrates that concentrations observed in the two brine shrimp samples are relatively close to brine fly samples from the same location and are well within the range of the brine fly data. However, as noted in Section 2.2.1.4, the brine flies likely did not hatch near the areas of collection. Thus, the uncertainty of the brine fly uptake model is discussed in Section 7.1.1.4.

2.3.3 Tissue Hazard Quotient Line of Evidence

The tissue body burden exposure pathway includes the accumulation of COPEC concentrations in the tissue of bird eggs, terrestrial plants, soil invertebrates, aquatic invertebrates, and small mammals.

2.3.3.1 Exposure Unit

For the tissue body burden LOE, the habitat within a PRI equals the exposure unit. The SVDD and GSLIC were considered separate exposure units from other areas of PRIs 5, 7, and 13.

2.3.3.2 Exposure Point Concentration

Point-by-point EPCs were used to evaluate modeled tissue concentrations for small mammals, soil invertebrates, terrestrial plants, and aquatic invertebrates.[8] Point-by-point EPCs were used to evaluate measured egg tissue concentrations in exposure units where eggs were collected.[9] The EPC type used for each exposure unit and receptor species evaluated with tissue body burden is presented in Table 2-22. EPC values of soil/sediment used to model tissue concentrations are within the ranges presented as concentration summary statistics in Table 2-7, and EPC values for eggs are presented in Appendix D.

2.3.3.3 Measures of Exposure

The measure of exposure for tissue concentrations of bird eggs was estimated using measured concentrations of COPECs in the egg tissue. The measure of exposure for tissue body burden of terrestrial plants, soil invertebrates, aquatic invertebrates, and small mammals was estimated by modeled tissue concentrations using bioaccumulation models that relate tissue burdens to media concentrations.

Site-specific and literature-based uptake models for bioaccumulative compounds were used to estimate tissue body burdens for soil invertebrates, aquatic invertebrates, terrestrial plants, and small mammals at each soil/sediment sample location where chronic exposure was assumed. As described above for the dietary dose exposure pathway, Site-specific bioaccumulation models were developed for the principal bioaccumulative COPECs for the Site (i.e., Avian TEQ, Mammalian TEQ, HCB, total PCBs, and mercury) as part of the Phase 2A study (Appendix G of ERM 2018a). Literature-based models were selected for the remaining bioaccumulative COPECs. Uptake models are presented in Table 2-20.

Avian TEQ and Mammalian TEQ were not evaluated in tissue for terrestrial plants, soil invertebrates, or aquatic/benthic invertebrates. Based on the recognition that (1) invertebrates and plants do not have a dioxin-sensitive AhR, (2) invertebrates and plants are substantially less sensitive to D/F than vertebrates, and (3) credible TRVs are generally not available for evaluation of invertebrate or plant hazard on a congener-specific basis, no attempt was made to quantify TEQ exposure to invertebrates or plants due to uptake from sediment or soil.

2.3.4 Site-Specific Toxicity Studies Line of Evidence

Site-specific toxicity studies utilize media samples collected at the Site to test for observed toxicity under controlled conditions. The exposure scenario, including media type (e.g., sediment, water), test subject (e.g., plants, invertebrates, birds), and test duration (e.g., acute, chronic), varies depending on the study design. For the BERA, a Site-specific toxicity studies LOE was evaluated for birds. The Site-specific toxicity studies LOE utilizes two studies that evaluated acute oral and dermal exposures of either acidic waste pond water or control water to birds. These studies are described fully in Section 3.2.3. No Site-specific toxicity studies were available for other receptors.

2.3.5 Ecological Field Surveys Line of Evidence

Ecological field surveys assess the health and functioning of the populations and communities at the Site, utilizing direct observations of habitats and wildlife. Exposure to Site-specific contaminants is controlled by the comparison of the field survey results to those at an appropriate reference area, which is ideally similar to the Site in all ways with the exception of the contamination. An ecological field surveys LOE

[8] Measured tissue concentrations of soil invertebrates, aquatic invertebrates, terrestrial plants, and small mammals were not evaluated for tissue body burden, which is a deviation from ERM 2020a. Modeled tissue concentrations were found to be more appropriate given the small number of tissue samples (or no samples) collected in each exposure unit.

[9] It should be noted that some nests were located close to the boundary between two PRIs, so in some cases the PRI where the nest occurred may not be the same PRI where the adult birds were exposed.

was used to evaluate birds, mammals, and plants. Ecological data were compared between Site and reference or between Site and the expected norm for the region (using best professional judgment and/or literature-based values). The ecological field surveys are described fully in Sections 3.2.4, 4.2.4, 5.2.4, and 6.2.7.

2.4 Effects Assessment

The effects assessment identifies toxicological effects data that are used to measure effects at the Site. The following sections describe the measures of effects for the direct contact HQ LOE, dietary dose HQ LOE, tissue HQ LOE, Site-specific toxicity studies LOE, and ecological field surveys LOE.

This section and Appendix C provide the same information presented in the *Final Problem Formulation and Baseline Ecological Risk Assessment Technical Memorandum* (ERM 2020a), with the following exceptions:

- Refinements to specific benchmarks and TRVs
- The addition of chronic LOAEL benchmarks for aquatic biota
- The measure of effects for the Site-specific toxicity studies LOE (Section 2.4.2)
- The measure of effects for the ecological field surveys LOE (Section 2.4.3)

2.4.1 Hazard Quotients

For the HQ analyses, toxicological effects data were used as benchmarks and TRVs to compare to Site-specific COPEC EPCs and doses, respectively. For the BERA, both NOAEL- and LOAEL-equivalent direct contact benchmarks, dose-based TRVs, and tissue residue benchmarks were utilized. The methodology for selection of benchmarks/TRVs is outlined below.

Both NOAEL and LOAEL benchmarks/TRVs were selected in a manner consistent with standard practice for ERA, using well-respected sources (see sections below) wherever available.

- **NOAEL-equivalent benchmarks/TRVs** – NOAELs are defined as the highest tested concentration at which no adverse effect is observed. NOAEL-equivalent toxicity values were selected that represent a toxicological threshold below which there is a high confidence in a finding of de minimis risk. Types of values selected as NOAEL-equivalent benchmarks/TRVs include but are not limited to: a NOAEL from one toxicity test, a low percentile (e.g., 5 or 10) of LOAEL distributions (by test or species), or geomeans of NOAELs or Maximum Allowable Threshold Concentrations (MATCs).
- **LOAEL-equivalent benchmarks/TRVs** – LOAELs are defined as the lowest tested concentration at which an adverse effect is observed (either statistically significantly different from controls, and/or greater than 20 percent different from controls). The LOAEL-equivalent benchmark/TRV represents a value above which risk adverse effects may be possible or further evaluation is needed. Types of values selected as LOAEL-equivalent benchmarks/TRVs include but are not limited to: a LOAEL from one toxicity test, a median of LOAEL distributions (by test or species), or a mid- to high-effects level (e.g., EC50) adjusted by an uncertainty factor as needed.

NOAEL and LOAEL benchmarks/TRVs include:

1. Direct contact benchmarks (in units of mg COPEC per kg soil/sediment or water) used to assess effects to plants, soil and sediment invertebrates, and aquatic biota
2. TRVs based on doses to avian and mammalian wildlife (in units of mg COPEC per kg-BW per day)
3. Tissue residue benchmarks (in units of mg COPEC per kg tissue)

Except where indicated otherwise, NOAEL and LOAEL benchmarks/TRVs are derived for all media and receptor types as described below. Details on the selection process for direct contact benchmarks (plant, soil invertebrate, benthic invertebrate, and aquatic biota benchmarks), dose-based TRVs, and tissue residue benchmarks are presented in Appendix C.

2.4.1.1 Direct Contact Hazard Quotient Line of Evidence

Direct contact benchmarks were used to evaluate effects from the direct contact exposure pathway. Direct contact benchmarks include concentrations in surface water, sediment, and soil that are protective of receptors that are potentially exposed to and affected by COPECs via direct contact pathways. These receptors include plants, soil invertebrates, benthic invertebrates, and aquatic biota.

Benchmarks were developed for all COPECs with the exception of Avian TEQ and Mammalian TEQ. As described previously, (1) invertebrates and plants do not have a dioxin-sensitive AhR, (2) invertebrates and plants are substantially less sensitive to D/F than vertebrates, and (3) credible TRVs are generally not available for evaluation of invertebrate or plant hazard on a congener-specific basis; therefore, no attempt was made to quantify hazard to aquatic invertebrates, soil invertebrates, or plants due to direct contact with D/F in water, sediment, or soil. We anticipate that any ecological adverse effects from D/F in Site media would be most significant in vertebrate species (birds and/or mammals), and that if adverse effects to these receptors do not rise to a level of concern, adverse effects to invertebrates and plants would also be acceptable.

NOAEL and LOAEL benchmarks were developed for surface water/aquatic biota, sediment/benthic invertebrates, soil/plants, and soil/invertebrates, and are presented in Tables 2-23, 2-24, 2-25, and 2-26 respectively. The development of these direct contact benchmarks is described in detail in Appendix C.

2.4.1.2 Dietary Dose Hazard Quotient Line of Evidence

The dietary dose pathway includes the consumption of COPECs in prey tissue and abiotic media (i.e., soil, sediment, and water) through diet and incidental ingestion. Dose-based TRVs were used to evaluate effects from dietary doses.

Acute and Chronic Dose-Based Toxicity Reference Values

A key component of a wildlife risk assessment is the identification of appropriate TRVs. A TRV is a “dose above which ecologically-relevant effects might occur to wildlife species following chronic dietary exposure and below which it is reasonably expected that such effects will not occur” (USEPA 2005b). This assessment is focused on food-chain exposure and incidental ingestion of soil in birds and mammals since these have been shown to be the major exposure pathways. TRVs were selected from studies that were based on ingestion of COPECs and were developed as an exposure dose expressed as mg/kg-BW/day for oral intake. Available sources of compiled toxicity data for birds and mammals were considered and used as the basis for selecting TRVs. Acute TRVs were based on the survival endpoint. Chronic TRVs were based on the lowest TRV for the growth, reproduction, or survival endpoints. TRVs for birds and mammals are presented in Tables 2-27 and 2-28, respectively. The development process for the NOAEL and LOAEL TRVs for acute and chronic exposures is described in Appendix C.

For the BERA, each avian representative receptor species was evaluated using TCDD TEQ TRVs for a Category 1 representative species, a Category 2 representative species, and a Category 3 representative species. In vitro studies indicate that avian species show varying degrees of sensitivity to TCDD depending on the species’ amino acid sequence of the AhR (Farmahin et al. 2013b). Additionally, as described in Section 2.1.4.4 and Section 7.1.1.5, the HCB TEFs used in the calculation of TCDD TEQ in soil, sediment, water, and tissue collected at the Site vary according to the category of the receptor species that is being evaluated. The relative sensitivity has been grouped into three categories:

- Category 1 species are the most sensitive to TCDD and least sensitive to HCB
- Category 2 species are moderately sensitive to TCDD and HCB
- Category 3 species are the least sensitive to TCDD and most sensitive to HCB

Intermittent Longer-Term Dose-Based Toxicity Reference Values

The intermittent longer-term exposure includes probing bird (snowy plover and American avocet) ingestion of COPECs in abiotic media (i.e., sediment and water) through incidental ingestion on an infrequent, repeated occurrence in the acidic waste ponds (PRIs 5, 6, and 7). Dose-based TRVs were used to evaluate effects from intermittent longer-term doses and are presented in Table 2-27. Available sources of compiled toxicity data for birds were considered and used as the basis for selecting TRVs for the intermittent longer-term exposure. The intermittent longer-term TRV was developed to be protective of impairments on growth, reproduction, and survival for birds by selecting the lowest TRV for the growth, reproduction, and survival endpoints. TRVs are presented in Table 2-27. The development of the NOAEL and LOAEL TRVs is described in Appendix C.

2.4.1.3 Tissue Hazard Quotient Line of Evidence

The tissue body burden exposure pathway includes the accumulation of COPEC concentrations in the tissue of bird eggs, terrestrial plants, soil invertebrates, aquatic invertebrates, and small mammals. Tissue benchmarks were used as a measure of effect for the tissue body burden exposure.

Tissue benchmarks were developed for COPECs evaluated as part of the modeled tissue body burden in small mammals, soil invertebrates, terrestrial plants, and aquatic/benthic invertebrates (Section 2.3.3). Tissue benchmarks were also developed for COPECs measured in bird egg tissue. Tissue benchmarks were derived as tissue concentrations that represent a no effects level (NOAEL benchmark) and an effects level (LOAEL benchmark) and are presented in Table 2-29.

For invertebrates and plants, tissue benchmarks were not developed for Avian TEQ or Mammalian TEQ since benchmarks are generally not available for evaluation of invertebrate or plant hazard on a congener-specific basis (see Section 2.3.3).

Benchmarks were selected by screening for relevant and appropriate species, endpoints, and tissue types. These criteria are described in Appendix C for aquatic/benthic invertebrates, soil invertebrates, terrestrial plants, small mammals, and bird eggs.

2.4.2 Site-Specific Toxicity Studies Line of Evidence

Site-specific toxicity studies may measure a variety of effects endpoints indicative of a toxic response in organisms or mesocosms, depending on the study design. Effects evaluated by the Site-specific toxicity studies LOE include: mortality, symptoms of sublethal intoxication, body weight, water and feed consumption, gross pathology, histopathological changes, blood count values, blood clinical chemistry, egg weight, and egg coloring changes. These studies are described fully in Section 3.2.3.

2.4.3 Ecological Field Surveys Line of Evidence

The effects endpoints measured in ecological field surveys may vary, but ideally have high ecological relevance to the population or community being assessed at the Site. Ecological metrics in the ecological field surveys LOEs include: daily survival rate of eggs, nest hatchability, egg shell thickness, adult body mass, adult wing chord, adult size corrected index, average foraging distance, and for plants and mammals, general appearance of health of individual organisms. The ecological field surveys are described fully in Sections 3.2.4, 4.2.4, 5.2.4, and 6.2.7.

2.5 Risk Characterization

Risk characterization integrates the results of the exposure and effects assessments to evaluate the potential for adverse ecological impacts associated with exposure to COPECs (USEPA 1992a). The risk characterization also considers the uncertainties associated with the estimation and description of risk (USEPA 1998). The estimation of risk focuses on quantitative methods to evaluate the potential for risk, which are primarily presented as HQs, but also includes other LOEs such as Site-specific toxicity tests and ecological field surveys, where available. A WOE process is used to integrate and interpret the LOEs. Risk estimates have been discussed in relation to AEs and management goals in support of decision-making for the facility. The description of the risk may also serve to identify COPECs that will be considered further in the subsequent phases of the risk assessment (if necessary) or in the RI or focused FS.

2.5.1 Hazard Quotients

The HQs used a measure of exposure compared to a measure of effect, for four different analysis types: direct contact exposure, dietary doses, and tissue body burden. The HQ calculation for each of these is presented below.

2.5.1.1 Direct Contact Hazard Quotient Line of Evidence

For sessile or small home range receptors (i.e., invertebrates and plants), the HQs were calculated based on direct comparisons of measured concentrations of COPECs in soil, sediment, or surface water to their respective benchmark. These comparisons were conducted for terrestrial plants and invertebrates exposed to soil, aquatic biota (aquatic plants and aquatic invertebrates) exposed to surface water, and benthic organisms exposed to sediment using the EPCs described in Section 2.3.1 and benchmarks described in Section 2.4.1.1. HQs were calculated on a point-by-point basis within each exposure unit. An assessment of the magnitude and frequency of point-by-point HQ values that are greater than 1 was performed. HQs were calculated using the following relationship:

$$HQ = \frac{EPC}{Benchmark} \qquad \text{Eqn 2-13}$$

Where:

EPC = measured medium-specific concentration (sample concentration) expressed in the same units as the benchmark (milligrams per kilogram [mg/kg] or micrograms per liter [µg/L])

Benchmark = media-based benchmark in matching units to that of the EPC

2.5.1.2 Dietary Dose Hazard Quotient Line of Evidence

For higher trophic-level wildlife receptors, the HQ is the ingested dose divided by the appropriate TRV. These comparisons were conducted for all bird and mammal receptors. HQs for acute and chronic exposure were calculated using the dose equation described in Section 2.3.2 and TRVs described in Section 2.4.1.2. HQs were calculated on a point-by-point basis within each exposure unit. The acute and chronic HQs for wildlife receptors were calculated using the following relationship:

$$HQ = \frac{Dose}{TRV} \qquad \text{Eqn 2-14}$$

Where:

Dose = estimated dietary dose (mg/kg-BW/day)

TRV = toxicity reference value (mg/kg-BW/day)

The dose model for intermittent longer-term exposure included an AHUF exposure factor, as described in Section 2.3.2, because this evaluation is intended to represent an infrequent, but repeated exposure, as opposed to a daily exposure. An AHUF of 0.033 was assumed as a conservative estimate based on field observations from BIO-Logic (2002, 2003), as discussed in Section 2.3.2. The HQs were calculated using the dietary dose equation described in Section 2.3.2.3, the AHUF, and the TRV described in Appendix C, as follows:

$$HQ = \frac{Dose * AHUF}{TRV} \qquad \text{Eqn 2-15}$$

Where:

AHUF = acid habitat utilization factor (unitless)

Dose = estimated dietary dose (mg/kg-BW/day)

TRV = toxicity reference value (mg/kg-BW/day)

2.5.1.3 Tissue Hazard Quotient Line of Evidence

For terrestrial plants, soil invertebrates, aquatic/benthic invertebrates, and small mammals, the HQs were calculated based on direct comparisons of modeled concentrations of COPECs in tissue to their respective benchmark. For bird eggs, HQs were calculated based on direct comparisons of measured concentrations of COPECs in tissue to their respective benchmark. These comparisons were conducted using the EPC described in Section 2.3.3 and the benchmark described in Section 2.4.1.3. HQs were calculated on a point-by-point basis within each exposure unit. An assessment of the magnitude and frequency of point-by-point HQ values that are greater than 1 was performed.

HQs were calculated using the following relationship:

$$HQ = \frac{EPC}{Benchmark} \qquad \text{Eqn 2-16}$$

Where:

EPC = measured or modeled tissue-specific concentration (sample concentration) expressed in the same units as the benchmark (mg/kg or µg/L)

Benchmark = media-based benchmark in matching units to that of the EPC

2.5.1.4 Comparison to Background

Understanding the background concentrations of inorganic and organic COPECs in the soil and sediment of the Site helps interpret the risk estimations developed in the BERA. Background concentrations in soils/sediments were developed during data collections for the Phase 1A-B field efforts and summarized in the Phase 1A-B data report (ERM 2016c). Background was characterized for inorganics (excluding essential nutrients) and organics at all background locations. The background dataset was developed as representative of upland and lakebed exposure units.

HQs calculated for the receptors in each exposure unit in the Site were compared to the HQs calculated for the same receptors in the background areas. This comparison was conducted to characterize the approximate fraction of the exposure and risk that is attributable to background (as opposed to Site-related) COPEC levels. Site HQs that are consistent with background HQs were identified during the risk characterization and used to indicate whether the potential for adverse effects is likely due to background concentrations.

2.5.1.5 Hazard Quotient Interpretation

As described further in Section 2.5.4.2, the HQ is not a predictor of risk, but rather is an index used to rule out potential risk. An HQ using a NOAEL-equivalent HQ benchmark that is less than or equal to 1 indicates that a given COPEC-receptor combination may be excluded from further consideration (i.e., adverse effects at the organism level are unlikely). An HQ using a LOAEL-equivalent benchmark that is greater than 1 indicates that potential adverse effects at the organism level cannot be ruled out and the likelihood and/or severity of the effect tends to increase as the magnitude of the HQ increases. For a given COPEC-receptor combination, a NOAEL HQ greater than 1 and a LOAEL HQ less than 1 suggests that adverse effects are unlikely, as the measurable effects level at the LOAEL has not been reached, but that there is higher uncertainty because the no effects level at the NOAEL has been exceeded.

In cases where a NOAEL benchmark/TRV is available, but not a LOAEL benchmark/TRV, there is uncertain potential for adverse effects, since the measurable effects level has not been exceeded. The potential for adverse effects in these situations has been characterized as uncertain and may require further evaluation, unless alternative analyses or LOEs were available to reduce the uncertainty.

The potential for adverse effects is also discussed in conjunction with risk levels associated with background exposure. Additionally, the Uncertainty Analysis (Section 7), discusses factors that can impact the qualification of exposure or effects, potentially leading to an over- or underestimation of the potential for adverse effects. Such factors include, but are not limited to, bioavailability of COPECs and Site use.

2.5.2 Site-Specific Toxicity Studies Line of Evidence

Information about exposure (acidic wastewater versus control water) and effects (e.g., mortality, body weight) from the Site-specific toxicity studies identified in Section 2.1.3.2 are integrated to form the Site-specific toxicity studies LOE for avian receptors. Statistically significant differences between treatment groups and the controls drive the results of this LOE, but non-significant results are also logically interpreted. The studies are summarized and the LOE results are presented in Section 3.2.3.

2.5.3 Ecological Field Surveys Line of Evidence

Information about exposure (Site versus reference) and effects (e.g., reproductive success) from the surveys identified in Section 2.1.3.3 are integrated to form the ecological field surveys LOE for avian receptors. Similar to the Site-specific toxicity studies LOE above, statistically significant differences between Site and reference areas drive the results of this LOE, but non-significant results are also evaluated. The survey methods and results are presented in Section 3.2.4.

For mammals and plants, the ecological field surveys LOE is limited to comparisons of organism health at the Site to organism health under normal conditions (see Section 2.1.3.3). Without a comparison to reference, these data are limited in their usefulness (see Section 2.5.4.2). However, this LOE may still provide important context for other LOEs as part of the risk characterization. Specific results for this LOE based on comparisons to health under normal conditions are presented in Sections 4.2.4, and 5.2.4).

2.5.4 Weight of Evidence

Each type of LOE provides important and different information, which increases the robustness of the risk characterization for the AE. However, integration of different LOEs to form a risk conclusion may be difficult due to: (1) advantages and limitations of each type of LOE, (2) variable confidence in the specific LOE according to its methodology and the clarity of the results, and (3) inconsistent results between the different LOEs. Thus, the WOE process is used to fully evaluate and integrate the different LOEs for each AE to form a single, concise risk conclusion.

2.5.4.1 Weight of Evidence Approach

The WOE approach for the BERA is based on guidance from USEPA (2016c). This guidance encourages risk assessors to tailor the WOE approach for each site and risk assessment. However, the WOE guidance does specify three properties to consider for each LOE: strength, reliability, and relevance.

- **Strength** – Strength is defined as the "degree of differentiation from randomness or from control, background, or reference conditions" (USEPA 2016c). USEPA's WOE guidance identifies magnitude, number (frequency), and association (e.g., statistically significant correlations or differences) as potential aspects of strength.
- **Reliability** – Reliability is defined as "the inherent qualities that make evidence convincing" (USEPA 2016c). USEPA's WOE guidance describes potential aspects of reliability, including scientifically robust design and execution of studies, adequate abundance of data, minimization of confounding factors, use of standardized methods or accepted technical practice, peer review of literature-based studies, and consistency with scientific knowledge and theory.
- **Relevance** – Relevance is defined as "the degree of correspondence between the evidence and the AE" (USEPA 2016c). Relevance may include the degree of correspondence between the AE and the taxa being measured, correspondence between the COPEC and the form of the chemical used in the test, and correspondence between current environmental conditions at the Site and test conditions.

The approach for the BERA is a narrative WOE. First, the results of the different LOEs are considered together. If the LOE results are consistent with each other (or if there is only one LOE), the risk conclusions are derived without an evaluation of strength, reliability, or relevance. However, if the LOEs do not have results consistent with each other, then the LOEs are evaluated narratively for the three properties identified by USEPA guidance described above. The LOE(s) with the highest weight (strongest, most reliable, and most relevant) then drive the risk conclusion.

The integration of LOEs to form a risk conclusion utilizes an understanding of both the key uncertainties of LOEs and the conclusiveness of the LOE results. Uncertainties play a major role in WOE, as the uncertainties have a direct tie to strength, reliability, and relevance as described above, as well as the overall confidence in the risk conclusion. The full uncertainty discussion for the BERA is provided in Section 7, and key uncertainties are emphasized as appropriate in the receptor-specific WOE sections. As described in USEPA (2016c) guidance, conclusive evidence is logically compelling, particularly in the elimination of a suspected cause of an effect. An example of this would be a COPEC present below screening level benchmarks; no other evidence is necessary to rule out this COPEC as a source of potential risk. The conclusiveness and uncertainties of LOEs are used, along with the LOE main findings, to integrate the LOEs into a WOE finding for each AE. A summary statement of confidence in this WOE finding is provided to aid risk managers in decision-making. Confidence is derived from a full understanding of all the factors described above (strength, reliability, relevance, conclusiveness, and uncertainties) as well as the agreement between LOEs.

2.5.4.2 Advantages and Limitations of Lines of Evidence

Each type of LOE has advantages and limitations that influence the usefulness of the LOE in risk characterization. These advantages and limitations are described below for each type of LOE.

Hazard Quotients Lines of Evidence

HQs are a common LOE used in ERA and use standard, well defined methods. HQs are relatively easy to calculate using Site data and literature-based toxicity benchmarks but deterministic HQs only use point estimates of environmental risk (USEPA 2022). The confidence that is placed in any particular HQ requires a detailed understanding of both the measure of exposure (the numerator of the HQ), the basis

of the benchmark of toxicity (the denominator of the HQ), especially the endpoint and the test species, and an understanding of the limitations of deterministic approaches to risk assessment. In general, both the measurement of exposure and measurement of effect may be uncertain to varying degrees due to a variety of differing causes. If both values have relatively low uncertainty and are considered to be reliable and relevant, then confidence in the HQ is increased. If there is substantial reason to consider one or both values to be uncertain or un-representative, then confidence in the HQ is reduced.

Considerations important to the overall reliability, relevance, and strength of HQ LOEs include the following:

- Estimate of exposure and/or the benchmark of toxicity are often derived in a way that is likely to be conservative. These conservative HQs may substantially overestimate the potential for adverse effects but result in relatively high confidence that an effect is not of concern, when HQs are less than 1 (Hull and Swanson 2006; Tannenbaum et al. 2003).
- Deterministic HQs do not incorporate variability in exposure and effects parameters, and thus do not account for the likelihood of the scenario, which can reduce relevance (Solomon and Sibley 2002).
- In the absence of an exposure-response model, the magnitude of an HQ above 1 is not a quantitative predictor of the magnitude of the hazard. For example, an HQ of 4 should not be thought of as twice the concern of an HQ of 2. However, an HQ may be useful as a semi-quantitative index of hazard for a given COPEC-receptor combination. For example, for a given receptor and a given COPEC, a sample location with an HQ of 60 would be more of a cause for concern than a sample location with an HQ of 6. In the absence of an underlying dose-response curve, the interpretation of HQ magnitudes above 1 is highly uncertain.
- While most AEs are defined at the population or community level, most benchmarks of toxicity are based on effects observed at the organism level. If survival, growth, or reproduction at the organism level is not impacted, population and community attributes such as structure and function are not likely to be impacted either. However, the reverse is not necessarily true; impacts at the organism level may not manifest as measurable impacts at the population or community level (Solomon et al. 2008; Newman and Clements 2008; Fairbrother 2003; Solomon and Sibley 2002).

Site-Specific Toxicity Studies Lines of Evidence

Laboratory-based toxicity tests are performed by exposing test organisms to known amounts of a contaminated medium (usually soil, sediment, or water) collected directly from the Site. The primary advantages and limitations of this type of study include the following (Burton et al. 2002; Chapman and Anderson 2005):

- Results capture the combined effects of all the chemical constituents of the medium, which is especially helpful for complex mixtures that have additive effects such as D/Fs and PCBs. However, if an effect is observed, it is difficult to attribute an observed effect to a specific component in the medium.
- The results account for Site-specific factors, which may influence bioavailability. This is especially useful for COPECs where bioavailability is likely to be less than 1 but where insufficient data are available to derive a reliable estimate.
- The exposure conditions used in the laboratory may not always be characteristic of exposure at the Site (e.g., 2 hours of continuous exposure to eyes) and potential effects or interactions with natural stressors are uncertain. However, for ingestion studies in birds or mammals, if the amount of medium ingested in the laboratory is similar to what would occur in the field, results are likely to be relevant.

- Laboratory test species are often model species, which may or may not have relevance to receptors present at the Site and which may be more or less sensitive to potential stressors than Site species. Absent any specific evidence of a substantial difference in sensitivity between the test species and the species of concern at the Site, the degree to which this negatively or positively impacts relevance is uncertain.
- Most laboratory tests can only evaluate effects from a limited number of Site samples. Thus, if there are substantial differences between the results for different samples, results are meaningful only for the specific areas from which the environmental media was sampled, and may not be relevant across the entire spatial area of the Site (Burton et al. 2002).
- For locations with HQs greater than 1 but no observed toxicity in bioassays, bioassay results provide compelling evidence that Site-specific conditions (such as bioavailability or COPEC interactions) mitigate adverse effects on test organisms.

As above, observed toxicity at the organism level does not necessarily translate to changes at the population or community level at the Site (Moore 1998; Solomon and Sibley 2002).

Ecological Field Surveys Lines of Evidence

Ecological field surveys can provide valuable information on the occurrence and status of ecological receptors at the Site. Surveys that list the ecological species observed at the Site are valuable in understanding the ecology of the Site but if data are not obtained for a reference area, the ability to assess potential impact to ecological receptors caused by COPECs at the Site is limited.

Advantages and limitations of ecological field surveys include the following:

- Measures of species density, diversity, and reproductive success are directly related to typical AEs, and generally reflect population- or community-level status.
- They provide a measure of effects under actual field conditions, including Site-specific conditions such as bioavailability of Site media and uptake of contaminants into the food web (Burton et al. 2002).
- Identifying well-matched reference areas is often difficult. If reference areas are not well matched, differences between the Site and a reference area may not be due to contamination but to other environmental factors such as habitat quality, predation, or disease (Burton et al. 2002; Fairbrother 2003).
- Ecological field surveys that indicate no difference in metrics between Site and reference conditions provide evidence that COPECs are not causing adverse effects on the AE (Hull and Swanson 2006). However, if an effect is observed between the Site and a well-matched reference, most studies do not include a basis with which to identify the specific contaminant(s) responsible for the effect.

2.5.5 Inferring Effects for Wildlife Populations within an Exposure Unit

To determine the effects at the population level, either field studies that directly measure species abundance (or other population-level metrics) at the Site compared to reference areas, or population-modeling that models changes in population growth rate (or other population-level metrics) based on exposure to COPECs at the Site, would need to be conducted. While it is important to recognize that this BERA focuses on the potential for adverse effects at the organism level through exposure at a specific exposure unit (e.g., PRI), the smaller the area, and/or the lower quality the habitat, the fewer organisms that can be supported by that exposure unit (e.g., PRIs 2, 4, 5, 6, 7, 9, 12, and the SVDD and GSLIC).

Defining the population as the number of organisms in an exposure unit is not unique to this BERA. However, it is important to note that from a population dynamics perspective, the population should be defined as the number of individuals in an area that supports a local, potentially viable population of the species of interest. This is usually defined as the minimum viable population (MVP) size, which is the smallest number of individuals required for a population to have a predetermined probability of persistence for a given length of time (Shaffer 1981). Traill et al. (2007) conducted a meta-analysis of MVPs for vertebrates and determined that the MVP for bird populations ranged from 2,544 to 5,244 and for mammals 2,261 to 5,095 (ranges represent the 95 percent confidence interval). However, the analysis from Traill et al. (2007) has uncertain relevance to Site-specific species and conditions at the Site. Based on the field surveys conducted in the past at the PRIs within the facility, it is unlikely that the PRIs (individually or combined) within the facility boundary have organism counts for a specific bird or mammal species that approaches the MVP ranges calculated in Traill et al. (2007). Therefore, effects at the level of the individual organism that impact a population's growth rate (e.g., survival or reproductive rate) are unlikely to result in population-level effects to that species since a large proportion of the MVP is expected to be located within those PRIs and would not be impacted by exposure to the COPECs located there.

3. RISK EVALUATION FOR BIRDS

Section 3 presents the risk evaluation findings for lakebed and upland birds at the Site.

3.1 Bird Usage of the Site

Understanding how and where the upland and lakebed birds use the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. As detailed in Section 2.2.1.4, upland habitat supports song birds (e.g., horned lark, Brewer's sparrow, mourning dove) and other passerines (e.g., sage thrasher, common raven). BIO-Logic (2002, 2003) and Cavitt (2008, 2010) observed snowy plovers, avocets, sandpipers, and other shorebirds at or near shoreline / playa PRIs within the Site. Past studies reported that shorebirds at waste lagoons are generally observed less frequently, and when observed, are restricted to short visits before flying off (BIO-Logic 2002, 2003). In general, PRIs within the facility boundary tend to have less bird usage due to disturbed habitat and/or ongoing physical disturbances. Bird usage is expected to be higher in PRIs 8, 13 through 16, and the GSLIC and SVDD, where minimally disturbed habitat is found. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence and behavior of birds at each exposure unit.

As discussed in Section 2.2.5, representative avian species selected for quantitative assessment are listed below:

- Horned lark (upland habitat)
- Tree swallow (upland and lakebed habitat)
- Mourning dove (upland and lakebed habitat)
- American kestrel (upland and lakebed habitat)
- Snowy plover (lakebed habitat)
- American avocet (lakebed habitat)

3.2 Risk Estimates

Risk estimates for birds were evaluated with multiple LOEs: dietary dose HQs, egg tissue HQs, Site-specific toxicity studies, and ecological field surveys. All results are representative of both current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The results of the dietary dose exposure (acute, chronic, intermittent longer-term exposures) and egg concentration analyses for birds are presented below. The detailed calculations for these evaluations are provided in Appendix E. Only the COPECs that showed potential for adverse effects, as determined by an HQ above 1, are presented below and in the tables and figures.

3.2.1 Dietary Dose Hazard Quotient Line of Evidence

The results of the dietary dose HQ analysis for birds is presented below. Exposure units supporting a chronic exposure had receptors evaluated using the 95UCL EPC in the dose model. Exposure units with an assumed acute exposure pathway had receptors evaluated using the point-by-point EPC. Exposure units supporting an intermittent longer-term exposure pathway had probing bird receptors evaluated using a SWAC EPC. Tables and figures showing results for each exposure pathway are detailed below.

- For the upland birds evaluated with chronic exposure, the NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 3-1 and illustrated on Figures 3-1a to 3-1h. For the upland bird receptors evaluated with acute exposure, the NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 3-2 and illustrated on Figures 3-2a to 3-2b.
- For the lakebed birds evaluated with chronic exposure, the NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 3-3 and illustrated on Figures 3-3a to 3-3h. For the lakebed bird receptors evaluated with acute exposure, the NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 3-4 and illustrated on Figures 3-4a to 3-4d.
- For probing birds (i.e., snowy plover and American avocet) evaluated with intermittent longer-term exposure, the NOAEL and LOAEL HQ results values in the CWP (i.e., PRI 5 and PRI 6 combined) and PRI 7 are presented in Table 3-5 and illustrated on Figures 3-5a to 3-5c. As discussed in Section 2.3.2.1, the SWAC was used as the sediment EPC in this evaluation because, unlike the 95UCL, the SWAC is less influenced by high-concentration outliers that may be located in relatively small foraging areas. To address potential uncertainties associated with estimating exposure using a SWAC, this evaluation was also conducted with the 95UCL sediment EPC and those results are presented in the Uncertainty Analysis in Section 7.1.1.6.

The NOAEL and LOAEL HQ results for all COPECs, including those that do not have HQs greater than 1 under all scenarios, are presented in Appendix E.

3.2.1.1 Main Findings

The following main risk evaluation findings for avian receptors are derived from the dietary dose HQ results presented in Tables 3-1 to 3-6 and Figures 3-1a to 3-5c:

- In all cases, the highest LOAEL HQ values for avian receptors are due to intake of TEQ (maximum LOAEL TEQ HQ = 60 at PRI 5). LOAEL HQs from other COPECs (HCB,[10] vanadium) are usually only a small fraction of the LOAEL TEQ HQs (maximum HCB LOAEL HQ = 2 at PRIs 5 and 8; maximum vanadium LOAEL HQ = 10 at PRI 8).
- Even though sensitivity to TEQ is highest for Category 1 receptors and lowest for Category 3 receptors, HQ values are generally rather similar across the three sensitivity categories. This is because the contribution of HCB to TEQ increases as the sensitivity to dioxin decreases.
- In upland habitats, HQ values for TEQ are generally similar for the tree swallow, horned lark, and American kestrel, while HQs for the mourning dove are lower. This is mainly because the mourning dove has a large foraging range and hence exposures in specific PRIs are low. In addition, uptake of TEQ into plants (the primary food source for the mourning dove) is lower than for the prey of the other species.
- In lakebed habitat, HQ values for TEQ are generally highest for the probing receptors (American avocet, snowy plover), but HQs for tree swallow and American kestrel are often similar. As above, HQs for the mourning dove are low.
- For chronic dietary exposure, the LOAEL TEQ HQs are elevated at a level of potential concern in upland habitats of PRIs 5, 6, 8, and 12 (Table 3-1, Figures 3-1a to 3-1h), and in lakebed habitats of PRI 7, PRI 8, PRI 14, and GSLIC (Table 3-3, Figures 3-3a to 3-3h). Table 3-6 shows that, for the PRIs with TEQ HQs of potential concern, the HQs are generally elevated due to soil/sediment

[10] This refers to HCB evaluated based on a TRV for HCB. Risks from HCB acting as a dioxin-like compound are included in the HQ for TEQ.

ingestion and tissue ingestion. However, water ingestion also results in elevated TEQ HQs in PRI 5 and 6 upland habitats.

- For single acute exposures, LOAEL TEQ HQs are low in frequency and magnitude in upland areas of the landfill (PRI 2) and the gypsum pile (PRI 4) (Table 3-2, Figures 3-2a and 3-2b), and in the lakebed areas of the acid ponds (Table 3-4, Figures 3-4a to 3-4d).
- For repeated acute exposures (i.e., intermittent longer-term) to TEQ in sediments of acidic ponds, LOAEL HQs are above 1 for snowy plover, but are low in magnitude (HQ=2). Additionally, since the AHUF is based on (1) the total time that 10 American avocets were observed in the acidic ponds (rather than an individual American avocet), and (2) observations in BIO-Logic (2003) that indicate an AHUF for snowy plover is much lower than an AHUF for American avocets, it is assumed that HQs are overestimated for both probing receptors (snowy plover and American avocet) (Table 3-5 and Figures 3-5a to 3-5c). See Section 2.3.2.4 for details on the AHUF derivation.

Confidence in the above main findings varies with both the magnitude of the HQ (i.e., strength) and the COPEC. Conservative assumptions were used to estimate exposure and effects (see Section 7.1); thus, there is moderate to high confidence that LOAEL HQs less than 1 indicate the potential for adverse effects on organisms is unlikely, with NOAEL HQs less than 1 having the highest confidence. For LOAEL HQs above 1 (TEQ, vanadium, and HCB), the confidence depends on the reliability and relevance of the specific underlying calculation parameters.

- **Avian TEQ.** The chemistry data and bioaccumulation models used to estimate uptake are reliable and Site-specific. However, the bioaccumulation model for brine flies is a constant value (see discussion in Section 7.1.1.4), which introduces uncertainty in the dose model for receptors that eat brine flies. This uncertainty is likely to overestimate dietary doses in exposure areas with comparatively lower TEQ concentrations in solids (i.e., lakebed habitats of PRIs 8, 13, 14, GSLIC, and SVDD) and underestimate dietary doses in exposure areas with comparatively higher TEQ concentrations (i.e., lakebed habitats of PRIs 5, 6, and 7). Additionally, there are uncertainties associated with interspecies differences in TCDD sensitivity and relative potency of dioxin-like compounds (DLCs) as well as inter-individual variation of the AhR response (see Section 7.1.1.5).

  The TRV is selected from a reliable study by Nosek et al. (1992a) on ring-necked pheasants; however, the dose administration method of intraperitoneal injection lacks relevance to oral ingestion by wild birds. Intraperitoneal injection bypasses the gut and does not account for differences in bioavailability when the COPEC is bound to food or solids. A companion study by Nosek et al. (1992b) found that oral bioavailability of TCDD in ring-necked pheasants varied with the food or solid substrate, ranging from 30 to 58 percent bioavailable. Thus, HQs above 1 for avian TEQ likely overestimate the potential for adverse effects, particularly in all upland habitats as well as the lakebed habitats of PRIs 8, 13, 14, GSLIC, and SVDD, and the confidence in these HQs is decreased.
- **Vanadium.** The EPC used to generate HQs for vanadium in PRI 8 is not considered relevant since it was calculated using chemistry data that are not representative of current conditions. LOAEL HQs above 1 for birds in PRI 8 are largely due to water ingestion, while HQs from solids ingestion are similar to background HQs (Table 3-6). The water EPC used in the modeled daily dose relied mostly on samples collected in 2014, where vanadium concentrations were as high as 320 µg/L. However, more recent samples collected in 2019, after the overflow pipe was installed at the CWP,[11] had nondetectable concentrations of vanadium, indicating the surface water concentrations in 2014 were due to commingled wastewater. Since the overflow pipe has eliminated the commingling of wastewater in PRI 8 under recent conditions, vanadium does not appear to be present at surface

[11] See Section 2.2.1.3 and Table 2-9 for description of current conditions in PRI 8.

water concentrations that would result in LOAEL HQs of concern. Therefore, the HQs in PRI 8 are substantially overestimated and have low relevance to current conditions, and confidence in these HQs is decreased.

- **HCB.** The chemistry data and bioaccumulation models are both reliable and Site-specific. The TRV study is relevant and presents no specific uncertainties. Thus, after acknowledging the many conservative assumptions used to calculate HQs (see Section 7.1), there is moderate confidence in the HCB HQs.

3.2.2 Egg Tissue Hazard Quotient Line of Evidence

HQs were calculated on a point-by-point basis for bird egg tissue collected from the Site (PRIs 5, 7, 13, 14) and from background areas during the 2004, 2005, and 2006 nesting seasons. The HQ results are provided in Table 3-7 and illustrated on Figures 3-6a to 3-6h. As seen in Table 3-7, avian HQ estimates for TEQ Category 1 and TEQ Category 2 are notably different when HQs were calculated using ND = 0 and ND = 1/2DL. The difference appears to be largely attributed to detection limits for the egg samples, which were roughly one to two orders of magnitude higher concentrations than the detection limits for biota collected for Phase 2A (Figure 3-7). In this BERA, TEQ risk estimates for other media have been focused on the TEQ HQs calculated with ND = 1/2DL since there is minimal difference in TEQ HQs calculated with ND = 0 and ND = 1/2DL. However, since high detection limits in the egg analyses are a large influence on the HQ results, TEQ HQ results for both ND = 0 and ND = 1/2DL are presented for the egg samples. Select COPEC HQs are also mapped on Figures 3-8a to 3-8d.

3.2.2.1 Main Findings

The following main risk evaluation findings for avian receptors are derived from the egg tissue HQ results presented in Table 3-7 and Figures 3-6a to 3-6h:

- In all cases, the magnitude and frequency of HQ values for egg tissue are highest due to TEQ and total PCBs. HQs for HCB are above 1 only in one sample in PRI 5.
- HQ values are generally similar across the three sensitivity categories, but tend to be slightly higher for Category 1 and Category 2 receptors.
- LOAEL HQs for TEQ and total PCBs are above 1 (LOAEL HQs are between 2 and 40) in areas around the acidic waste ponds (PRIs 5, 7, and 14). LOAEL HQs for HCB are above 1 (LOAEL HQ = 4) in one horned lark sample in PRI 5.

As with the dietary dose HQs above, confidence is moderate to high that LOAEL HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section 7.1). The confidence for individual COPECs with LOAEL HQs above 1 is discussed below.

- **Avian TEQ**. The chemistry used in developing the EPCs is reliable and Site-specific. There are uncertainties with the EPC and benchmark associated with interspecies differences in TCDD sensitivity and relative potency of DLCs as well as inter-individual variation of the AhR response (see Section 7.1.1.5). However, it is unclear if these variations influence (by direction and/or magnitude) the potential for adverse effects. Thus, there is moderate confidence in the avian TEQ HQs for egg tissue.
- **Total PCBs**. The chemistry used in developing the EPCs is reliable and Site-specific. As discussed in Section 7.1.2.2, the egg tissue benchmark for total PCBs is highly uncertain since (1) the PCB mixture at the Site is very different from the mixture used in the Carro et al. (2013) study and is largely dominated by a nontoxic, non-coplanar PCB congener, and (2) the benchmark is based on a

highly sensitive test species that is not found at the Site. Therefore, there is low confidence in the egg tissue HQs for total PCBs because the benchmark is likely to overestimate the potential for adverse effects.

- **HCB.** The egg tissue HCB concentrations are reliable and Site-specific. The egg tissue benchmark for HCB is relevant. Overall, there is moderate confidence in the HCB HQs for egg tissue.

3.2.3 Site-Specific Toxicity Studies Line of Evidence

The studies available for the Site-specific toxicity studies LOE were inventoried and assessed for data quality and suitability in Section 2.1.1. The studies used for the Site-specific toxicity studies LOE, Parametrix (2004) and Hooper et al. (2008), provide data on the acute oral and dermal toxicity of acidic wastewater to mallard ducks, house finches, and Japanese quail eggs. These studies are relevant to exposures at the Site when acidic wastewater is present. The amount of acidic wastewater fluctuates with process facility operations and seasonally, as seen in the ranges in measured surface water pH in the BERA dataset: 1.16–9.34 (PRI 5), 1.06–9.17 (PRI 6), and 6.56–7.59 (PRI 7) (ERM 2014b, 2016a, 2016c, 2018b, 2020b).

3.2.3.1 Parametrix 2004

Parametrix (Appendix K of Parametrix 2004) collected USM facility process waste from the active pond on 17 March 2003 to test the effects of its ingestion on aquatic birds and migrating shorebirds. Juvenile mallards (10 weeks old) were randomly assigned to hydrated and dehydrated groups (n = 5) and exposed to active pond water of varying pH to compare potential effects of its ingestion. Test duration was 48 hours followed by a 72-hour recovery period; water consumption, mortalities, and sublethal effects were observed and recorded, and differences between treatment groups were statistically tested.

For the Parametrix (2004) study, the unadjusted pH of the active pond water ranged from 1.10 to 1.23, and some treatment groups were offered pH-adjusted (pH 3 or 5) pond water. Control water was standard laboratory water from a well (pH 6 to 7). Wastewater samples and a sample from the GSL were analyzed for water quality ions and metals. No statistical comparison between the wastewater samples and the GSL sample was performed. The presence and concentrations of other COPECs in the test wastewater were unknown, as additional chemical analysis was not performed.

Observations were made in the Parametrix (2004) study for mortality, symptoms of sublethal intoxication, body weight, water and feed consumption, and gross pathology. Differences between control and acid wastewater treatment groups were tested parametrically or non-parametrically, depending on the normality and homogeneity of variances, using appropriate statistical methods for the data type. Results for the different MEs are discussed below, using a statistical significance level of 0.05.

- **Water consumption** – The non-dehydrated birds in the non-adjusted wastewater treatment group drank significantly less water than controls during days 1 and 2. Birds given a choice between non-adjusted acidic wastewater and control water drank significantly less water than controls on days 1 to 2 as well. The birds preferentially did not drink the non-adjusted acidic wastewater despite dehydration.
- **Feed consumption** – Feed consumption was reduced compared to controls in dehydrated birds offered acidic wastewater only on days 1 and 2. Dehydrated birds offered pH-adjusted (pH 3 or 5) wastewater also ate less feed on days 1 and 2. The study notes that mallards do not eat if they are not drinking water.
- **Body weight** – Both dehydrated and non-dehydrated birds offered only unadjusted wastewater lost more body weight (as percent change) than control birds during the 48-hour exposure period.

However, these birds gained weight during the recovery period such that there was no difference in body weight change at the termination of the study.

- **Mortality** – Mortality was observed but not assessed for statistical significance. One bird in the preference (choice of control water or non-adjusted wastewater) treatment group died on the final test day. This bird consumed very little food and water, and showed signs of emaciation but otherwise normal organ systems and parameters in the post-mortem analysis. The bird did not drink more wastewater than other birds in the treatment group, thus the authors infer that the bird avoided the wastewater but could not differentiate the control water in a separate container.

3.2.3.2 Hooper et al. 2008

Hooper et al. conducted five experiments to assess potential adverse health effects of acidic pond water on birds by means of its consumption and contact to the birds and their eggs. The experiments used unadjusted acidic pond water (pH approximately 1), pH-adjusted (pH 2 or 3) acid pond water, and tap water as control water.[12] The experiments are described below.

Two experiments assessed the palatability and acute oral toxicity of acid pond water collected from the Site toward both fasted and dehydrated adult mallards (n = 5, ages 18 to 20 weeks old). The first experiment exposed the test animals to acid pond water (pH approximately 1) for approximately 24 hours with an approximately 24-hour recovery period. The second experiment exposed the test animals to pH-adjusted (pH 2 to 3) acid pond water for 48 hours with no recovery period. A third experiment assessed the acute (24-hour) oral toxicity of acid pond water (pH approximately 1) and pH-adjusted (pH 2 to 3) acid pond water, under acute exposure scenarios in dehydrated and fasted adult house finches (n = 5). A fourth experiment assessed effects to gas exchange (as measured by weight loss) and egg discoloration (necessary for camouflage) in eggs by varying degrees of exposure to acid pond water collected from the Site. This experiment exposed Japanese quail eggs to either control or acidic wastewater one, two, or four times (immersion for 1 minute each time, with 20 minutes of drying allowed after each immersion). The final experiment assessed dermal and ocular effects of acid pond water exposure (approximately 2 hours) in adult mallard ducks (n = 5). This experiment exposed mallard duck eyes, bare skin (down feathers removed), and feet for 2 hours continuously to either control or acidic wastewater.

Observations were made in the Hooper et al. (2008) study for mortality, symptoms of sublethal intoxication, body weight, water and feed consumption, gross pathology, histopathological changes, blood count values, blood clinical chemistry, egg weight, and egg coloring changes. Differences between control and acid wastewater treatment groups were tested parametrically or non-parametrically, depending on the normality and homogeneity of variances, using appropriate statistical methods for the data type. Results for the different MEs are discussed below, using a statistical significance level of 0.05.

- **Water consumption** – Mallards given non-adjusted wastewater drank significantly less water than controls during the exposure window, and more control water during the recovery period. Mallards given pH-adjusted wastewater also drank significantly less water than controls for nearly all time intervals during the exposure. The finches given wastewater drank significantly less water than controls during the first hour of exposure, but following time intervals showed variable results. There was no difference in total water consumption across the entire experiment for the finches.
- **Feed consumption** – Only one of the pH-adjusted (pH 3) treatment groups of finches ate significantly less food than controls; no other significant differences in feed consumption are noted.

[12] The Hooper et al. (2008) study did not analyze wastewater chemistry beyond pH value.

- **Body weight** – There is no discussion of significant differences in body weight between treatments and controls, though it is noted that control finches regained lost weight from fasting during the exposure time while treatment finches continued to lose weight.
- **Hematology** – There were no significant changes in hematological parameters or clinical chemistry with the exception of higher uric acid and sodium in the blood of mallards exposed to pH-adjusted wastewater.
- **Gross pathology and histopathology** – There were no pathological findings attributable to oral exposure of acid wastewater, except for two mallards from the pH-adjusted treatment groups with mucus accumulation in air sacs peripheral to the lungs. This mucus may have been associated with aspiration of acidic material, though the small number of birds presenting this condition precludes understanding the significance of this finding. Tearing was observed in all mallard eyes exposed dermally to acid wastewater, and mild inflammation and/or reddening was observed in some treated eyes.
- **Mortality** – Mortality was observed but not assessed for statistical significance. Two finches from different acidic wastewater treatment groups were euthanized due to lethargy and labored breathing. The authors state that these birds seemed to have an underlying disease condition, but it could not be diagnosed histologically.
- **Egg weight loss and discoloration** – No significance testing was reported in the Hooper et al. (2008) study for egg dermal exposures. The greatest weight loss was observed in eggs treated with tap water. Bubbling on the egg surface was observed for all eggs immersed in acid wastewater, and loss of speckling and/or blanching was observed in eggs immersed two or four times in the acid wastewater.

3.2.3.3 Main Findings

Both Parametrix (2004) and Hooper et al. (2008) studies are used together to characterize risk for the Site-specific toxicity studies LOE. Main findings of each study are:

- The Parametrix (2004) study concludes that (1) the acidic wastewater was not acutely toxic to mallards drinking approximately 30 milliliters per day, and (2) birds can avoid the water, even if dehydrated, and still survive and recover body weight within a few days. In the post-mortem examinations, all birds were considered normal. Sublethal effects could not be determined due to variability common in mallard studies.
- The Hooper et al. (2008) study does not provide conclusions, but the results indicate that similar conclusions to the Parametrix (2004) study, regarding the palatability and acute oral toxicity of acidic wastewater, can be made. Expert opinion by Stubblefield (2007), based on the Hooper et al. (2008) studies, is that potential acute risks to aquatic birds ingesting acidic water from the waste pond are negligible. The Hooper et al. (2008) experiments on dermal exposures indicate that effects are negligible. Expert opinion by Stubblefield (2007) on these observations for dermal exposure is that effects to the overall health of the birds are not likely to be significant as study exposure was constant. Wild birds in the field would be expected to avoid contact with pond water causing any irritation, thus minimizing any ocular exposure.

The studies taken together indicate that (1) most birds preferentially avoid acidic wastewater, even when dehydrated, (2) consumption of acidic wastewater is not acutely toxic to mallards or finches, (3) birds that have acute exposures to acidic wastewater readily recover any lost body weight from reduced water and feed consumption after the exposure ends, and (4) dermal exposure of acidic wastewater to eggs does not result in weight loss but may alter egg camouflage characteristics. The logical interpretation of this

information is that acute exposures to acidic wastewater are unlikely to result in adverse effects to bird populations at the Site.

The above conclusions are used to characterize risk to avian receptors as the Site-specific toxicity studies LOE. These evaluations are relevant for all areas and times when acidic wastewater may be present. This includes PRIs 5 and 6, as well as PRI 7, which receives seasonal releases of acidic wastewater into PRI 7. As part of the WOE process (see Section 2.5.4), this information is combined logically with the results of the other available LOEs to form the full risk characterization.

Uncertainties associated with these studies are discussed in Section 7.2. Confidence in these studies is high, as they are both reliable (conducted using appropriate methods and controls) and relevant (conducted with Site-specific media on relevant species). Because the exposure scenarios represented a worst-case scenario, and minimal effects were observed, this provides strong evidence that adverse effects to bird populations are unlikely due to acute exposures to acidic wastewater.

3.2.4 Ecological Field Surveys Line of Evidence

The studies available for the ecological field surveys LOE were inventoried and assessed for data quality and suitability in Section 2.1.1. The Cavitt (2008, 2010) studies are the most valuable for the ecological field surveys LOE because of the quantitative comparison to reference; these studies provide data on the reproductive success of snowy plovers, American avocets, and horned larks at the Site compared to reference areas. Other field data available for birds (Glover 1983; Halford et al. 1999; BIO-Logic 2006; Beltman and Stackhouse 2007) qualitatively compare generalized bird behavior or state at the Site compared to normal conditions, which is a less precise and less useful type of information for the ecological field surveys LOE. The primary sources for the LOE (Cavitt 2008, 2010) are discussed below first, then other sources are presented in chronological order.

3.2.4.1 Cavitt 2008, 2010

The Cavitt (2008, 2010) surveys reported on avian utilization and reproductive success near the Site CWP and OWP during the summer breeding seasons of 2008 and 2010. The Cavitt (2008, 2010) studies monitored bird activity at the Site and reference areas from 15 May to 12 August 2008 and 20 April to 10 August 2010. Information was collected on behavioral activity, nesting locations, hatchability of eggs, and nesting success (nests were defined as successful if at least one young hatched and survived to nest-leaving). In addition, dissections were performed on eggs that failed to hatch by the time of nest termination. Stage of development, position of the embryo, condition of the embryo, and shell thickness were recorded for each dissected egg.

Survey areas at the Site included portions of PRIs 5 (upland habitat), 6 (upland habitat), 7, 13, and 14 (both upland and lakebed habitat), as well as an area east of PRIs 13 and 14 (see Figure 2-5). A small corner of PRI 15 adjacent to the southern side of the USM facility was included in the Unit 1 survey area, but no nests were found or monitored in that location or nearby, thus results are not considered applicable to PRI 15. The surveyed portions of PRIs 5, 6, 7, 13, and 14 are expected to have as high or higher concentrations of COPECs than non-surveyed portions of the respective exposure areas. Analysis of eggs for potential contaminants was not part of the Cavitt (2008, 2010) study design. Therefore, results from these surveys cannot be attributed to any particular chemical, but instead are expected to be broadly applicable to the chemical mixtures of COPECs near the waste ponds.

Cavitt (2008, 2010) compared the results for the Site against reference areas. Three reference areas per year were monitored for investigation. The 2008 study included the GSL Shorelands Preserve, Ogden Bay Waterfowl Management Area, and the Saltair area, south of the GSL along Interstate 80. The 2010 study used the same reference areas, except the Ogden Bay Waterfowl Management Area was replaced with the Bear River Migratory Bird Refuge. Each of the reference areas is on the eastern side of the GSL

from the USM facility. The Site and the reference areas have similar types of habitats (uplands, wetlands, and mudflats of the GSL); however, the reference areas may differ from the Site in terms of habitat quality, hydrologic regimes (e.g., freshwater inflows), or predator management programs (Bear River Migratory Bird Refuge). The reference areas are sufficiently distanced from the Site that Site-related contamination is not expected to occur at these areas. However, the reference areas may have contamination from other sources, such as the Kennecott wastewater discharge at the Saltair area, or urban runoff from the city of Ogden at the GSL Shorelands Preserve. Overall, the selected reference areas are considered to be appropriate references for avian nesting activities at the Site.

The three species of breeding birds observed were snowy plovers, American avocets, and horned larks. Snowy plovers and American avocets are migratory birds that utilize lakebed habitat. Horned larks are year-round residents that utilize upland habitat. Thus, survey results are relevant to both types of habitat and both migratory birds and year-round residents. Exposures for the Cavitt (2008, 2010) surveys are considered chronic, as the surveys were conducted across the entire breeding season for the three bird species. The breeding adults were observed foraging on average approximately 47 meters from their nest, but ranged up to 689 meters, and were observed foraging within the OWP. The majority of nests were found in PRIs 7 and 14, with a single nest each in PRIs 5, 6, and 13. However, many of these nests were within foraging distance of an adjacent PRI (e.g., nests within PRI 7 were within foraging distance of both PRI 5 and PRI 13, and nests in PRI 14 were within foraging distance of PRI 5) (see Figure 2-5). Data from all the Site and proximal (area east of PRIs 13 and 14) nests were pooled by Cavitt before statistical comparisons against reference areas. Thus, results from these surveys are indistinguishable between the surveyed portions of PRIs 5 (upland habitat), 6 (upland habitat), 7, 13, and 14 (both upland and lakebed habitat), and the area east of PRIs 13 and 14. However, the results have the highest relevance to PRIs 7 and 14, due to the larger number of nests within those exposure units compared to the other survey areas at the Site.

The majority of observed nests in the Cavitt (2008, 2010) studies were snowy plover, followed by the horned lark. The American avocet was only observed foraging in 2008 and only two nests were found in 2010. Predation was the main cause of nest failure at both the Site and the reference areas. Combined nest success rates for both years at the Site were: 100 percent successful in PRI 6 (1 nest), 56 percent successful in PRI 14 (23 nests), 33 percent successful in PRI 7 (9 nests), 20 percent successful in the area east of PRIs 13 and 14 (10 nests), and 0 percent successful in PRI 13 (1 nest). Statistical comparisons were made between the Site and the individual reference areas for the following endpoints: daily survival rate of eggs, nest hatchability, egg shell thickness, adult body mass, adult wing chord, adult size corrected index, and average foraging distance.

At a significance level of 0.05, the following endpoints yielded statistically significant differences between the Site and the reference areas:

- **Adult body mass** – In 2010 only, breeding adults captured at the Site (n = 14) were significantly lighter in mass than adults at both of the two reference areas where adults were captured (n = 8 or 29).
- **Adult wing chord** – In 2010 only, adults captured at the Site had smaller wing chords than those at one of the reference areas.
- **Adult size corrected index (mass/wing chord)** – In 2010 only, adults captured at the Site were smaller than those at one of the reference areas.

There were no statistically significant differences observed between the Site and any of the reference areas for the reproductive success endpoints. Hatchability at the Site for American avocet and horned lark was high for both years (1.0). However, for the snowy plover, the 2010 hatchability at the Site (0.75) was lower than both the 2008 hatchability at the Site (0.95) and the 2010 reference area hatchability (0.94

to 1.0). While technically a non-significant finding (p = 0.07), the lower hatchability at the Site in 2010 compared to reference may represent (1) a real effect that would be noticeable with increased statistical power, (2) seasonal variability in snowy plover hatchability, or (3) statistical variability. Without chemical analysis of the eggs, the exact cause of the lower hatchability cannot be determined. Despite potentially lower hatchability, the mean number of young produced per successful snowy plover nest was comparable between the Site (2.85 and 2.57) and reference areas (2.76 to 3.0 and 2.61 to 2.87) for 2008 and 2010, respectively. Thus, while lower hatchability may have occurred in 2010, it did not seem to affect the number of young recruited into the population from nests at the Site.

Nest sample size was smaller at the Site (n = 16 and 18) than the reference areas (n ranged from 20 to 64) and nests at the Site were initiated later in the season than at the reference areas. Nesting density at the Site (1.14 to 4.64 nests per square kilometer; lowest densities in PRI 7 and highest densities in PRI 14 north of the P-11 canal shown on Figure 2-3) was lower than the reference areas (2.52 to 9.45 nests per square kilometer), suggesting that habitat quality at the Site is poor. The classification of dissected eggs ranged from not viable to early dead to normally developed, at both the Site and reference areas.

3.2.4.2 Glover 1983

The study by Glover (1983) presents the findings of a reconnaissance survey conducted on 27 October 1983 on and near the USM property to determine if indigenous plants and animals had experienced environmental stress. The author notes that this survey was conducted after the fall migration had already passed. Observations were made at most of the weather station locations on or near USM property, in addition to springs, waterholes, trails, roads, and raptor perches. Observations were limited to visual sightings of wildlife, tracks, scat, or other signs.

Birds observed during the survey include: golden eagle, magpie, sage sparrow, meadowlark, raven, avocet, and eared grebe, with the meadowlark and eared grebe being the most abundant (500 to 750 individuals observed for each species). The reduced diversity of animals observed was attributed to the homogeneity and dryness of the survey area. The author reports “no discernable effects on the animals nor their habitats evident at the time of this survey.” These observations cannot be linked to specific PRIs from the limited documentation available in the report.

3.2.4.3 Halford et al. 1999

Halford et al. 1999 performed a field survey on 18 to 20 August 1999. Visible observations of plants, wildlife, and wildlife signs were made in 10 locations.

Birds (loggerhead shrike, western meadowlark, and hummingbird) were observed at a survey location within PRI 10. Direct bird observations were not reported at the survey locations within other PRIs (5, 6, 7, 9, and 15). The authors note that “none of the animals observed appeared to show outward signs of toxicity.”

3.2.4.4 BIO-Logic 2006

Bird presence and relative abundance during the 2006 breeding season (May to June) was studied. Relative abundance of birds (detections per point) were compared between the OWP (PRI 7) and other adjacent habitats (portions of PRIs 5, 6, 8, 10, 13, 14, and 15, as well as the GSLIC and SVDD) of saline mudflats and manmade dikes. Other adjacent habitats do not constitute reference areas. Locations of bird nests, egg counts (minimum clutch size estimate), and anecdotal observations of bird presence and behavior were evaluated.

There were 140 bird detections comprising 14 species, a majority of which (65 percent) were horned larks. The next three most abundant species were snowy plovers, American avocets, and western

meadowlarks, in that order. Within the USM facility, nests of two bird species were observed. There were nine horned lark nests spotted, with three in or adjacent to the OWP, and six snowy plover nests with four in or adjacent to the OWP. Of the nests and young observed on the facility, no abnormal nesting behavior or clutch size was observed. In adjacent habitats compared to the OWP, bird abundances were double and anecdotal observations of bird presence with their behavior suggests they are twice as likely to breed or forage in adjacent habitats compared to the OWP. Snowy plovers were observed regularly foraging at the margins of the OWP along the dike berms; with the exception of the southwest edge, the OWP was mostly unattractive to the snowy plover. Overall, the OWP was found to be poor breeding and foraging habitat for all bird species present as compared to adjacent sites.

3.2.4.5 Beltman and Stackhouse 2007

Beltman and Stackhouse (2007) detail the results of a 2002 bird survey conducted at the Site to qualitatively characterize bird use in the wastewater ditches and ponds. The timing of the survey (8 days in May to June and 16 days in July to November) was such that it likely missed the peak of spring migration but did capture the fall migration. Approximately 7,000 individual birds of more than 60 species were documented in the general vicinity of the Site. More than 5,000 of the individual birds sighted were California gulls. Of the birds sighted, approximately 30 individuals from 10 species were reliably observed to come into contact with water in PRI 1, PRI 5, and PRI 6, for an unspecified period of time. More individuals may have come into contact with water at PRI 7, but these observations were made from a greater distance and thus are expected to be less reliable. After contact with acidic wastewater, birds were observed shaking their heads, gagging, limping, hopping on one foot, and having malaise. Beltman and Stackhouse (2007) interpreted these behaviors to be signs of distress, though many of these behaviors are described in the scientific literature as normal (Boyle 2007). The evidence as presented in Beltman and Stackhouse 2007 indicates that birds are present at the Site, but that very limited numbers of birds are in contact with acidic wastewater. From this evidence, it is uncertain whether birds that contact acidic wastewater are experiencing distress.

3.2.4.6 Main Findings

The ecological field surveys LOE for avian receptors is composed of two parts: (1) the reproductive success studies of Cavitt (2008, 2010) comparing the Site against reference areas, and (2) the more generalized statements of bird behavior or state at the Site compared to normal conditions (Glover 1983; Halford et al. 1999; BIO-Logic 2006; and Beltman and Stackhouse 2007). Both of these parts are used to characterize risk as the ecological field surveys LOE. The main findings are:

- First, Cavitt (2008, 2010) finds no statistically significant differences in reproductive success at the Site compared to the reference areas, for either study year. Reproduction endpoints are generally considered to be more sensitive endpoints than growth or survival.
- Cavitt notes that in 2010, the nest hatchability at the Site for snowy plover was lower (0.75) than in 2008 (0.95), and that the average hatchability for uncontaminated aquatic bird eggs has been suggested to be above 0.91. Numerous factors may cause low hatchability, including contamination from PCBs and dioxins. Without chemical analysis of the eggs, the possibility of Site-related reproductive toxicity cannot be ruled out. However, hatchability was the highest at the nests in the OWP (PRI 7), the area expected to have the highest levels of contamination. Lower hatchability could also result from factors such as: inexperienced breeding adults, high ambient temperatures, or other stressors such as food availability. The author also notes that the Site is likely poor quality breeding habitat, due to low food availability, higher thermal and osmotic stress, increased distance to freshwater, and higher predator density. More favorable breeding areas are typically utilized first by more experienced breeding adults, leaving the lower quality breeding areas for younger, inexperienced breeders or birds in poor condition. In 2010, the breeding adults at the Site were

statistically smaller than those at the reference areas, which may represent younger birds or birds in poor condition. The poorer condition of both the breeding habitat and the breeding adults may lead to lower hatchability or higher seasonal variation. Finally, the lower hatchability did not translate to a decreased mean number of young per successful nest, indicating that the low hatchability did not affect population recruitment.

- No signs of overt toxicity were observed for birds at the Site (Glover 1983, Halford et al. 1999), and nesting behavior and clutch sizes appeared normal (BIO-Logic 2006). It is unclear whether observed bird behaviors after contact with acidic wastewater were normal or abnormal (Beltman and Stackhouse 2007, Boyle 2007).

Uncertainties associated with these surveys are discussed in Section 7.3. Confidence in these studies varies with the study design, with Glover (1983), Halford et al. (1999), BIO-Logic (2006), and Beltman and Stackhouse (2007) having substantially lower confidence than Cavitt (2008, 2010) due to the limited generalized nature of their qualitative comparisons of bird behavior or state at the Site to normal conditions. The Cavitt (2008, 2010) studies are more reliable (monitoring conducted throughout two breeding seasons, quantitative comparison of multiple metrics between Site and appropriate reference areas) and more relevant (evaluation of reproductive success of receptor species). Thus, the LOE findings are driven primarily by the Cavitt (2008, 2010) studies, except for exposure scenarios and areas for which the Cavitt studies are not applicable.

Key uncertainties of the Cavitt (2008, 2010) studies are: pooling of all Site nest data before comparison to reference, potential confounding from other natural stressors (e.g., predation, weather, or disease), and the lack of chemical analysis of eggs. These uncertainties may lead to either over- or underestimation of risk. Overall confidence in the Cavitt (2008, 2010) studies is moderate to high.

3.3 Weight of Evidence

WOE is conducted narratively, as described in Section 2.5.4. Four LOEs are available for birds: dietary dose HQs, egg tissue HQs, ecological field surveys, and Site-specific toxicity studies. The different LOEs have different advantages and limitations, as discussed in Section 2.5.4.2. Not all LOEs are available for each exposure area. The presentation of the WOE findings is organized by exposure areas and exposure durations with similar available LOEs.

3.3.1 Acute Exposures

Risk for acute exposures is characterized separately for upland and lakebed habitats using WOE in the below sections.

3.3.1.1 Upland Habitats (PRIs 2, 4, and 9)

Field studies indicate that birds are present within PRIs 2 (Landfill), 4 (Gypsum Pile), and 9 (Smut Pile), though avian use of these areas is expected to be minimal due to the industrial nature of these areas, including barren ground largely devoid of vegetation (ERM 2014a). Two LOEs, dietary dose HQs, and ecological field surveys, are used to characterize risk to birds from acute exposures in PRIs 2, 4 and 9. As discussed in Section 3.2.1, there are few NOAEL-based and no LOAEL-based HQs at or above a level of concern. The ecological field surveys LOE has limited usefulness and low confidence, particularly for these areas, but noted no discernable signs of toxicity to the birds observed at the Site. Thus, acute exposures in PRIs 2, 4, and 9 are not expected to pose a risk to individual birds and are unlikely to result in population-level risk to avian species. Confidence in the above finding is high, as the HQs represent a conservative estimate of risk and there were no LOAEL-based HQs greater than 1.

3.3.1.2 Lakebed Habitats of the Waste Ponds (PRIs 5, 6, and 7)

Surface water in PRIs 5 and 6 is generally acidic, with pH values as low as approximately 1 (see Section 3.2.3). PRI 7 may also have acidic surface water, depending on seasonal variation in water levels and the influx of wastewater from PRI 5. Because the acidity of the water is likely to limit the growth of aquatic or benthic prey organisms, especially in PRIs 5 and 6, it is anticipated that most avian receptors will not utilize the acid ponds as a regular foraging area. This expectation is supported by field observations reported by BIO-Logic (2002, 2003, 2006) and Beltman and Stackhouse (2007), which indicated that the active ponds did not appear to be attractive to water birds or shore birds, and were utilized far less than the mudflats and pools of PRI 7. However, several species were observed to have contact with the water in the active ponds, so it is considered reasonable that some birds may occasionally attempt to forage in or drink from the acid ponds.

Three LOEs are used to characterize risk to birds from acute exposure in lakebed habitats of the waste ponds:

- Dietary Dose HQs
  - **Single Exposures**. As discussed in Section 3.2.1, if a 1-day foraging event were to occur in the waste ponds, intake of TEQ and HCB from sediment and water would only rarely result in LOAEL-based HQ values at or above a level of concern in PRI 5, and would not reach or exceed a level of concern for any receptor at any location in PRIs 6 or 7 (see Figures 3-4a to 3-4d). In PRI 5, only 2 samples out of 12 have HQs greater than 1; these samples are on opposite sides of the PRI from each other. Because nearly all LOAEL-based HQ values are less than 1, this line of evidence indicates that single acute exposures to sediment and water in the lakebed habitat of PRIs 5, 6, and 7 are not expected to pose a risk to most individual birds and are unlikely to result in population-level risk to avian species.
  - **Intermittent Longer-Term Exposures**. Because prey items are absent in PRIs 5 and 6 and are likely absent for most of the year in PRI 7, it is suspected that if a bird were to forage in the acid ponds or OWP, that same individual bird would be unlikely to repeat the foraging activity. This is supported by BIO-Logic (2002, 2003), which indicated that if repeat acute exposures were to occur, the frequency would likely be no more than once per month, and probably less. As discussed in Section 3.2.1, based on the dietary dose HQ LOE, intermittent longer-term exposures of this frequency do not reach a level of concern (see Figure 3-5a to 3-5c). Moreover, even if risks were to reach a level of concern, the number of individuals that might engage in repeated exposures is likely to be small. On this basis, intermittent longer-term exposures in the lakebed habitat of PRIs 5, 6, and 7 are not expected to pose a risk to individual birds, and are unlikely to cause population-level risk to avian species.
  - **Confidence**. Uncertainties associated with the dietary dose HQs LOE are discussed fully in Section 7.1 and confidence in this LOE is described in Section 3.2.1.1. Taken in total, the uncertainties associated with the HQs LOE are likely to overestimate risk to birds. Thus, there is high confidence that the results from the dietary dose HQs LOE are a conservative estimate of risk. Consequently, there is good confidence in the conclusion that acute or intermittent exposures are not of significant ecological concern for birds.
- Site-Specific Toxicity Studies
  - **Acute Oral and Dermal Exposure to Acidic Wastewater**. As discussed in Section 3.2.3, two laboratory-based toxicity studies have been performed in which birds were provided with drinking water collected from the acidic ponds for periods of 1 to 2 days. Both studies found that birds provided with acid water tended to reduce their water intake compared to controls, presumably because of the acidity. This in turn resulted in decreased food intake, which resulted in decreased

body weight, but this effect was temporary once access to clean water was restored. Neither study reported any evidence of significant toxic effects of contaminants in the water (either the acidic content or dissolved COPECs) after several days of observation. Exposure of eyes, skin, or feet to the acid water resulted in mild irritation only. Taken together, these two studies indicate that acute oral exposure to acidic water from PRIs 5 and 6 does not cause acute toxicity other than transient secondary effects on body weight, and that dermal or ocular effects from direct contact are minimal.

- **Confidence**. Overall confidence in the Site-specific toxicity studies LOE is detailed in Section 3.2.3.3, and the associated uncertainties are presented fully in Section 7.2. Overall, there are few sources of uncertainty for this LOE, leading to high confidence in the LOE findings.

- Ecological Field Surveys
  - **Qualitative statements of bird condition**. Only qualitative statements on bird condition, as compared to normal conditions, are available to evaluate acute exposures within these exposure areas (Glover 1983; Halford et al. 1999; BIO-Logic 2006; and Beltman and Stackhouse 2007). These studies either indicate no discernable effects on birds, or uncertainty as to whether the observed behaviors were normal.
  - **Confidence**. As discussed in Section 3.2.4.6, there is very low confidence in the qualitative comparisons between Site conditions and normal conditions from the available studies. Thus, for acute exposures in these exposure areas, this information is minimally useful for the WOE.

All three of the above LOEs indicate that toxic effects from acute exposures to water or sediment in the acid ponds are unlikely to result in any meaningful adverse effects on individual birds or on avian populations under current Site conditions. The confidence associated with that finding is high, as the three LOEs are in agreement, the HQs LOE is conservative, and the Site-specific toxicity studies LOEs has few sources of uncertainty.

However, it is important to note that this absence of significant risk is due to limited exposure, not limited contamination. Given the levels of contamination measured in pond sediments, if Site conditions were to change in the future such that prey items could grow in the ponds, foraging by avian species would likely increase, and this in turn would result in increases in exposure and risk that might well exceed a level of concern. Risk estimates for this scenario are presented in Appendix C.

3.3.2 Chronic Exposures

For chronic exposures to birds, risk is characterized using WOE as described by spatial area groups below.

3.3.2.1 Areas Around the Waste Ponds (PRIs 5, 6, 7, 13, and 14)

Lakebed habitat in PRI 7 is poor due to the occasional presence of acidic wastewater, and birds may be half as likely to use habitat in PRI 7 compared to adjacent areas (BIO-Logic 2006; ERM 2014a). Field studies indicate that berms and other areas in the vicinity of the waste ponds and inner PRI 14 (the area north of the P-11 canal, abutting the waste ponds of PRIs 5 and 7) are utilized for nesting and foraging by several avian species (BIO-Logic 2002, 2006; Beltman and Stackhouse 2007; Cavitt 2008, 2010; ERM 2014a). Solids samples in these areas show comparatively higher concentrations of TEQ and HCB in PRIs 5, 6, and 7 than in PRIs 13 and 14.

For chronic exposure in exposure areas around the waste ponds, three LOEs are used to characterize risk:

- Dietary Dose HQs

- **Chronic Exposures**. As discussed in Section 3.2.1, chronic LOAEL-based HQ values for sample locations in PRIs 5, 6, and 7, as well as inner PRI 14 are often greater than 10 and may range up to 60. Adverse effects, particularly due to TEQ and to a much lesser extent HCB, are possible for individual birds in these areas, with TEQ in PRIs 5, 6, and 7 representing the highest level of concern. In PRI 13, LOAEL-based HQs rarely exceed 1 and only for avian TEQ Category 1, and the magnitude is low (maximum HQ = 2). Thus, adverse effects on individual birds are not expected in PRI 13. As seen in Table 3-8, TEQ HQs in PRI 14 are substantially different in the inner area that is west of Solar Pond 1 North and north of the P-11 canal, compared to the outer areas south or east of the P-11 canal (Figure 2-3). The LOAEL-based HQs for TEQ in the outer part of PRI 14 rarely exceed 1, and the magnitude is low (maximum observed LOAEL HQ = 3). Thus, COPECs in the outer portion of PRI 14 are unlikely to pose a risk to individual birds.
- **Confidence**. Confidence for this LOE is described in Section 3.2.1.1 and varies with the COPEC. Confidence is higher in the HQs for HCB than for TEQ, and the TEQ HQs likely overestimate the potential for adverse effects on individual birds (see Section 3.2.1.1). As above, uncertainties associated with the dietary HQs LOE are likely to yield a conservative estimate of risk to birds (see Section 7.1).

- Egg Tissue HQs
  - **Eggs**. Avian eggs of snowy plover and several other species collected from nests in the areas around the waste ponds and inner PRI 14 show evidence of elevated levels of TEQ, PCBs, and to a lesser extent, HCB (see Section 3.2.2) compared to background levels. These data suggest that adult female birds nesting in the area of the ponds are exposed to Site-related contaminants and that these contaminants are transferred to egg tissue. These data do not identify the source of the uptake, but maternal exposure through diet (ingestion of contaminated soil and prey at the Site) is a reasonable source. Based on the measured levels of COPECs in the eggs, a majority of the eggs yield LOAEL-based HQs for TEQ that are above 1, mainly in the 2 to 10 range, with a few somewhat higher (Figures 3-6a to 3-6h). The results indicate a level of concern that hatchability and survival of chicks from nests in areas around the ponds might be impaired.
  - **Confidence**. See Section 3.2.2.1 for a discussion of confidence in the egg tissue HQs LOE, which varies by COPEC. There is moderate confidence in the HQs for HCB and TEQ, but low confidence in the total PCB HQs which are likely to overestimate risk.

- Ecological Field Surveys
  - **Reproductive Success**. Two field studies (Cavitt 2008, 2010) have been performed that provide direct observations of avian reproductive success in snowy plover nests located in the vicinity of the Site waste ponds compared to three reference locations that are not believed to be impacted by the Site (see Section 3.2.4). In the 2008 study, hatchability was high (0.95) and was similar to the reference areas (0.94 to 1.00). However, in the 2010 study, hatchability at the Site was low (0.75) compared to the reference areas (0.93 to 0.98, $p = 0.07$). This low hatchability did not translate to a decrease in the mean young produced per successful nest in 2010. The author discussed a number of plausible hypotheses for the low hatchability, but noted that without chemical analysis of the eggs, the cause could not be determined. The possibility that the low hatchability was related to chemical exposure cannot be excluded.
  - **Confidence**. Uncertainties associated with the ecological field surveys LOE are discussed fully in Section 7.3, and the moderate to high confidence in this LOE is discussed in Section 3.2.4.6. However, the ecological field surveys LOE has varying relevance by PRI; numerous nests were found in PRIs 7 and 14 near the boundaries of PRIs 5 and 6, but a single nest was found in PRI 13. Thus, this LOE has high relevance to exposures in PRIs 5, 6, 7 and 14, and low relevance to

PRI 13. Uncertainties associated with the Cavitt (2008, 2010) studies may lead to either over- or underestimation of risk.

Because of uncertainties that may exist in both the estimate of dietary exposure and in the benchmarks used to evaluate risk (see Section 7.1), an elevated dietary intake HQ value is not proof that adverse effects will definitely occur. However, the indication of risk based on dietary dose HQ values is supported by the egg tissue HQs, which indicate that a majority of eggs from nests in the vicinity of the waste ponds are contaminated with Site COPECs, and that some eggs have contaminant levels that could impair hatchability. This is also consistent with the observation of decreased hatchability in one of two field studies, although other causes could be responsible, in part or in whole. Because all of these LOEs either indicate or are consistent with the occurrence of decreased reproductive success in birds nesting near the waste ponds, adverse effects could occur for individual birds. Whether the magnitude and severity of the effect could lead to a significant population level effect is not certain. However, nesting density at the Site, particularly around the waste ponds, is low compared to reference areas, likely due to poor quality habitat. With an observed nesting density of 0.0114 to 0.0464 nests per ha (Cavitt 2008, 2010), the above areas (upland habitat of PRI 5, upland habitat of PRI 6, the portion of PRI 7 not underwater during spring [ERM 2018b], and the inner portion of PRI 14, totaling 337 ha) represent only 4 to 16 nests and thus a maximum of 36 breeding adults. With a maximum of 16 nests with potentially decreased reproductive success, a substantial impact on the populations of exposed species is not expected. However, effects on individual snowy plovers may be of concern, as these are a species of Utah Greatest Conservation Need.

No eggs were collected for chemical analysis in PRI 13 or the portion of PRI 14 south and east of the P-11 canal. A single nest was observed in PRI 13 as part of the ecological field surveys LOE, and the outer part of PRI 14 was not included in the Cavitt (2008, 2010) survey area. Thus, conclusions for PRI 13 and the outer portion of PRI 14 rely on the dietary dose HQs LOE. This LOE indicates that adverse effects on individual birds are unlikely in PRI 13 and the portion of PRI 14 south and east of the P-11 canal (see Section 3.2.1); thus it is determined that risks to bird populations in these areas do not pose a level of concern.

Confidence in the WOE finding above is moderate, as the three LOEs are in agreement, but two of the three LOEs may overestimate risk to individual birds. Confidence is higher in the findings for PRI 13 and the outer portion of PRI 14, as the conservative HQs indicate that effects on individual birds are unlikely. The population-level context from the ecological field surveys LOE provides important realism regarding impacts at the population level.

3.3.2.2 Exposure Areas Away From the Waste Ponds (PRIs 8, 10, 12, 15, 16, SVDD, and GSLIC)

Birds have been observed using the upland habitats away from the waste ponds to a greater degree than at the waste ponds themselves, and may be twice as likely (BIO-Logic 2006) to forage or breed in the areas away from the waste ponds. Measurements of COPECs in these areas show notably lower concentrations than around the waste ponds, with the exception of PRI 8.

Two LOEs, dietary dose HQs and ecological field surveys, are available to assess risk to birds in PRIs 8, 10, 12, 15, 16, the SVDD, and the GSLIC.

- Dietary Dose HQs
  - **Chronic Exposures**. This LOE has LOAEL-based HQs greater than 1 in PRIs 8, 12, 15, the SVDD, and the GSLIC. For the remaining PRIs (10 and 16), there are no LOAEL-based HQs greater than 1 (see Section 3.2.1). Adverse effects on individual birds are possible in PRI 8, due to exposure to TEQ and vanadium, with LOAEL HQs ranging up to 40. In PRIs 12, 15, the SVDD, and the GSLIC, the only LOAEL-based HQs greater than 1 are for Avian TEQ Category 1

(maximum HQ = 5). However, these specific HQs have uncertainties that lead to overestimations of risk (see Section 3.2.1.1). For TEQ, the TRV likely overestimates oral bioavailability of TEQ, perhaps substantially. For vanadium, the calculated EPC is not relevant to current conditions in PRI 8, after installation of the overflow pipe, and substantially overestimates exposure. Given the overestimation inherent in the TEQ HQs and the low magnitudes, it is concluded that adverse effects to individual birds are unlikely in PRIs 12, 15, the SVDD, and the GSLIC, as well as the lakebed habitat of PRI 8. For the upland habitat of PRI 8, adverse effects to individual birds are possible due to exposure to TEQ, but not vanadium.

- **Confidence**. Confidence in this LOE is discussed in Section 3.2.1.1. The confidence in the findings for PRIs 8, 12, 15, the SVDD, and the GSLIC is moderate, as the degree of overestimation of TEQ oral bioavailability is uncertain. There is high confidence in the compelling evidence that risks to individual birds and bird populations are unlikely in PRIs 10 and 16.

- Ecological Field Surveys
  - **Qualitative statements of bird condition**. For these exposure areas, only qualitative statements on bird condition compared to normal conditions are available (Glover 1983; Halford et al. 1999; and BIO-Logic 2006). These studies indicate no discernable effects on birds.
  - **Confidence**. As discussed in Section 3.2.4.6, there is very low confidence in the qualitative comparisons between Site conditions and normal conditions from the available studies. Thus, this information is minimally useful for the WOE for these exposure areas.

Thus, for chronic exposures in areas away from the waste ponds, only the upland habitat of PRI 8 has possible adverse effects on individual birds. The upland area of PRI 8 is small (67 ha) and likely supports a maximum of three nests from six breeding adults; therefore a potential decrease in reproductive success in nests of this limited area is not expected to have a substantial impact on bird populations. However, effects to individual snowy plovers in PRI 8 may still be of concern, as this is a species of Utah Greatest Conservation Need. The confidence in this WOE finding for PRI 8 is moderate, as the dietary dose HQs for TEQ are expected to overestimate risk.

3.4 Summary of Findings for Birds

Risk evaluation was conducted for avian AEs at the population level. AEs represent the following feeding guilds: gleaning invertebrate-consuming birds, aerial invertebrate-consuming birds, herbivorous birds, and carnivorous birds. Representative receptor species were selected for each feeding guild. PRIs 5 (upland), 6 (upland), 7, 8, 10, 12 through 16, and the GSLIC and SVDD were evaluated for chronic exposures, and PRIs 2, 4, 5 (lakebed), 6 (lakebed), 7, and 9 were evaluated for acute exposures. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix C; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

Four LOEs were used to characterize risk to avian AEs for the different exposure units: dietary dose HQs, egg tissue HQs, Site-specific toxicity studies, and ecological field surveys. Uncertainties associated with the LOEs used to characterize risk to birds are presented in Section 7. Due to the conservative assumptions used to calculate HQs, there is high confidence in results where risks are not expected for individual birds. The above LOEs were integrated into a WOE finding (see Section 3.3 above), which is summarized below.

Risks for individual birds are unlikely across much of the spatial area of the Site, including PRIs 2, 4, 9, 10, 12, 13, the portion of PRI 14 south or east of the P-11 canal, 15, 16, the GSLIC, and the SVDD. Acute

risks to individual birds in the lakebed habitats of PRIs 5, 6, and 7 are also unlikely, due to limited exposure as most birds are expected to avoid the acidic waste pond water. However, COPECs in the following areas may pose a risk to individual birds:

- **Upland Habitats of PRIs 5 and 6** – Adverse effects are possible for individual birds, particularly due to TEQ, PCBs, and HCB.
- **Lakebed Habitats of PRI 7 and PRI 14 (north of the P-11 canal)** – Adverse effects due to chronic exposure to TEQ are possible for individual birds in PRI 7 and the inner portion of PRI 14 north of the P-11 canal shown on Figure 2-3.
- **Upland Habitat of PRI 8** – Risks to individual birds are possible in the upland habitats of PRI 8, due to TEQ.

The above areas may pose a risk to individual birds, which may be of concern for the snowy plover, which is a species of Utah Greatest Conservation Need. For other species, it is unclear whether these risks for individual birds may be of sufficient severity and magnitude to lead to population-level impacts. Each of the above exposure areas with potential risk to individual birds are noted to be small in size, ranging from 28 to 340 ha large, and also composed of poor quality habitat. Using the observed Site-specific nesting density from Cavitt (2008, 2010), the above areas together are estimated to support a maximum of 38 nests from 76 breeding adults. This represents a fraction of bird populations (see Section 2.5.5). Thus, it is considered unlikely that decreased reproductive success in the limited number of nests present in the above areas would elicit changes in the populations of bird species utilizing habitat at the Site. There is moderate confidence in these findings, as the HQs LOE is likely to overestimate risk, particularly for TEQ.

4. RISK EVALUATION FOR MAMMALS

Section 4 presents the risk evaluation findings for lakebed and upland mammals at the Site.

4.1 Mammal Usage of the Site

Understanding how and where the upland and lakebed mammals use the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence and behavior of mammals at each exposure unit. In general, observations have included sightings and/or scat of rodents (deer mouse, kangaroo rat, and white-tailed antelope squirrel), medium-sized mammals (black-tailed jackrabbit and desert cottontail), and larger mammal (badger, deer, and coyote). Small mammals are present (and likely residents) at or near PRIs within the Site. Trails of large mammal prints in lakebed habitat suggest these animals are likely to be transient visitors. Scat and prints of large mammals in upland habitat suggests these animals are likely to forage in upland PRIs. Like birds, most mammals are anticipated to be attracted to undisturbed habitat offering superior (relative to disturbed areas) refuge and foraging habitat.

As discussed in Section 2.2.5, representative mammalian species selected for quantitative assessment are listed below:

- Grasshopper mouse (upland and lakebed habitat)
- Ord's kangaroo rat (upland and lakebed habitat)
- Badger (upland and lakebed habitat)
- Pronghorn antelope (upland habitat)

4.2 Risk Estimates

Risk estimates for mammals were evaluated with the dietary dose HQs LOE, tissue HQs LOE, and ecological field survey LOE. No Site-specific toxicity studies were identified as LOEs for mammals.

HQs were developed using dietary dose and tissue body burden. All results are representative of current and future conditions with the following exceptions: exposure units in the RCRA Carve-Out Cleanup Project Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after the realignment (Table 2-9).

The results of the dietary exposure and tissue body burden risk analysis for mammals are presented below. The comprehensive results for these evaluations are provided in Appendix E. Only the COPECs that showed potential risk, as determined by an HQ above 1, are presented below and in the tables and figures.

4.2.1 Dietary Dose Hazard Quotient Line of Evidence

The results of the dietary dose HQ analysis for mammals are presented below. Exposure units supporting a chronic exposure for the badger and pronghorn antelope were evaluated using the 95UCL EPC in the dose model. Exposure units supporting a chronic exposure for the small mammals (grasshopper mouse and Ord's kangaroo rat) were evaluated using point-by-point EPCs in the dose model. Exposure units where the habitat does not support dietary items for mammals have an assumed acute exposure pathway and all mammals were evaluated on a point-by-point basis. HQs are only presented for COPECs with HQs greater than 1.

- For the large home range upland mammals evaluated with chronic exposure (i.e., badger and pronghorn antelope), the NOAEL and LOAEL HQ results are presented in Table 4-1 and illustrated on Figures 4-1a to 4-1b. For small home range mammals (i.e., grasshopper mouse and Ord's kangaroo rat) evaluated under acute and chronic exposure scenarios in upland habitat, and for the badger under acute exposure scenarios in upland habitat, the NOAEL and LOAEL HQ results are presented in Table 4-2 and illustrated on Figures 4-2a to 4-2d.
- For lakebed habitat, the large home range mammal (i.e., badger) was evaluated with chronic exposure and the NOAEL and LOAEL HQ results are presented in Table 4-3 and illustrated on Figures 4-3a to 4-3b. The HQ results for small home range mammals (i.e., grasshopper mouse and Ord's kangaroo rat) evaluated under acute and chronic exposure scenarios in lakebed habitat, and for the badger under acute exposure scenarios in lakebed habitat are presented in Table 4-4 and illustrated on Figures 4-4a to 4-4d.

4.2.1.1 Main Findings

The following main risk evaluation findings for mammal receptors are derived from the dietary dose HQ results presented in Tables 4-1 to 4-5 and Figures 4-1a to 4-4d:

- In all cases, the highest HQ values for mammalian receptors are due to intake of TEQ (maximum LOAEL HQ = 10). HQs from other COPECs (HCB,[13] total PCBs, aluminum, iron) are lower in magnitude (maximum LOAEL HQ = 3) and/or are consistent with background HQs.
- In upland habitats, HQ values for TEQ are generally highest for the grasshopper mouse. HQs for the Ord's kangaroo rat, badger, and pronghorn antelope are lower. The grasshopper mouse diet consists of invertebrates, which has higher uptake rates of TEQ in comparison to prey items of other species. The pronghorn antelope and the badger have low HQs due to large foraging ranges, which leads to lower exposures within a PRI for these species. The Ord's kangaroo rat has a much smaller home range, but the primary food source for this species, plants, has low uptake of TEQ.
- In lakebed habitat, HQ values for TEQ are generally highest for the badger at PRI 7, while HQs for the Ord's kangaroo and grasshopper mouse are low.
- For chronic dietary exposure, TEQ reaches a level of potential concern in the upland habitat of PRIs 5, 6, and 8 (Table 4-1, Figures 4-1a and 4-1b), and in the lakebed habitat of PRI 7 (Table 4-3, Figures 4-3a and 4-3b). Table 4-5 shows that intake from solids and/or prey items are the main source of exposure and elevated HQs. Elevated LOAEL HQs are generally not attributable to intake from water with the exception of TEQ HQs in PRI 5 upland habitat.
- For some COPECs, the magnitude of the HQs at the Site are comparable or less than the magnitudes for background (Figures 4-1a to 4-4d). This is true of aluminum in lakebed and upland habitats of PRI 8 for both the grasshopper mouse and Ord's kangaroo rat. In these situations, any potential risk is considered to be consistent with background conditions and thus does not reach a level of concern.
- For single acute exposures to large and small home range receptors, no LOAEL HQs are above 1 in any of the PRIs with an acute exposure pathway (PRI 2, PRI 4, PRI 9, [Table 4-2] and lakebed areas of the waste ponds [Table 4-4, Figure 4-4a]).

For dietary dose HQs, confidence in the main finding above is dependent on the magnitude of the HQ (i.e., strength) and the specific COPEC. Since a number of conservative assumptions were used to calculate HQs (see Section 7.1), there is high confidence that HQs less than 1 indicate the potential for

[13] This refers to HCB evaluated based on a TRV for HCB. Risks from HCB acting as a dioxin-like compound are included in the HQ for TEQ.

adverse effects on organisms is unlikely, particularly for NOAEL HQs less than 1. For LOAEL HQs above 1 and higher than background levels (TEQ, total PCBs, and HCB), the confidence depends on the reliability and relevance of the specific underlying calculation parameters noted below.

- **Mammalian TEQ**. The chemistry data and bioaccumulation models used to estimate uptake are reliable and Site-specific. However, the bioaccumulation model for brine flies is a constant value (see discussion in Section 7.1.1.4), which introduces uncertainty in the dose model for receptors that eat brine flies. This uncertainty is likely to overestimate dietary doses in exposure areas with comparatively lower TEQ concentrations in solids (i.e., lakebed habitat of PRI 8) and underestimate dietary doses in exposure areas with comparatively higher TEQ concentrations (i.e., lakebed habitats of PRI 7). The TRV is selected from a reliable study with no specific uncertainties. There is moderate confidence in the calculation parameters.
- **Total PCBs**. The chemistry data and bioaccumulation models are both reliable and Site-specific. The TRV study is relevant and presents no specific uncertainties. Thus, there is moderate confidence in the calculation parameters.
- **HCB**. The chemistry data and bioaccumulation models are both reliable and Site-specific. The TRV study is relevant and presents no specific uncertainties. Thus, there is moderate confidence in the calculation parameters.

4.2.2 Tissue Hazard Quotient Line of Evidence

Small mammal tissue was evaluated by modeling tissue concentrations and comparing against tissue benchmarks. Modeled tissue HQs were evaluated in exposure units assumed to provide habitat that could result in chronic exposure: PRIs 5 (upland), 6 (upland), 7, 8 (lakebed and upland), 10, 12, 13, 14 (lakebed and upland), 15, and 16, and the SVDD and GSLIC.

Uptake models for mammalian tissues were available for TEQ, HCB, PCBs, and mercury. However, tissue-based benchmarks for mammals were only available for TEQ, total PCBs, and mercury. Therefore, HQs were derived only for these three COPECs. The NOAEL and LOAEL HQ results are presented in Appendix E. In brief, no HQs were greater than 1. As with the dietary dose HQs above, confidence is high that HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section 7.1).

4.2.3 Site-Specific Toxicity Studies Line of Evidence

There are no available data for the Site-specific toxicity studies LOE for mammals (see Section 2.1.1).

4.2.4 Ecological Field Surveys Line of Evidence

Limited data are available for mammals for the ecological field surveys LOE. These data provide superficial assessments of mammal health. No quantitative comparisons between Site and a reference area were conducted. Thus, this LOE does not specifically answer the question of whether mammal species at the Site have been impacted by COPECs, but provides circumstantial evidence on mammal health.

4.2.4.1 Glover 1983

Methods for Glover (1983) are described in Section 3.2.4.2. Glover (1983) notes the relative abundance of mammal species as: abundant (black-tailed jackrabbit), common (desert cottontail and coyote), and scarce (pocket mouse, kangaroo rat, whitefooted mouse, woodrat, and pocket gopher). The reduced diversity of animals observed was attributed to the homogeneity and dryness of the survey area. The author reports “no discernable effects on the animals nor their habitats evident at the time of this survey.”

These observations cannot be linked to specific PRIs from the limited documentation available in the report.

4.2.4.2 Halford et al. 1999

General methods for Halford et al. 1999 are described in Section 3.2.4.3. In addition, small mammals were identified and inventoried by placing overnight trapping transects in four selected areas in the Site. Trapping transects comprised approximately 10 stations placed 15 meters apart. Signs of mammals or direct observations (visual or trapping) were made for rabbits, coyote, badger, and mice at survey locations within PRIs 5, 6, 9, 10, and 15. Halford et al. reports that none of the animals appeared to show outward signs of toxicity and the trapped small mammals appeared to be robust and in good condition.

4.2.4.3 Main Findings

The survey efforts described above noted the presence of mammals and visually assessed body condition. However, they did not conduct any quantitative comparisons between Site and an appropriate reference. The main finding is:

- The presence of mammals with robust body condition suggests that overt toxicity is not occurring in PRIs 2 to 10, 12, and 15 due to COPECs, but cannot be used as a conclusive evaluation.

Confidence in the above main finding is very low, due to the generalized qualitative nature of the comparison between mammal body condition at the Site and a normal body condition for the species in question. Uncertainties associated with these surveys are discussed in Section 7.3.

4.3 Weight of Evidence

For mammals, three LOEs are available to characterize risk; uncertainties associated with these LOEs are discussed in Section 7. The dietary dose HQs LOE is available for all exposure units. The ecological field surveys LOE is also available for all exposure units, but due to their qualitative comparisons to normal conditions they do not provide definitive evidence on whether mammal species have been impacted at the Site. Finally, the tissue HQ LOE is available for all exposure units that support chronic exposure. The following subsections are organized by exposure duration (e.g., acute or chronic), as the different exposures have different LOEs. WOE for mammals is conducted according to the methods described in Section 2.5.4.

4.3.1 Acute Exposures

The WOE for acute exposures to mammals is presented below by habitat type. Mammal presence has been documented in field studies of the upland habitats of PRIs 2, 4, and 9, and in the lakebed habitats of PRIs 5, 6, and 7 (see Section 4.2.4). However, mammal use of these areas is expected to be minimal due to the poor quality habitat, lack of food, and presence of acidic wastewater in the waste ponds.

Dietary dose HQs indicate that there is minimal risk from acute exposures, as there are no LOAEL-based HQs greater than 1 and almost no NOAEL-based HQs greater than 1 (see Section 4.2.1). The ecological field surveys LOE is in agreement with this finding. Thus, acute exposures are not expected to pose a risk to individual mammals. This is compelling evidence with high confidence that population-level risk to mammal species is unlikely in the upland habitats of PRIs 2, 4, and 9 and the lakebed habitats of PRIs 5, 6, and 7.

4.3.2 Chronic Exposures

The areas that support chronic exposure for mammals have higher quality habitat and presumably a larger available food supply than the areas that support acute exposure. Risk to mammal populations was

evaluated for chronic exposures in the upland habitats of PRIS 5, 6, 7, 10, 12, 14, 15, and 16, as well as the lakebed habitats of PRIs 7, 8, 13, 14, SVDD, and the GSLIC. Mammal presence has been observed in these areas (see Section 2.2.1.4).

The dietary dose HQs LOE indicates that mammalian TEQ may elicit adverse effects in individual mammals, particularly in PRI 5s, 7, and 8, and to a lesser degree PRIs 6 and 12 (see Section 4.2.1). There are no LOAEL-based HQs greater than 1 for PRIs 10, 13, 14, 15, 16, SVDD, and GSLIC; thus, no adverse effects on individual mammals are expected in these areas. All sample locations in PRI 5 have LOAEL-based HQs greater than 1 for TEQ; thus, this evidence strongly indicates adverse effects on individual mammals may occur in the upland habitats of PRI 5. PRIs 7 and 8 (upland habitat only) have a lower frequency but a higher magnitude (maximum HQ = 10 and 6, respectively) of LOAEL-based HQs above 1, which is also considered an indication of potential adverse effects on individual mammals. The LOAEL-based HQs in PRIs 6 and 12 are infrequently above 1 and low in magnitude (maximum frequency of 30 percent and maximum HQ = 3); thus, adverse effects on individual mammals are considered unlikely.

The tissue HQ LOE strongly indicates that, across all exposure units, risks to individual mammals from chronic exposures are unlikely, as there are no NOAEL-based or LOAEL-based HQs greater than 1 (see Section 4.2.2). Because both the tissue HQ LOE and the dietary dose HQ LOE have similar uncertainties that are likely to overestimate risk (see Section 7.1), no specific uncertainties related to TRVs, and they use the same solids sample data as well as TEQ bioaccumulation models derived from the same source (ERM 2018a), reliability and relevance (see Section 2.5.4.1) is considered roughly equivalent for these two LOEs. The tissue HQ LOE strongly indicates adverse effects to individual mammals are unlikely because there are no NOAEL-based HQs above 1, while the dietary dose HQ LOE indicates effects are possible to individual mammals in PRIs 5, 7, and the upland habitat of 8 and indicates effects are unlikely for individual mammals in PRIs 6 and 12. After a conservative integration of these two LOEs together, the areas retained as posing potential risk for individual mammals due to chronic exposure to TEQ are PRIs 5, 7, and the upland habitat of 8, due to the high frequency and/or moderate magnitude of LOAEL-based dietary dose HQ exceedances.

Similar to bird receptors in Section 3, the exposure areas over which adverse effects are possible are small in size (68 ha for PRI 5 upland habitat, 129 ha for PRI 7 areas that are not underwater at some point of the year, and 67 ha for PRI 8 upland habitat), representing a limited number of individual mammals. The mammalian receptors expected to be most numerous at the Site, grasshopper mouse and Ord's kangaroo rat, are both territorial (California Department of Fish and Wildlife 2014), and thus their home range may be used to estimate population density. Using the home ranges presented in Table 2-18, it can thus be estimated that a maximum of 115 grasshopper mice and 189 Ord's kangaroo rats may be residents of the exposure areas where adverse effects are possible. The number of individual mice and rats at risk of adverse effects due to TEQ in these areas represents a small fraction of the population. In addition, the habitat quality is poor in PRIs 5 and 7 (see Section 2.2.1.4), thus mammal densities are expected to be lower at the Site than in areas with optimal habitat. Particularly in the lakebed habitat of PRI 7, the lack of vegetation cover, lack of food items, and marshy or salt-crusted substrates are unlikely to support frequent use by mammals. Thus, risks due to TEQ to individual mammals in PRIs 5 (upland habitat), 7, and 8 (upland habitat) are not expected to translate to overall population-level risks.

There is high confidence in the WOE finding for PRIs 8 (lakebed habitat), 10, 13, 14, 15, 16, the SVDD, and GSLIC, as the conservative HQs LOEs indicate that risks to individual mammals are unlikely. For PRIs 5, 6, 7, 8 (upland habitat), and 12, the confidence in the WOE finding is moderate, as either the evidence has weak strength or the two HQ LOEs are contradictory, but ultimately any impacts would be limited to a small number of individual mammals.

4.4 Summary of Findings for Mammals

Risk evaluation was conducted for mammalian AEs at the population level. AEs represent the following feeding guilds: invertebrate-consuming mammal, herbivorous mammal, carnivorous mammal, and large herbivorous mammal. Representative receptor species were selected for each feeding guild. PRIs 5 (upland), 6 (upland), 7, 8, 10, and 12 through 16, and the GSLIC and SVDD were evaluated for chronic exposures; and PRIs 2, 4, 5 (lakebed), 6 (lakebed), 7, and 9 were evaluated for acute exposures. Three LOEs (dietary dose HQs, tissue HQs, and ecological field surveys) were available to characterize risk to mammal AEs across the different exposure areas of the Site. Uncertainties associated with the LOEs used to generate the WOE findings above are discussed in Section 7.

The WOE findings are that risks are unlikely for individual mammals for all exposure areas of the Site, except:

- **PRI 5 (Upland Habitat), PRI 7, and PRI 8 (Upland Habitat)** – Mammalian TEQ may pose a risk to individual mammals within the upland habitat of PRI 5, the lakebed habitat of PRI 7, and the upland habitat of PRI 8. However, these exposure areas are small in size (68, 339, and 67 ha, respectively) and support a maximum of approximately 200 individual mammals per species. This represents a small fraction of the population; thus, it is unlikely that any adverse effects on individual mammals in the above areas would translate to population-level effects. Therefore, risks to mammal populations are considered unlikely.

The confidence in the above WOE findings is moderate to high. The HQs were calculated with conservative assumptions, and thus provide compelling evidence that risks are unlikely for all exposure areas except PRIs 5 (upland habitat), 7, and 8 (upland habitat). In PRIs 5 (upland habitat), 7 and 8 (upland habitat), the two conservative HQ LOEs have contradictory results, but ultimately the small number of individual mammals that might be impacted is unlikely to translate to impacts on the population.

5. RISK EVALUATION FOR PLANT COMMUNITIES

Section 5 presents the risk evaluation findings for terrestrial plants at the Site.

5.1 Plant Occurrences at the Site

Understanding where the terrestrial plants are present in the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. As described in Section 2.2.1.4, upland habitat at the Site generally includes invasive grasses, mixed greasewood scrub, and ruderal vegetation. Much of the Site does not support plant communities and/or has plants that are ruderal, sparse, patchily distributed, short in stature, and do not provide suitable refuge or foraging habitat for wildlife. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence of plants at each exposure unit.

5.2 Risk Estimates

Risk estimates for terrestrial plants were evaluated with the direct contact HQs LOE, tissue HQs LOE, and ecological field survey LOE only. No Site-specific toxicity studies were identified as LOEs for plants. Risk estimates for terrestrial plants exposed through direct contact with soil were evaluated on a point-by-point basis using NOAEL and LOAEL benchmarks, when available, resulting in a NOAEL or LOAEL HQ. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The results of the direct contact exposure and tissue body burden analyses for terrestrial plants are presented below.

5.2.1 Direct Contact Hazard Quotient Line of Evidence

The results of the direct contact exposure risk analysis for terrestrial plants are presented below. Exposure units supporting a chronic exposure in upland habitat were evaluated using point-by-point EPCs (PRIs 5 [upland], 6 [upland], 8 [upland], 10, 12, 14 [upland], 15, 16). Terrestrial plants were not evaluated in exposure units where current conditions do not allow for meaningful plant growth (PRIs 2, 4, and 9) or exposure units with lakebed habitat only (PRIs 7 and 13, GSLIC, and SVDD).

The NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 5-1 and illustrated on Figures 5-1a to 5-1i. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E.

5.2.1.1 Main Findings

The following main risk evaluation findings for plant receptors are derived from the direct contact HQ results presented in Table 5-1 and Figures 5-1a to 5-1i:

- The highest LOAEL HQ values for plant receptors are due to direct contact with aluminum and chromium. However, HQ values for these metals are consistent with background HQs (Table 5-1 and Figures 5-1a to 5-1i). Thus, aluminum and chromium concentrations at the Site are due to naturally occurring concentrations in the upland soil.
- Several other inorganics have LOAEL HQs above 1 but are low in frequency (e.g., only one sample) and magnitude (LOAEL HQ = 2), which are not considered to be a concern to the plant community.
- Risk to plants does not reach a level of concern for any COPECs.

For the direct contact HQ LOE, confidence is high that HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section 7.1).

5.2.2 Tissue Hazard Quotient Line of Evidence

Terrestrial plant tissue was evaluated by comparing plant tissue benchmarks to tissue concentrations modeled from soil sample concentrations (uptake models described in Section 2.3.3). Exposure units supporting a chronic exposure in upland habitat were evaluated using point-by-point EPCs. Plants were not evaluated in exposure units where current conditions preclude the growth and development of meaningful plant communities.

Plant uptake models were available for the following bioaccumulatives COPECs: TEQ, HCB, PCBs, hexachlorobutadiene, pentachlorobenzene, and mercury. However, tissue-based benchmarks for plants were only available for PCBs and mercury. Therefore, HQs were derived only for these two COPECs. The NOAEL and LOAEL HQ results are presented in Appendix E. In brief, no HQs were greater than 1.

As with the direct contact HQs above, confidence is high that HQs below 1 indicate the potential for adverse effects at the organism level are unlikely, due to the conservative assumptions used to calculate HQs (see Section 7.1).

5.2.3 Site-Specific Toxicity Studies Line of Evidence

There are no available data for the Site-specific toxicity studies LOE for plants (see Section 2.1.1).

5.2.4 Ecological Field Surveys Line of Evidence

Similar to mammals, limited data are available for plants for the ecological field surveys LOE. These data provide documentation of observed plant presence and overall health at the Site, as well as an assessment of plant species composition over time. None of the studies conducted a quantitative comparison between Site and a reference area. Thus, determinations about whether impacts have occurred on plants at the Site due to soil COPECs have a degree of uncertainty.

5.2.4.1 Thompson 1983

The study by Thompson (1983) reports the findings of a vegetation survey conducted on 25 October 1983 at a number of sites within 3 miles of the facility. Some of the sites in the survey were qualitatively compared to results from a previous plant survey done prior to the operation of the facility, on 8 June 1971. The eight sites from the 1971 survey were located within a 0.5-mile radius of the facility and included a count of the major plant species within a 36-foot-diameter circle. An additional six sites that were not in the 1971 survey were also surveyed by Thompson and these sites were located within 3 miles of the facility. The report's limited descriptions of the survey sites preclude the identification of these sites with specific PRIs. The objective of the survey by Thompson (1983) was to determine if any major changes in plant species composition had occurred after 12 years of production. In addition to evaluating plant species at each site, Thompson (1983) also examined the lichen population.

Thompson (1983) found that the predominant species that were present in 1971 were still present at the time of the survey in 1983. However, many of the sites experienced disturbance due to heavy equipment, which was assumed to have caused the changes in some plant populations. For example, the disturbed areas were quickly colonized by halogeton, cheatgrass, and clasping pepperweed (*Lepidium perfoliatum*). Heavy cattle grazing was assumed to have affected plant populations as well, as evidenced by squirreltail (*Sitanion hysterix*) being present under the protection of saltbushes (*Atriplex*) and greasewood plants. Black sagebrush (*Artemisia nova*) was found at two sites in the previous 1971 survey, but were absent

when surveyed by Thompson. Reasons for this decrease were hypothesized as physical disturbances or fluctuating levels of the lake resulting in high-water tables or rising saline levels. Thompson observed heavy lichen growth on soil, twigs, and rocks in the majority of the sites, and suggested that this sensitive plant species is not affected by emissions from the facility. However, lichen were not surveyed in the 1971 study, thus there are no previous observations that can be used as a comparison. Overall, Thompson (1983) concluded that his findings showed no significant plant damage, with the caveat that the survey was conducted after several heavy frosts, which did not allow for careful observation of phytotoxic reactions in plant species.

5.2.4.2 Glover 1983

The survey methods for Glover (1983) are presented in Section 3.2.4.2. The Glover (1983) results specific to terrestrial plants are limited to a list of habitats used by wildlife species: greasewood, saltbrush, cheatgrass, rocky outcrops, marsh edges, marsh flats, lake edge, and ditch. The author reports “no discernable effects on the animals nor their habitats evident at the time of this survey.” These observations cannot be linked to specific PRIs from the limited documentation available in the report.

5.2.4.3 Halford et al. 1999

Methods for Halford et al. (1999) are presented in Section 3.2.4.3. Halford et al. made observations on plant species and general plant health in the following locations: west margin of the Smut Area (PRIs 9 and/or 15), Barium Sulfate Area (PRI 10), and around the waste ponds (PRIs 5, 6, 7). Live vegetation was observed on the west margin of the Smut Area (PRIs 9 and/or 15), the Barium Sulfate Area (PRI 10), north pond island (PRI 6), and the south pond berm (PRI 5). The plants in the Barium Sulfate Area and on the west margin of the Smut Area were noted as appearing healthy. Dead vegetation was observed at the old wastewater pond (PRI 7) and the barrow pits of PRI 6,[14] possibly due to fluctuating pond water levels.

5.2.4.4 Main Findings

The survey efforts described above noted the presence/absence of live vegetation and visually assessed plant condition and species composition. While the surveys provided a comparison to a normal plant conditions, the surveys did not conduct any quantitative comparisons between the Site and an appropriate reference. Main findings are:

- Dead vegetation is noted in PRIs 6, 7, and 8, though the cause of plant mortality is often ascribed to physical soil conditions and/or water levels.
- The presence of healthy vegetation in other PRIs and/or other studies suggests that adverse effects on plants are not occurring in those areas of the Site, but cannot be used as a conclusive evaluation.

Confidence in the ecological surveys LOE is low due to the generalized qualitative nature of the comparisons between Site and normal conditions. The Thompson (1983) comparisons of species composition are relevant to plant communities, but lack temporal relevance to current conditions due to any facility changes that have occurred since 1983. These studies suggest a lack of phytotoxicity at the Site, but are not conclusive. Uncertainties associated with this LOE are detailed in Section 7.3.

5.3 Weight of Evidence

WOE is conducted as described in Section 2.5.4. Three LOEs are available for the terrestrial plant community risk characterization: direct contact HQs, tissue HQs, and ecological field surveys. Field

[14] The barrow pit in PRI 6 is no longer hydrologically separate from the acidic wastewater; thus, vegetation is no longer present in this area.

surveys document observations of plants growing in locations across the Site, although habitat is poor (Glover 1983; Thompson 1983; Halford et al. 1999).

All three LOEs are in agreement that risk to individual plants is unlikely for all exposure areas evaluated for plants (upland habitat of PRIs 5, 6, 8, 10, 12, 14, 15, and 16). For the direct contact HQs LOE, no COPECs raise to a level of concern: either HQs at the Site are consistent with those from background areas, or LOAEL-based HQ exceedances are rare and of low magnitude (see Section 5.2.1). As described in Section 5.2.2, there are no HQs greater than 1 for the tissue-based HQ LOE. The ecological field surveys indicate that plants are growing at the Site, although the poor habitat quality (poor physical soil conditions, compacted soils, high osmotic stress, or fluctuating water levels near ponds) may lead to pockets of dead vegetation in some areas (see Section 5.2.4). The three LOEs together provide compelling evidence that risks from COPECs to individual terrestrial plants are unlikely. Thus, risk to the terrestrial plant community is also unlikely. There is high confidence in these findings, as the LOEs are in agreement and the HQs LOEs, which are derived using conservative assumptions, indicate unlikely risks.

5.4 Summary of Findings for Plants

Risk evaluation was conducted for the terrestrial plant community AE in upland habitat. PRIs 5 (upland), 6 (upland), 8 (upland), 10, 12, 14, 15, and 16 were evaluated for chronic exposures. Exposure units where current conditions do not allow for meaningful plant growth were not evaluated. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The three LOEs used for evaluating plants were: direct contact HQs, tissue HQs, and ecological field surveys. These LOEs were combined to generate a WOE finding (see Section 5.3 above). The WOE finding is that risks to the terrestrial plant community at the Site are unlikely, for all evaluated upland habitat areas, and there is high confidence in these findings. The uncertainties associated with the above LOEs are described in Section 7.

6. RISK EVALUATION FOR INVERTEBRATES AND AQUATIC BIOTA

Section 6 presents the risk evaluation findings for soil invertebrates, benthic invertebrates, and aquatic biota (aquatic invertebrates and aquatic plants) at the Site.

6.1 Invertebrate Occurrences at the Site

Understanding where the upland and lakebed invertebrates are present in the various exposure units is important for interpreting the quantitative risk estimate results and providing meaningful determinations of risk within the Site. As described in Section 2.2.1.4, invertebrates in upland habitat at the Site include soil invertebrates such as beetles, ants, and wasps. Adult and larval brine flies are present in (exposed at) lakebed habitats. The survey efforts from BIO-Logic (2004) and ERM (2014a) indicate waste pond water (PRIs 5, 6, and 7) is invertebrate-poor, likely due to the influx of acidic wastewater. Limited brine fly reproduction may occur when acidic wastewater is not present in PRI 7. While BIO-Logic (2004) observed brine flies in PRI 6, this former barrow pit area is no longer hydrologically separate from the acidic wastewater of the active waste pond, thus eliminating brine fly reproduction in PRI 6. See Section 2.2.1.4 for a detailed description of the historical observations on occurrence of invertebrates at each exposure unit.

6.2 Risk Estimates

Risk estimates for invertebrates and aquatic biota were evaluated with the direct contact HQs LOE and tissue HQs LOE. No Site-specific toxicity studies or ecological field surveys were identified as LOEs for invertebrates or aquatic biota. Risk estimates for soil invertebrates, benthic invertebrates, and aquatic biota were evaluated on a point-by-point basis using NOAEL and LOAEL benchmarks, when available, resulting in a NOAEL or LOAEL HQ. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The results of the direct contact exposure analyses are presented below.

6.2.1 Direct Contact Hazard Quotient Line of Evidence for Soil Invertebrates with Upland Soil

Soil invertebrates were evaluated for direct contact exposure with upland soil in exposure units with upland habitat. Exposure units supporting a chronic exposure were evaluated using point-by-point EPCs (PRIs 5 [upland], 6 [upland], 8 [upland], 10, 12, 14 [upland], 15, and 16). Risks were not evaluated in exposure units that are judged to provide inadequate habitat for soil invertebrates (PRIs 2, 4, and 9).

The results of the direct contact exposure analysis for soil invertebrates are presented below. The NOAEL and LOAEL HQ results for COPECs with an HQ greater than 1 are presented in Table 6-1 and illustrated on Figures 6-1a to 6-1c. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix D.

6.2.1.1 Main Findings

The following main risk evaluation findings for soil invertebrates are derived from the direct contact HQ results presented in Table 6-1 and Figures 6-1a to 6-1c:

- The highest HQ values for soil invertebrate receptors are due to direct contact with chromium. However, HQ values for this metal are consistent with background HQs (Table 6-1 and Figure 6-1b).

Thus, chromium concentrations at the Site are due to naturally occurring concentrations in the upland soil. The other COPECs with HQs greater than 1 are barium and mercury. HQs above 1 for both of these COPECs are very low in magnitude and frequency, which is not a concern for soil invertebrate communities.

- Risk to soil invertebrates does not reach a level of concern for any COPECs (Table 6-1 and Figure 6-1a to 6-1c).

For direct contact HQs, confidence in the findings above is dependent on the magnitude of the HQ and the frequency of which HQs exceed 1 (i.e., strength) and the specific COPEC. HQs less than 1, particularly NOAEL HQs less than 1, have high confidence that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). For LOAEL HQs above 1 and higher than background levels (mercury), the confidence depends on the reliability and relevance of the specific underlying calculation parameters. As the chemistry data is both reliable and Site-specific, and the benchmark is relevant and presents no specific uncertainties, there is moderate confidence in the calculation parameters.

6.2.2 Direct Contact Hazard Quotient Line of Evidence for Benthic Invertebrates with Sediment

Benthic invertebrates were evaluated for direct contact exposure with sediment in lakebed habitat where the surface water was not acidic (PRIs 7 [chronic exposure assumption], 8, 13, and 14, the GSLIC, and the SVDD) on a point-by-point basis. Benthic invertebrates were not evaluated in lakebed exposure units with an assumed acute exposure pathway for birds and mammals because acidic wastewater precludes growth of benthic invertebrates (PRIs 5 and 6).

In general, there were a number of organics and metals that have HQs greater than 1 in the lakebed exposure units. The results are summarized in Table 6-2 and illustrated on Figures 6-2a to 6-2l. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E. As noted in Section 2.4.1.1, it is unclear whether saltwater and freshwater benchmarks are more relevant to species at the Site. Thus, the lower of the saltwater and freshwater benchmarks were used for HQ calculations in lieu of toxicity data on brine shrimp and/or hypersaline conditions. The uncertainty of using these benchmarks to evaluate hypersaline surface water and sediment toxicity is discussed in the Uncertainty Analysis (Section 7).

6.2.2.1 Main Findings

The following main risk evaluation findings for benthic invertebrates are derived from the direct contact HQ results presented in Table 6-2 and Figures 6-2a to 6-2l:

- The highest LOAEL and unbounded NOAEL HQ values for benthic invertebrate receptors are due to direct contact with total PCBs, phenol, carbon disulfide, and inorganics. Other COPECs with LOAEL or unbounded NOAEL HQs above 1, such as HCB and pentachlorobenzene, are low in frequency (less than 10 percent of samples with HQ above 1) and magnitude. The HQ values for inorganics are consistent with background values and do not reach a level of concern in sediment. The unbounded NOAEL HQs above 1 are relatively low in frequency (20 to 32 percent of samples with HQ above 1) with a maximum NOAEL HQ of 10 for phenol and 7 for carbon disulfide. Given the consistencies with inorganic background HQs, low frequency or magnitude unbounded NOAELs for SVOCs/VOCs, and the likelihood that a LOAEL HQ would not be above 1, the only COPEC of potential concern to benthic invertebrates is total PCBs.
- Total PCBs reach a level of potential concern to benthic invertebrates in PRI 7 sediments under the assumption of a chronic exposure pathway, which is unlikely to occur given the periodic flooding of

PRI 7 with acidic wastewater. While LOAEL HQ values are elevated for total PCBs in the GSLIC and PRI 14, the magnitude and frequency of the HQs above 1 are limited, thus not reaching a level of concern in GSLIC sediments.

Similar to direct contact HQs for soil invertebrates, HQs less than 1, particularly NOAEL HQs less than 1, have high confidence that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). For unbounded NOAELs and LOAEL HQs above 1 that are higher than background levels and greater than 10 percent in frequency (i.e., total PCBs, phenol, and carbon disulfide), the confidence depends on the reliability and relevance of the specific underlying calculation parameters.

- **Total PCBs** – The chemistry is reliable and Site-specific, but assumes the entirety of PRI 7 is suitable habitat for benthic invertebrates, which is not relevant to the acidic conditions that occur during periodic flooding of wastewater. Additionally, the benchmark has low relevance as it is based on saltwater benthic invertebrates rather than Site-specific hypersaline brine shrimp and brine fly larvae. There is low to moderate confidence that the potential for adverse effects to benthic invertebrate is likely, but the COPEC is still considered to be a potential concern due to the high magnitude and frequency of LOAEL HQ above 1.
- **Phenol** – The EPC values used in the unbounded NOAEL HQ calculation for phenol are likely overestimated as only three out of nine sampling locations with HQs above 1 are detected concentrations. The benchmark has low relevance since it is based on a freshwater aquatic benchmark for the Great Lakes rather than Site-specific hypersaline brine shrimp and brine fly larvae (see Section 7.1.2.2). There is low confidence in the findings that adverse effects may potentially occur based on overestimated EPCs, low relevance benchmark, and low frequency of NOAEL HQs above 1, phenol is not considered to be a COPEC of potential concern to benthic invertebrates.
- **Carbon disulfide** – The chemistry used in the HQ calculation is reliable and Site-specific. Similar to the phenol benchmark discussed above, the carbon disulfide benchmark has low relevance as it is based on a freshwater aquatic benchmark for the Great Lakes (see Section 7.1.2.2). There is low confidence in the findings that adverse effects may potentially occur. Because there is low confidence in this finding due to a low relevance benchmark, and the frequency of NOAEL HQs above 1 is limited, carbon disulfide is not considered to be a COPEC of potential concern to benthic invertebrates.

6.2.3 Direct Contact Hazard Quotient Line of Evidence for Aquatic Invertebrates with Surface Water

Aquatic biota were evaluated for direct contact exposure with surface water in lakebed habitat where the surface water was not acidic and where surface water was collected (PRIs 7 [chronic exposure assumption], 8, and 14, and the SVDD). Aquatic biota were not evaluated in lakebed exposure units with an assumed acute exposure pathway for birds and mammals because acidic wastewater prohibits the growth of aquatic biota (PRIs 5 and 6).

The results are summarized in Table 6-3 and illustrated on Figures 6-3a to 6-3w. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E.

6.2.3.1 Main Findings

The following main risk evaluation findings for aquatic invertebrates are derived from the direct contact HQ results presented in Table 6-3 and Figures 6-3a to 6-3w:

- The majority of LOAEL-based HQs above 1 are infrequent and low in magnitude, with high variability of concentrations within an exposure unit, resulting in low risk to aquatic invertebrates.

- Unbounded NOAEL and LOAEL HQ values for aquatic invertebrates are highest in frequency and magnitude for direct contact with total PCBs, chlorine, aluminum, and iron. The COPECs with low frequency unbounded NOAEL or LOAEL HQs above 1 (indicating high variability of concentrations) include chromium, copper, manganese, mercury, vanadium, and zinc; these COPECs do not reach a level of concern for aquatic biota.
- Background surface water was not collected for the BERA and thus, HQs for Site COPECs were not compared to background HQs, resulting in high uncertainty as to whether COPEC concentrations are attributable to naturally occurring background.

As with other direct contact HQs, HQs less than 1, particularly NOAEL HQs less than 1, have high confidence that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). For unbounded NOAELs and LOAEL HQs above 1 that are relatively high in magnitude or frequency (i.e., total PCBs, chlorine, aluminum, and iron), the confidence depends on the reliability and relevance of the specific underlying calculation parameters, as discussed below.

- **Total PCBs** – HQs may reach a potential level of concern in PRIs 7 and 8, based on frequency and magnitude of NOAEL HQs. However, no LOAEL HQs could be calculated due to unavailability of a benchmark, meaning it is uncertain if an actual effect concentration has been exceeded. In addition, total PCB bioavailability is likely overestimated due to low solubility of PCBs in surface water (see Section 7.1.2.2). Thus, total PCBs are unlikely to pose a concern for aquatic biota.
- **Chlorine** – LOAEL HQs range from 8 to 10 in PRIs 7, 8, and 14. While the benchmark is based on the National Ambient Water Quality Criteria (NAWQC) for saltwater, it has low relevance to aquatic organisms in hypersaline environments (see Section 7.1.2.2). Additionally, the chemistry in PRI 8 surface water has overestimated concentrations under current conditions since the majority of the samples were collected prior to the installation of the overflow pipe, which removed the wastewater from PRI 8. The LOAEL HQs are highly uncertain and likely overestimated. Therefore, chlorine is not considered to be a potential concern.
- **Aluminum** – No LOAEL benchmark is available for aluminum. The NOAEL HQs for aluminum are likely resulting in overestimated NOAEL HQs since the aluminum benchmark does not account for the extremely hard water at the Site, which will cause reduced bioavailability of aluminum to aquatic organisms. In addition, aluminum concentrations in measured surface water samples are highly variable even within the same sample locations (Section 7.1.2.2). Aluminum is not a potential concern to aquatic invertebrates.
- **Iron** – Similar to aluminum, iron HQs are likely overestimated as elevated iron concentrations at the Site are above the expected solubility of iron in seawater (see Section 7.1.2.2). As such, iron is not considered to be a potential concern to aquatic invertebrates.

6.2.4 Soil Invertebrate Tissue Hazard Quotient Line of Evidence

Soil invertebrate tissue was evaluated by comparing soil invertebrate tissue benchmarks to tissue concentrations modeled from soil sample concentrations (soil invertebrate uptake models described in Section 2.3.2). Modeled tissue was evaluated for tissue body burden in PRIs 5, 6, 8, 10, 12, 14, 15, and 16. PRIs 2, 4, and 9 were not evaluated for modeled tissue body burden since the habitat does not support soil invertebrate communities (Section 2.2.3).

Soil invertebrate uptake models were available for TEQ, PCBs, HCB, mercury, hexachlorobutadiene, and pentachlorobenzene. However, soil invertebrate tissue benchmarks were only available for total PCBs, mercury, and pentachlorobenzene. Thus, HQs were only derived for these three COPECs. The NOAEL and LOAEL HQ results are presented in Table 6-4 and illustrated on Figure 6-4, although there is only

one sample in PRI 5 that has an HQ greater than 1. The NOAEL and LOAEL HQ results for COPECs that do not have HQs greater than 1 are presented in Appendix E.

6.2.4.1 Main Findings

The following main risk evaluation findings for soil invertebrates are derived from the tissue HQ results presented in Table 6-4 and Figure 6-4:

- The only COPEC with an HQ above 1 is total PCBs. Only the NOAEL benchmark for total PCBs is exceeded, and this low-magnitude HQ is only at one sample location in PRI 5. Thus, total PCB HQs do not reach a level of potential concern for tissue concentrations of soil invertebrates.

For tissue HQs less than 1, particularly NOAEL HQs less than 1, confidence is high that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). Given that there are no LOAEL HQs above 1, there is moderate to high confidence that COPECs are not a potential concern for soil invertebrate tissue.

6.2.5 Aquatic Invertebrate Tissue Hazard Quotient Line of Evidence

Aquatic invertebrate (both benthic invertebrates and aquatic biota) tissue was evaluated by comparing aquatic invertebrate tissue benchmarks to tissue concentrations modeled from sediment sample concentrations (aquatic invertebrate, i.e., brine fly, uptake models are described in Section 2.3.2). Modeled aquatic invertebrate tissue was evaluated for tissue body burden in PRIs 7, 8, 13, and 14, the SVDD, and the GSLIC.

Aquatic invertebrate uptake models and tissue-based benchmarks were available for TEQ, PCBs, HCB, mercury, hexachlorobutadiene, and pentachlorobenzene. Thus, HQs were derived for all of these COPECs. The NOAEL and LOAEL HQ results that are above 1 are presented in Table 6-5 and illustrated on Figure 6-5. The NOAEL and LOAEL HQ results are presented in Appendix E.

6.2.5.1 Main Findings

The following main risk evaluation findings for aquatic invertebrates are derived from the tissue HQ results presented in Table 6-5 and Figure 6-5:

- HCB is the only COPEC with an HQ above 1, and these are limited to NOAEL HQs in PRI 7 and PRI 14. Given that no LOAEL HQs are above 1, and that NOAEL HQs are low in frequency and magnitude, HCB does not reach a level of potential concern for tissue concentrations of aquatic invertebrates.

For tissue HQs less than 1, particularly NOAEL HQs less than 1, confidence is high that the potential for adverse effects on organisms is unlikely due to the number of conservative assumptions used to calculate HQs (see Section 7.1). Since no LOAEL HQs are above 1 for aquatic invertebrate tissue, there is moderate to high confidence that COPECs are not a potential concern.

6.2.6 Site-Specific Toxicity Studies Line of Evidence

There are no available data for the Site-specific toxicity studies LOE for invertebrates (see Section 2.1.1).

6.2.7 Ecological Field Surveys Line of Evidence

There are no available data for the ecological field surveys LOE for invertebrates (see Section 2.1.1). Of the field studies discussed in Section 2.1.3.3, none had either a quantitative comparison between the Site and reference areas or a qualitative comparison between the Site and normal conditions appropriate for invertebrates.

6.3 Weight of Evidence

WOE is conducted as described in Section 2.5.4. Two LOEs were available for use in characterizing risk to invertebrates: direct contact HQs and tissue HQs. Uncertainties associated with these LOEs are discussed in full in Section 7 and the confidence in each LOE is described in Sections 6.2.1 through 6.2.5.

6.3.1 Soil Invertebrates

Soil invertebrates were evaluated for chronic exposures in upland habitats of PRIs 5, 6, 8, 10, 12, 14, 15, and 16, and live soil invertebrates have been observed in these areas (see Section 6.2.7). Both LOEs were available for use in these areas, and are in agreement that risks to soil invertebrates are unlikely. No COPECs reach a level of concern for the direct contact HQs or the tissue HQs (see Sections 6.2.1 and 6.2.4). Based on the two HQ LOEs, risks are not anticipated for either individual soil invertebrates or the soil invertebrate community due to Site COPECs, and there is high confidence in these findings due to the LOE agreement.

6.3.2 Benthic Invertebrates

The exposure areas evaluated for benthic invertebrates include the sediments of PRIs 7, 8, 14, 13, the GSLIC, and the SVDD. Only total PCBs in PRI 7 reaches a level of concern from the direct contact HQs (see Section 6.2.2). For the tissue HQs, no COPEC reaches a level of concern (see Section 6.2.5). Since PRI 7 provides poor habitat for brine flies due to periodic influxes of acidic wastewater, the risk to benthic invertebrates due to total PCBs in PRI 7 is ultimately low. Confidence in these WOE findings is high, as the LOEs are in agreement and the HQs LOEs are calculated using conservative assumptions likely to overestimate risk (see Section 7.1).

6.3.3 Aquatic Biota

Evaluations for aquatic biota were limited to lakebed habitats outside of the waste ponds with available surface water samples: PRIs 7, 8, 14, and the SVDD. A challenge with the interpretation of results for aquatic biota is that background values are not available for surface water; thus, results for naturally occurring constituents should be interpreted with caution. The direct contact NOAEL-based HQs indicate that aluminum (PRIs 7, 8, and SVDD), iron (SVDD), total PCBs (PRIs 7, 8, and SVDD), and chlorine (PRIs 7, 8, and 14) may pose a risk to aquatic invertebrates (see Section 6.2.3). However, these results are likely overestimated, due to: (1) the use of unbounded NOAEL benchmarks and/or benchmarks with low relevance to species that live in hypersaline waters, (2) low solubility of PCBs in surface water, and (3) decreased bioavailability in extremely hard Site surface waters, as discussed in Section 7.1. For constituents with available LOAELs, no other COPEC(s) raise to a level of concern due to the rarity of HQs above 1 (frequencies of one in six or one in two samples) and the low magnitude (HQs of 2 to 8) of those exceedances, as seen in Table 6-3. Same as for the benthic invertebrates above, the tissue HQs yield no COPECs of concern (see Section 6.2.5), and the field surveys discussed in Section 6.1 suggest that PRI 7 provides limited habitat for aquatic biota, due to the presence of acidic wastewater. The integration of the above LOEs, along with an understanding of the uncertainties and likely overestimations of risk (see Section 7.1), yields a conclusion that risks at the Site to aquatic biota are likely low. There is low to moderate confidence in these findings, as the direct contact LOE has a number of uncertainties that make interpretation challenging.

6.4 Summary of Findings for Invertebrates and Aquatic Biota

Risk evaluation was conducted for the invertebrate community AEs: soil invertebrates, benthic invertebrates, and aquatic biota. The LOEs used to evaluate invertebrates and aquatic biota are direct

contact HQs (upland soils, lakebed sediments, and lakebed surface water) and HQs using modeled tissue from soil/sediment chemistry. PRIs 5 (upland), 6 (upland), 7, 8, 10, 12 to 16, and the GSLIC and SVDD were evaluated for chronic exposures. All results are representative of current and future conditions with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP (Table 2-9).

The WOE integrated the results of the three LOEs listed above into the following findings:

- **Soil invertebrates** – There is compelling evidence that risks are unlikely for the soil invertebrate community in the upland habitats of PRIs 5, 6, 8, 10, 12, 14, 15, and 16.
- **Benthic invertebrates** – Benthic invertebrate community risk is low for the lakebed habitats of PRIs 7, 8, 13, 14, the GSLIC, and the SVDD. In the active ponds (PRIs 5 and 6), the acidic water precludes presence of benthic invertebrates. PRI 7 is intermittently acidic, so even though there may be some risk from total PCBs in PRI 7, growth of benthic invertebrates in this PRI is likely to be limited.
- **Aquatic biota** – Due to a number of uncertainties leading to overestimations of risk, interpretation of the results for aquatic biota are challenging. However, the evidence suggests that overall risks to the aquatic biota community in the surface waters of PRIs 7, 8, 14, and the SVDD are probably low.

Confidence in the above WOE findings is moderate to high. The LOEs are all in agreement, but for aquatic biota there are increased uncertainties, which decreases confidence. Uncertainties associated with the above LOEs are discussed in Section 7.

7. UNCERTAINTY ANALYSIS

Analyses in support of a BERA are typically subject to a number of uncertainties. An analysis of these uncertainties is a standard element of all risk assessments. Accordingly, this uncertainty analysis will:

- Identify sources of uncertainty related to assessments of exposure and effects;
- Identify assumptions used to address these uncertainties; and
- Discuss potential consequences these assumptions may have on characterizations of risk.

In general, assumptions used in this BERA are intended to overestimate (rather than underestimate) characterizations of potential ecological risk. A summary of the uncertainties by LOE, including their potential to over- or underestimate the potential for adverse effects, is presented in Table 7-1.

7.1 Uncertainties for Lines of Evidence based on Hazard Quotients

Many uncertainties and assumptions were made in the formulation of the dietary dose HQs LOE, tissue HQs LOE, and direct contact HQs LOE. The uncertainties around these HQs are detailed below, organized by exposure-related and effects-related uncertainties.

7.1.1 Exposure-Related Uncertainties

Sources of uncertainty related to characterization of exposures in this BERA are described below.

7.1.1.1 Representative Species

Given the number of species and the complexity of biological communities at the Site, it is impracticable to individually evaluate all species that may be present within the Site. Representative species were selected with the intent to overestimate (i.e., produce a protective estimate of) exposure in taxonomically and functionally related species (i.e., other guild members) (ERM 2020a). Accordingly, in addition to being present within the Site, exposure factors of representative wildlife species were selected to minimize underestimates of exposure to other species at the Site—i.e., preferable traits include, but are not limited to, small body size, small home ranges, and high body-weight normalized ingestion rates.

It should be noted that exposures of terrestrial plants, soil invertebrates, aquatic biota, and benthic invertebrates were not inferred from representative species—risks were evaluated using state-of-the-practice organism-level toxicity values (ERM 2020a).

7.1.1.2 Site Use Factors

Site use by wildlife is a fundamental factor when estimating exposure. Given limited detailed monitoring, the SUF by receptors was used to estimate the fraction of time that a receptor is likely to spend (be exposed) at a particular exposure unit and is the ratio of the exposure unit area relative to an individual's home range or foraging area. Moreover, to ensure a protective BERA, it is assumed that wildlife receptors obtain all their drinking water from water occurring at the exposure unit.

SUFs are purely mathematical constructs and do not account for cues (e.g., presence and quality of refuge habitat, prey resources) that are known to influence decisions by animals regarding frequency and duration of occurrence at locations. As described in Section 2.2.1.4, the PRIs that are within the facility boundaries are significantly disturbed with low-quality habitat. The SUFs used to estimate exposure are based on the species' home ranges within a high-quality habitat. It is unlikely that Site usage in the low-quality habitats at the Site is the same as Site usage in an undisturbed high-quality habitat. Assuming that the SUF is applicable to all PRIs within the Site boundaries that have disturbed habitat (PRIs 2 to 7, and 9 to 12) will tend to result in overestimates of exposure for these PRIs.

Moreover, AEs are typically concerned with receptors at the population level (consisting of multiple individuals) or community level (consisting of multiple populations)[15]; however, SUFs are calculated using data (e.g., home range) for a typical individual. In general, both populations and communities are considered to occupy an area several times larger than an individual's home range—only a portion of the population or community may be exposed at smaller exposure units depending on the MVP for that habitat and quality of habitat. Low-quality habitats will have fewer individuals that can be maintained, while higher quality habitats can have more. Accordingly, SUFs used in this BERA are likely to overestimate the exposure for a population- or community-level receptor of concern at smaller exposure units.

7.1.1.3 Bioaccessibility

Bioaccessibility is the amount of an administered dose that is available for uptake across cell membranes (i.e., uptake into the organism) and is commonly expressed as a proportion or percentage of the total administered dose. Studies indicate that bioaccessibility of contaminants in soil is dependent on several factors (e.g., soil pH, particle size, constituent speciation) and the proportion of the total dose available for uptake is typically less than 100 percent of the administered dose (Ruby et al. 1993; NRC 2002; Drexler et al. 2003). Nonetheless, for this BERA it was assumed that 100 percent of the administered dose (e.g., ingested dose) is available for uptake into the organism. This assumption is considered likely to result in an overestimate of potential risk to biota for some COPECs.

7.1.1.4 Bioaccumulation Models

To evaluate the dose due to the ingestion of prey, a Site-specific bioaccumulation study was conducted and Site-specific bioaccumulation models were developed to support this BERA (ERM 2018a). Tissue from the following prey types were collected in the early/mid-summer[16] and analyzed for bioaccumulative COPECs:

- Herbaceous portions of dominant grasses, forbs, and shrubs
- Soil invertebrates captured in pit fall traps
- Small mammals captured in Sherman live traps
- Brine flies captured in array traps

Site-specific bioaccumulation models were developed assuming the samples of prey materials are characteristic of the long-term average composition of the diet.[17] Prey species composition is likely to vary seasonally and year-to-year. However, dominant herbaceous plant species that were collected are characteristic of upland habitats and are anticipated to be representative plant "food" for herbivores. Similarly, soil invertebrates captured (e.g., darkling beetles, carpenter ants) are commonly, often-observed soil invertebrates that are characteristic of upland habitats and are anticipated to be representative invertebrate "food" for invertivores. Capture and use of small mammals to develop a Site-specific bioaccumulation model is a potential source of uncertainty in this BERA. These rodents are mobile and relative abundances are likely to change from season-to-season and year-to-year. However, the effect (under- or overestimate of dose) due to the variability of representative small mammal prey is not known.

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15 Generally, community-level for plants and soil invertebrates and population-level for wildlife.

16 This time period coincides when prey (particularly brine flies) are generally abundant and when many of the wildlife of interest are actively feeding and supporting offspring.

17 To attain sufficient sample mass, composite samples comprising different herbaceous plant species or different soil invertebrate species collected at a particular sampling location were constructed and analyzed for COPECs.

Site-specific bioaccumulation models were selected based on an understanding of biological processes and statistical "best fit" to the empirical data. Selected models were not "forced" through the origin and, hence, best represented tissue burdens over the range of environmental concentrations observed within the Site. Investigations suggest that "best fit" regression models are preferred over point-estimate BAFs as they do not *a priori* presume a monotonic relationship.

For bioaccumulative COPECs that were not analyzed in ERM 2018a, tissue burdens were estimated using bioaccumulation models from standard, well-recognized sources (USEPA 1999). Despite the fact that these models were developed based on abiotic and biotic media that are not characteristic of conditions or habitats observed in the Site, these particular COPECs (hexachlorobutadiene and pentachlorobenzene) are not considered to be primary risk drivers at the Site. Hence, whether and/or the degree to which these bioaccumulation models are reasonable predictors of bioaccumulation for representative prey within the Site is likely to have a negligible influence on the estimate of potential risk to biota.

Toxicity Equivalency Models for Brine Fly

The uptake models for Avian TEQ and Mammalian TEQ into brine flies were used to predict concentrations TEQ in invertebrate prey items (i.e., brine flies and brine shrimp) in the diet of the snowy plover, American avocet, tree swallow (lakebed habitat only), and grasshopper mouse (lakebed habitat only). There are some specific uncertainties with the Avian TEQ and Mammalian TEQ uptake models in brine flies that are associated with the uptake models and the samples used to develop the models.

The bioaccumulation models for Avian TEQ and Mammalian TEQ in brine flies are based on a constant because none of the brine fly models were significantly different from the null models for Avian and Mammalian TEQ (ERM 2018a). The use of a constant to predict concentrations of brine flies assumes that the uptake into the tissue is not dependent on the concentration in sediment and occurs at a constant rate. However, for brine fly samples collected for the model, there was high variability in the brine fly tissue concentrations when sediment concentrations were the highest. For example, the tissue sample with the highest concentration of the dataset and the tissue sample with the lowest concentration of the dataset were both co-located with high sediment concentrations.

Given this variability in tissue concentrations, it is possible that the brine flies in these samples either accumulated the TEQ concentrations from an area outside the collection area or there was high-concentration soil/sediment on the exterior of the brine flies (not accumulated in the tissue). Brine flies collected around the waste ponds (PRIs 5 and 6) were potentially blown in from another location than the collection areas since the acidity of the wastewater would preclude the brine flies from hatching in that area. As such, it is possible that brine flies did not accumulate TEQ body burdens from the waste ponds, and that the brine flies with high tissue concentrations of TEQ accumulated dust on the dermis while in the collection area. That dust would have contributed to the TEQ concentrations measured in the laboratory, potentially overestimating body burden concentrations and uptake.

The use of a constant based on high variability in tissue concentrations presents a significant source of uncertainty in the modeled concentrations of brine flies and brine shrimp. This results in uncertainty in the HQ values calculated for insectivorous birds and mammals in the lakebed habitat.

7.1.1.5 Avian Toxicity Equivalency Concentrations

The Avian TEQ concentrations were calculated using concentrations for D/F congeners and coplanar PCBs; the Avian TEQ concentrations also included HCB (described in Section 2.1.4). The constituents in the TEQ calculation can be referred to as DLCs, since the mode of toxicity is similar to TCDD. TEFs express the toxicity of DLCs in relation to the potency of TCDD, which is thought to be the most toxic form of DLCs. However, there are a number of *in vitro* and *in vivo* studies on birds in recent years that have

shown there are interspecies and inter-individual variations in TCDD sensitivities and in the relative potencies of other DLCs to TCDD. This variation of responses to DLCs presents significant challenges and uncertainties in estimating the appropriate toxic concentration for each avian receptor as well as the appropriate TRV to estimate effects. Uncertainties in the calculation of Avian TEQ exposure are presented in this section, and uncertainties related to TEQ TRVs presented in Section 7.1.2.1.

Interspecies Differences in TCDD Sensitivity

Toxicity of DLCs is associated with concentration-dependent induction of cytochrome P4501A (CYP1A) enzymes. The CYP1A induction has been linked to the sequence of the ligand-binding domain of the AhR and its ability to bind DLCs and initiate changes in gene expression. *In vitro* studies on avian species indicate there are varying degrees of sensitivity to TCDD, which are dependent on the species' amino acid sequence of the AhR (Head et al. 2008; Farmahin et al. 2013b). In other words, the sequence of the AhR ligand-binding domain influences the between-species relative sensitivity to TCDD (Herve et al. 2010a; Farmahin et al. 2013b; Wei et al. 2016).

There are three variations of the amino acid sequences that correlate with three categories of differential sensitivity among avian species. Based on the available evidence, the domestic chicken (*Gallus gallus domesticus*) is the most sensitive species to the toxic effects of DLCs, and is considered a Category 1 species. The rank order of sensitivity to TCDD is Category 1 > Category 2 > Category 3. Phylogenetic relationships among species do not always correspond to sensitivity classifications or AhR genotypes, which makes predictions on a species' sensitivity level very challenging if the species' AhR ligand-binding domain has not been sequenced (Farmahin et al. 2013b).

A recent study by Bianchini and Morrissey (2020) suggests that differences in avian diet, habitat, and migration may have influenced avian exposure to naturally occurring DLCs, which in turn became the primary factor contributing to the evolution of the three variations of amino acid sequences of the AhR. Using species traits, phylogeny, and the AhR sequence, Bianchini and Morrissey (2020) found the strongest predictors of the sequence (which determines TCDD sensitivity) are egg incubation period and habitat type. Birds with longer incubation times and those that reside in lake/pond and marsh habitats tend to be in Category 3, which is the least sensitive to TCDD. The most sensitive to TCDD, which are birds in Category 1, were associated with open woodland and scrub habitats, shorter fledge periods, lower testes masses (due to lower sexual competition), and use inland migration routes or were non-migratory. Phylogeny was not found to be a strong predictor of any of the categories (Bianchini and Morrissey 2020).

The ligand-binding domain was sequenced and presented in Farmahin et al. 2013b for three of the avian representative receptor species in this BERA. The tree swallow and mourning dove were found to be Category 2 species and the American kestrel was found to be a Category 3 species (Farmahin et al. 2013b). The other avian receptors (snowy plover, American avocet, and horned lark) have not been sequenced. However, these species are intended to serve as indicators for all of the other species in each of the feeding guilds they represent, and sensitivity categories are not known for most of the avian species that utilize the Site. However, the data of Farmahin et al. (2013b) along with the analysis by Bianchini and Morrissey (2020) indicate that most birds are likely to be Category 2 or Category 3, and that Category 1 birds are not likely to be common. For example, based on the amino acid sequencing results in Farmahin et al. (2013b), only 4.5 percent of the 89 species sequenced were found to be in Category 1. Those four species were red jungle fowl (*Gallus gallus*), European starling (*Sturnus vulgaris*), gray catbird (*Dumetella carolinensis*), and ruby-throated hummingbird (*Archilochus colubris*). Most species in the dataset (55 percent) were found to be in Category 2. Thirty-six of the 89 species (40 percent) were found to be in Category 3 (Farmahin et al. 2013b). Based on this information, it is considered likely that upland habitat at the Site have Category 2 species, and that lakebed habitat is likely to have mainly Category 2 and 3 species. However, the occurrence of occasional Category 1 species cannot be excluded.

Interspecies Differences in Relative Potency of Dioxin-like Compounds

The Avian TEQ concentrations were calculated using TEFs for D/F and coplanar PCBs based on Van den Berg et al. (1998), and using TEFs for HCB based on Mundy et al. (2012). The avian TEFs from Van den Berg et al. (1998) were adopted by the World Health Organization and were based on the assumption that the TEF assigned to each DLC is the same for all species within a vertebrate class and the most potent constituent is TCDD. However, the avian TEFs were derived with relative potency (ReP) values (i.e., the potency of the DLC relative to TCDD) that were based on a small number of studies on the chicken.

More recent studies indicate that the ReP values of some DLCs vary among avian species (Herve et al. 2010a, 2010b; Farmahin et al. 2012; Manning et al. 2012; Farmahin et al. 2013a, 2013b; Manning et al. 2013; Zhang et al. 2013). Interspecies variation of relative potency values for DLCs appears to be attributable to differences in the AhR amino acid sequence. For the chicken AhR sequence, ReP values of all DLCs were less than that for TCDD, meaning TCDD was the most toxic DLC, which is consistent with the TEFs developed by Van den Berg et al. (1998). For the Japanese quail AhR sequence (Category 3 species), except for octachlorodibenzodioxin (OCDD) and octachlorodibenzofuran (OCDF), ReP values of other DLCs were greater than that of TCDD, with values 1-fold to 22-fold greater than that of TCDD (Wei et al. 2016). Study data available for 2,3,4,7,8-pentachlorodibenzofuran (PeCDF) suggest that between-species relative sensitivity to PeCDF differs from TCDD/2,3,7,8-Tetrachlorodibenzofuran (TCDF) (Cohen-Barnhouse et al. 2011). Farmahin et al. (2014) found that PeCDF and TCDD bind with equal affinity to chicken AhR, but PeCDF binds with greater affinity than TCDD to pheasant (3-fold) and Japanese quail (5-fold) AhR.

Since there are no studies reporting the species-specific TEFs for all of the avian receptors in the Site, TEFs were based on the historically used values for D/F and coplanar PCBs from Van den Berg et al. (1998). Thus, it is possible that the TEFs used to calculate the TEQ dose are not accurately estimating the contribution of the various DLCs to the overall TEQ concentration. However, the TEF for OCDF (i.e., the relative potency) was found to be an order of magnitude larger for the pheasant and the Japanese quail compared to the chicken (Wei et al. 2016). This suggests that the OCDD TEF from Van den Berg et al. (1998) is potentially underestimating the contribution of OCDF to the overall TEQ concentration for birds in Category 2 and Category 3.

The TEF for HCB also appears to vary among species according to the amino acid sequence of the AhR. Mundy et al. (2012) tested 7-ethoxyresorufin-O-deethylase (EROD) and CYP1A induction (markers of a dioxin-like response) by HCB in avian hepatocyte cultures from chicken, ring-necked pheasant, and Japanese quail (Category 1, Category 2, and Category 3 species, respectively) and compared it to CYP1A induction by TCDD. The author found that HCB induced a relatively similar dioxin-like response in each species, but the relative potency to TCDD was different among species due to the species' differential sensitivity to TCDD. Mundy et al. (2012) found HCB to have the highest relative potency (i.e., HCB TEF) in the Category 3 bird species since this category is the least sensitive to TCDD, which in turn results in HCB contributing a larger fraction of the overall TEQ concentration (Category 3 HCB TEF = 0.01). HCB contributed less to the TEQ concentration in the ring-necked pheasant than in the Japanese quail since the Category 2 bird species is more sensitive to TCDD (Category 2 HCB TEF = 0.001). The chicken, a Category 1 bird species, is the most sensitive to TCDD, thus the HCB contributed the least amount to the TEQ concentration (Category 1 HCB TEF = 0.0001).

While other studies have established the concept of using relative potencies of DLCs in avian embryo hepatocytes to predict the *in ovo* response in birds (Kennedy et al. 1996; Head and Kennedy 2010), these studies have not been conducted using HCB. It is likely that this concept applies to HCB as well, but the lack of direct evidence presents a level of uncertainty in the HCB TEFs derived from avian embryo hepatocytes. Further studies using egg injection or other *in vivo* methods would decrease this uncertainty.

Inter-individual Variation of AhR Response

A recent study has shown that the cytochrome P4501A response to TCDD can also vary among an individual test species, where herring gull embryo hepatocytes ranged from no response above baseline values to as much as 57-fold above baseline levels (Head and Kennedy 2019). This inter-individual variation is an additional uncertainty that complicates the estimates of dioxin sensitivity in birds. It is unknown if this uncertainty results in underestimation or overestimation of risk for each receptor.

7.1.1.6 Intermittent Longer-term Dose Estimation

As described in Section 2.3.2, the intermittent longer-term dose estimation was developed to evaluate potential hazards of probing birds attempting to forage in the acidic waste ponds (PRIs 5, 6, and 7) repeatedly over several months. Since there are no data on how often an individual bird may return to an acidic waste pond at the Site, the hazard was characterized by calculating the dose from one Site visit per month.

One major source of uncertainty in this calculation is the estimation of sediment ingestion. Typically, sediment ingestion rates used in dose estimations are based on the amount of sediment that a bird will ingest while it is foraging for food. It is assumed that a bird will forage longer when there is a food source near/in the sediment, which, in turn, results in a higher sediment ingestion. Thus, it is also likely that a bird is ingesting less sediment when there is no food source, as in the acidic waste ponds. However, the sediment ingestion rate that is currently being used to estimate the dose is based on birds that are in an optimal habitat (Beyer et al. 1994). It is highly likely that the amount of sediment the probing birds are ingesting while foraging in the waste ponds is overestimated using the sediment ingestion rate from Beyer et al. (1994).

Additionally, as discussed in Section 2.3.2, the AHUF used in this evaluation is based on the study by BIO-Logic (2002, 2003), which estimated a mean exposure for American avocets of only 6 hours per month (AHUF = 0.033), which is a very conservative estimate as it is based on all individuals, not per individual. An AHUF based on individual American avocets would be 0.0033, since BIO-Logic based their estimation on 10 individual birds. Additionally, the AHUF is based solely on American avocets since BIO-Logic did not observe any other species in the waste water for more than 1 minute per month. Given the overly conservative nature of the AHUF and the low relevance to the snowy plover, the HQs presented in Table 3-5 are likely substantially overestimated.

Intermittent Longer-Term Hazard Quotient Results Using a 95UCL EPC

As discussed in Section 2.3.2, the SWAC was selected as the sediment EPC for this evaluation, as opposed to the 95UCL, because an area-weighted concentration is less influenced by high-concentration outliers that are located in relatively small foraging areas of the waste ponds. However, the intermittent longer-term exposure was also evaluated by estimating the dose using the 95UCL EPC for sediment, mainly to provide results that are consistent with the methodology for other area-wide evaluations. These results are considered to be highly conservative due to the high-concentration outliers (e.g., sample 1-11 in PRI 5) that heavily influenced the 95UCL, as well as the overly conservative AHUF and low relevance to the snowy plover (as discussed above). The results of this analysis are shown in Table 7-2.

7.1.1.7 Scenarios Not Evaluated

Inhalation and dermal contact by wildlife were considered negligible exposure pathways and were not quantitatively evaluated in this BERA.

Inhalation Pathway

The inhalation pathway was considered negligible for wildlife. VOC vapors are rapidly dispersed in aboveground air following volatilization from soil or surface water and are considered to result in very low EPCs of VOCs in aboveground air (USEPA 1998). Further, though fugitive dust is assumed to be inhaled, the majority of inhaled fugitive dust adheres to mucous and the mucous is subsequently swallowed (therefore, it is accounted for in the incidental ingestion of soil pathway). Hence, while potentially complete, inhalation exposures are considered an insignificant exposure pathway or are already accounted for in exposure assessments for wildlife (USEPA 2005b).

The omission of quantitative evaluations of exposure due to inhalation may result in underestimates of potential risk; however, this omission is considered unlikely to significantly impact the overall findings of this evaluation as it pertains to AEs of this BERA.

Dermal Contact Pathway

Dermal absorption by wildlife is considered to be a negligible exposure pathway relative to ingestion of food and incidental ingestion of soil because:

- Dense undercoats or down are likely to effectively limit contact of contaminants with the skin of wildlife species and significantly reduce the total surface area of exposed skin (Peterle 1991); and
- Results of exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (USEPA 2005b; Peterle 1991).

The omission of quantitative evaluations of exposure due to dermal contact may result in underestimates of potential risk; however, this omission is considered unlikely to significantly impact the overall findings as it pertains to AEs of this BERA.

7.1.2 Effects-Related Uncertainties

Sources of uncertainty related to characterization of effects in this BERA are discussed below.

7.1.2.1 General Uncertainties of Relevant Benchmarks and Toxicity Reference Values

In general, there are a number of uncertainties inherent in the derivation and application of benchmarks and TRVs used in ERAs. These general uncertainties and described in this section, while specific uncertainties associated with the specific benchmarks and/or TRVs used in this BERA are discussed in Section 7.1.2.2.

Use of NOAELs as Chronic NOAEL-Equivalent Benchmarks

By definition, the NOAEL is the highest dose where no effect was observed in a toxicological study. Hence, the reported NOAEL may be affected by several study design factors (independent of the toxicity), including, but not limited to, the sensitivity of a method to observe (detect) an effect and the scale and finite precision of the serial dosing regimen.

Given the study design, the “actual” no-effect concentration can occur anywhere within the “flat” portion of the “no-effect” range. Therefore, NOAELs reported in toxicity studies commonly underestimate the “actual” no-effect concentration (the threshold). Because of this, exceedance of a NOAEL-based benchmark should not be interpreted as proof that an adverse effect is likely. For example, USEPA (2005b) considers chronic NOAELs to generally be about 10 times more sensitive than LOAELs. Thus, use of NOAELs as chronic benchmarks provides a substantially greater level of protection than the use of LOAELs.

Species-to-Species Extrapolations

A source of uncertainty in the BERA is the lack of applicable wildlife species-specific toxicity data. Because of this data limitation, TRVs were developed using available toxicity data for laboratory test species. For example, TRVs for the kangaroo rat were developed from toxicity data for laboratory mice and rats.

Species vary with respect to sensitivity to specific chemicals (Calabrese and Baldwin 1993). Based on reviews of the lethality data, the range of sensitivity for avian species were typically within a factor of 10 (Chapman et al. 2009; Calabrese and Baldwin 1993). Based on reviews of the subchronic and chronic dietary toxicity data, the range of sublethal toxicity sensitivities for mammal and bird species were typically within a factor of 50 (Chapman et al. 2009; Calabrese and Baldwin 1993). Chapman et al. (2009) suspected that the variability in sublethal studies was greater than lethality studies because:

- Lethality studies were conducted following standardized protocols, whereas the chronic studies were variable in design; and
- Lethality studies measured only mortality, whereas the sublethal studies measured different reproductive, developmental, and other nonlethal endpoints (e.g., clutch or litter size, number of fledglings or weanlings, growth rate, change in organ weight, presence of stress indicators).

Although a range in sensitivity may be described, the relative sensitivity (and the “direction” of sensitivity) to COPEC exposures by representative species and wildlife species observed in the Site as compared to laboratory test species is not known.

Since chemical sensitivity may vary between different ecological species, the use of a single TRV for all species in a group (mammals, birds, plants) is a potential source of uncertainty. For this reason, TRVs used in this assessment were selected from the low end of the range of values identified in the literature, and this tends to minimize the potential for underestimation of potential adverse effects.

Laboratory-to-Field Toxicity Extrapolations

A number of studies (primarily for aquatic systems) have evaluated the ability of single-chemical laboratory toxicity test results to predict adverse effects of that chemical on organisms under field conditions. Preliminary chemical contaminant studies suggest that laboratory toxicity tests represent more conservative exposure scenarios than those that occur in nature (USEPA 1991). Furthermore, concentrations of chemicals causing no effect in laboratory tests also do not appear to affect communities in the field. Thus, chronic NOAEL-equivalent benchmarks are likely to provide a conservative level of protection to plant and wildlife communities and populations observed in the field.

Organism-to-Population Level Effect Extrapolations

The individual organism is the smallest biological “unit” that interacts directly with the environment (Suter 1992). Toxicity data selected to derive benchmarks and TRVs are from studies that evaluate potential reproductive and developmental effects on organisms. Chronic reproductive impairment and abnormal development toxicity values were then used to infer effects at the population and community level; if effects are not anticipated at the organism level, effects are not expected at the population or community level either. However, the reverse is not necessarily true, as effects may occur at the organism level that do not manifest as measurable effects at the population or community level. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Therefore, the increasing robustness with increasing biological organization would suggest that inferences from toxic

effects on organisms should provide a greater level of protection to populations and communities (Suter 1992).

7.1.2.2 Uncertainties of Specific Benchmarks and Toxicity Reference Values

General uncertainties associated with the derivation of ecotoxicological benchmarks and TRVs are described in Section 7.1.2.1. Notable uncertainties in the derivation and/or application of specific benchmarks and TRVs used in this assessment are described below.

Unbounded NOAEL Effects Levels

Some of the HQ evaluations for invertebrates and plants in this BERA were based on unbounded effect levels, meaning there was only a NOAEL-equivalent or a LOAEL-equivalent benchmark (not both) for characterizing potential adverse effects. The margin between the two benchmark values can be broad and evaluating the potential for adverse effects solely based on an unbounded NOAEL-equivalent benchmark can lead to overly conservative assumptions. In other words, in cases where only an unbounded NOAEL-equivalent benchmark is exceeded, there is uncertainty as to whether the EPC is greater than the measurable adverse effects level (i.e., the LOAEL). Conversely, if an unbounded NOAEL benchmark is not exceeded, there is high certainty that a threshold for measurable adverse effects has not been reached. Unbounded NOAEL benchmarks resulted in HQs greater than 1 in the following receptors and COPECs.

- **Aquatic biota** – Many benchmarks for aquatic biota are unbounded NOAEL-equivalent benchmarks (see Table 2-23 for specific COPECs with unbounded NOAEL-equivalent benchmarks). Across PRIs 7, 8, and 14, and the SVDD, HQs above 1 occur for the following COPECs based on unbounded NOAELs: aluminum, iron, and total PCBs.
- **Benthic invertebrates** – COPECs with unbounded NOAEL-equivalent benchmarks have HQs greater than 1 in PRIs 7, 8, and 14, the SVDD, and the GSLIC. Barium (in PRI 8) is consistent with background levels, HCB and pentachlorobenzene have an HQ above 1 for a single sampling location in PRI 7. Carbon disulfide has HQs above 1 in four sampling locations of PRI 7, all falling below an HQ of 10. Phenol has sampling locations with HQs that fall below 10 solely in PRI 14.
- **Soil invertebrates** – The only COPEC with unbounded NOAEL HQs greater than 1 is barium. For barium, only one sampling location in each of PRIs 8 and 10 have NOAEL HQs above 1 (2 and 3, respectively).

COPECs with unbounded NOAEL-equivalent benchmarks have HQs greater than 1 for aquatic biota and benthic invertebrates. For benthic invertebrates, the overly conservative nature of these benchmarks produce moderate to high magnitude HQs (greater than 10) for only barium; all other COPECs with unbounded NOAEL-equivalent benchmarks either have no HQs greater than 1, or HQs of 10 or less. Given the limited frequency and spatial occurrence of unbounded NOAEL-equivalent HQs greater than 1, as well as most being low-magnitude HQs, the use of these unbounded NOAEL-equivalent benchmarks does not influence the confidence in the risk findings for benthic invertebrates. There is, however, uncertainty regarding risk findings for aquatic biota, as many COPECs for the receptor type have unbounded NOAEL-equivalent benchmarks (see Table 2-23). As the benchmarks are based on concentrations that elicit no adverse effects or only elicit adverse effects in a small proportion of species (e.g., a 5th or 10th percentile of a species sensitivity distribution) and it is unknown what concentration would elicit measurable adverse effects in a substantial portion of organisms and/or species, the risk narrative for aquatic biota at the Site is likely overly conservative and may report the possibility of adverse effects from COPECs that are not harmful to the aquatic biota.

Direct Contact Benchmarks for Aquatic Biota and Benthic Invertebrates in Hypersaline Waters

Due to the limited availability of toxicity literature for hypersaline environments, there is uncertainty regarding the appropriateness of the selected benchmarks. Freshwater and saltwater benchmarks were evaluated to establish appropriate surface water and sediment direct contact benchmarks. The uncertainty of this approach is due to the nature of the test species and the potential for hypersaline conditions to modulate COPEC bioavailability.

The test species used to derive the freshwater benchmarks would not occur in the saline waters present at the Site. Similarly, most of the test species used to derive the saltwater benchmarks, typically present in marine or estuarine environments, would not occur in the hypersaline waters at the Site. It could not be stated whether either benchmark would be over- or under-protective of the species present at the Site. As there was uncertainty regarding which benchmark would be more representative of the Site, the more conservative of the two values was selected for use in the BERA. This is likely to overestimate the potential for adverse effects in the HQs LOE.

The dissolved solids that represent salinity and hardness, such as calcium, magnesium, and sodium ions, are known to modulate bioavailability of constituents by altering the degree of sorption, ligand binding on membranes, and the formation of precipitates; USEPA's NAWQC account for this modulation by the use of hardness-adjusted equations or the Biotic Ligand Model (USEPA 2013b). The NAWQC do not allow for hardness inputs outside the empirical range of data for which they were derived; minimum and maximum hardness values are 25 and 400 mg/L as calcium carbonate for most metals with hardness-dependent equations (USEPA 1996). Calculated hardness values for surface water samples at the Site range from 1,100 to 489,000 mg/L as calcium carbonate, substantially higher than the maximum allowed hardness input for freshwater NAWQC. The degree to which hypersaline conditions, as compared to freshwater or saltwater conditions, may modify bioavailability is not well studied.

Seawater is generally 35 ppt saline and freshwater is considered to be less than 10 ppt (USGS 2018). Salinity in the GSL varies spatially, temporally, and across depth strata, and is dependent on freshwater inputs and lake elevation (Utah DWQ 2014). In 2011 and 2012, the following average salinities were measured in the GSL in the shallow oxygenated surface layer where brine flies and brine shrimp live: 125 ppt (Gilbert Bay), 41 ppt (Farmington Bay), and 10 to 50 ppt (Bear River Bay) (Utah DWQ 2014). Water quality monitoring data from the United States Geological Survey National Water Information System database indicates that nearly all salinity measurements from 2011 through 2019 in the GSL are greater than 80 ppt ranging up to approximately 225 ppt, with only a handful of samples measuring salinities as low as 1 to 5 ppt (Utah DWQ 2019).

Measured salinities at the Site vary by exposure unit (see Section 2.2.1.3). All Site samples are more saline than freshwater, and nearly all samples are also more saline than seawater. Site salinity shows a similar high variability and range compared to the GSL, though a few samples are higher than the maximum measured salinity at the GSL between 2011 and 2019 (Utah DWQ 2019). From this comparison, it is clear that neither freshwater nor saltwater benchmarks are optimal for the hypersaline conditions at the GSL and the Site, and both may be substantially overprotective for COPECs with decreased bioavailability in saline conditions. The use of the lower of the freshwater and saltwater benchmarks to calculate HQs is likely to overestimate the potential for adverse effects from the HQs LOE.

Since it is unclear if the benchmarks for aquatic biota and benthic invertebrates are relevant and if the surface water concentrations are consistent with background levels, additional research was done to identify (1) how the benchmark was derived, (2) more relevant toxicity and/or bioavailability data, particularly for brine shrimp and hypersaline water, and (3) approximate background levels of COPECs in

GSL surface water. This additional information was used to reduce uncertainties for COPECs with an HQ above 1 and is discussed below:

- **Aluminum benchmark for aquatic biota** – The freshwater aluminum NAWQC adjusts for Site-specific bioavailability using inputs for water quality parameters (pH, dissolved organic carbon [DOC], and hardness) (USEPA 2013b). Dissolved aluminum and calcium cations compete for uptake; increasing hardness is observed to decrease aluminum toxicity in daphnids and fish, though this effect is lessened at higher pH (USEPA 2013b). Site-specific aluminum benchmarks using the NAWQC cannot be calculated due to a lack of measured DOC. However, there is uncertainty around the true toxicity thresholds for aluminum because of the extremely hard surface water conditions at the Site that are not appropriately accounted for in the available benchmarks. In addition, aluminum concentrations in measured surface water samples are highly variable even within the same sample locations (see Figure 7-1). Thus, while potential toxicity due to aluminum in surface water cannot be ruled out, there is a high degree of uncertainty in the results of the aquatic biota HQs LOE for aluminum.
- **Chlorine benchmark for aquatic biota** – The NAWQC benchmark for chlorine is based on the 1986 NAWQC report, which necessarily rejects any data obtained using brine shrimp as the saltwater benchmarks are not calculated for waters with salinity greater than 35 grams per kilogram, which brine shrimp would be found in. Therefore, the benchmark used to estimate risk to aquatic biota to chlorine is specifically not intended for use in hypersaline waters.
- **Iron benchmark for aquatic biota** – Iron concentrations in measured Site surface water samples are highly variable, ranging from ND to concentrations above the expected solubility of iron in seawater (Liu and Millero 2002). Measured concentrations of dissolved iron may overestimate the true amount of dissolved iron, as standard filtration methods do not adequately remove iron colloids (Church et al. 1997). Thus, there is a high degree of uncertainty in the iron results for the aquatic biota HQs LOE.
- **Total PCBs benchmark for aquatic biota** – As a chemical class, PCBs have low solubility and thus partition to the organic portion of solids, such as sediments and water column particulates and colloids (Erickson 2001). Therefore, it is uncertain how much of the measured PCBs in Site surface water may actually be bioavailable to aquatic biota.
- **Carbon disulfide and phenol benchmarks for benthic invertebrates** – These benchmarks are derived using data from USEPA's AQUIRE (AQUatic toxicity Information REtrieval) database, which could not be accessed for a complete assessment of its relevance. Significant uncertainty though still remains as they are based off benchmarks for freshwaters of the Great Lakes, which are converted to a sediment ecological screening level by use of the equilibrium partitioning equation that incorporates the soil adsorption coefficient.

Egg Tissue Benchmark

The egg tissue benchmark for total PCBs is based on a 20 percent effect concentration (EC20) for cardiomyopathy in chicken embryos exposed to a PCB mixture (Carro et al. 2013). A large degree of uncertainty in this benchmark is due the PCB mixture and the test species used in this study. The PCB mixture used in the Carro et al. (2013) study was formulated to mimic the relative concentrations of primary PCB congeners measured in sandpiper eggs collected at the upper Hudson River, New York. However, this mixture is very different from the composition and relative abundance of PCB congeners found at the Site, which is largely dominated by PCB 209, the decachlorobiphenyl (Figure 7-2). In addition, the PCB mixture at the Site is not similar to any of the Aroclor mixtures, which are typically used in avian reproductive toxicity studies (Peakall et al. 1972; Britton and Huston 1973; Gould et al. 1997). PCB 209 is a non-coplanar PCB congener, which does not bind with the AhR, thus does not exhibit

dioxin-like toxic effects. Some studies have suggested that non-coplanar PCBs can have neurotoxic and/or endocrine effects in mammals (Fischer et al. 1998). However, to date, the one study that has evaluated PCB 209 individually has demonstrated that PCB 209 did not exhibit genotoxic or endocrine-modulating effects in mammalian cells (Han et al. 2009). No studies were identified on PCB 209 toxicity in birds.

Previous research has also established that the test species used in the Carro et al. (2013) study, the chicken, is highly sensitive to PCB exposures, in terms of cytochrome P450 induction (Kennedy et al. 1996). In fact, Carro et al. (2013) reported that the concentrations of the PCB mixture in the study were 10 to 100 times lower than those in wild bird populations, but lethal and nonlethal effects were discernable in the chicken at these lower concentrations because it is such a highly sensitive species.

There is a large degree of uncertainty in the relevance of the total PCB egg tissue benchmark given that: (1) the PCB mixture at the Site is very different from the mixture used in the Carro et al. (2013) study and is largely dominated by a nontoxic, non-coplanar PCB congener, and (2) the benchmark is based on a highly sensitive test species that is not found at the Site. Therefore, HQ results using this benchmark should be interpreted as uncertain and likely overestimated.

Terrestrial Plants Tissue Benchmark

There were no tissue residue toxicity studies on terrestrial plant species exposed to PCBs. Therefore, the total PCB tissue residue benchmark was developed using data from an aquatic plant species (green algae). Using this total PCB benchmark, none of the modeled tissue concentrations at soil sample locations throughout the Site had an HQ greater than 1. The use of an aquatic plant species to evaluate potential adverse effects in terrestrial plant species is an uncertainty in this assessment. However, since the assessment using the direct contact total PCB benchmark for plants also resulted in no HQs greater than 1, the tissue residue benchmark for total PCBs is not a significant source of uncertainty in the assessment of plants.

Soil Invertebrate Tissue Benchmarks

When tissue-based benchmarks for soil invertebrates were not available, benchmarks for aquatic emergent insects, if available, were used to evaluate modeled soil invertebrate tissue. The use of aquatic invertebrate tissue data for estimating tissue-based benchmarks in soil invertebrates is an uncertainty in this BERA. However, the tissue benchmarks that are based on emergent insects (total PCBs, arsenic, cadmium, chromium, copper, mercury, selenium, and zinc) are from toxicity studies on early life stages, which are typically more sensitive than later life stages (when they are considered terrestrial). Since it is likely that these benchmarks are based on a more sensitive life stage, the use of the emergent insect tissue-based benchmarks to evaluate modeled tissue for soil invertebrates is not a significant source of uncertainty in the findings of the BERA.

Avian Toxicity Reference Values

The avian TRVs for Avian TEQ Category 1 and Avian TEQ Category 3 were derived by applying a relative sensitivity ratio to the TRV for Avian TEQ Category 2, as described in Section 2.4.1.2. The TEQ Category 1 and Category 3 TRVs were extrapolated because there are limited data on dietary effects of TEQ in birds, and the data are limited to a Category 2 species, the ring-necked pheasant. Therefore, relative sensitivity ratios were developed from egg injection studies on the chicken (a Category 1 species) and the Japanese quail (a Category 3 species). However, as shown in Table C-7 in Appendix C, the study results were variable within each species, which has been shown in other studies as detailed in Section 7.1.1.5. Thus, the relative sensitivity ratios were based on a geomean of variable study results. Given the variability of study results even among the same test species, it is likely that the relative

sensitivities of bird species at the Site are different from the relative sensitivities calculated from a geomean of study results. Accordingly, there is an uncertainty in the avian TRVs for Avian TEQ Category 1 and Avian TEQ Category 3. See Section 7.1.1.5 for a full discussion on uncertainties associated with Avian TEQ.

In addition to the uncertainty in extrapolating from TEQ Category 2 to TEQ Categories 1 and 3, the toxicity study used to derive the Avian TEQ TRV, which is used to calculate dietary dose HQs, is conservatively overestimating the bioavailable dose to birds at the Site. The TRV is selected from a reliable study by Nosek et al. (1992a) on ring-necked pheasants; however, the dose administration method of intraperitoneal injection lacks relevance to oral ingestion by wild birds. Intraperitoneal injection bypasses the gut and does not account for differences in bioavailability when the COPEC is bound to food or solids. A companion study by Nosek et al. (1992b) found that oral bioavailability of TCDD in ring-necked pheasants varied with the food or solid substrate, ranging from 30 to 58 percent bioavailable. Thus, HQs above 1 for avian TEQ likely overestimate the potential for adverse effects.

The avian TRVs for total PCBs are based on reproductive effects in mourning doves fed Aroclor 1254 (Tori and Peterle 1983). Similar to the egg tissue benchmark discussed above, the PCB congeners used in the TRV derivation study have a different composition and relative abundance compared to the PCB mixture at the Site (Figure 7-2). The dominant PCB congener at the Site is a non-coplanar PCB (PCB 209) with no demonstrated effects to date (Han et al. 2009). Therefore, there is a large uncertainty in the avian TRV for total PCBs and HQ results for this analysis are likely overestimated.

7.1.2.3 Uncertain COPECs Not Quantitatively Evaluated

“Uncertain COPECs” were identified in the SLERA as compounds that were either: (1) never detected at the Site and the DL was greater than the RBESL, or (2) there was no RBESL available for comparison. The following sections describe these constituents and discuss the uncertainty of not quantitatively evaluating the constituents in the BERA.

Nondetects with Elevated Detection Limits

Across the PRIs, there are 58 constituents that were not detected in Site samples for a given PRI but that had mean detection limits above their respective RBESLs (Table 7-3). Elevated detection limits occurred for a number of reasons including the use of RBESLs derived from back calculations and matrix interference. These 58 constituents are not evaluated in this BERA. While this introduces uncertainty due to the potential for adverse effects of unevaluated constituents, the level of potential hazard they might pose is likely to be small compared to the hazards presented from other, well characterized COPECs such as TEQ and HCB.

Lack of Screening Values

Several constituents screened in the SLERA lack sufficient toxicity data to develop a screening value in one or more exposure media. Since screening values were not available, these constituents were not evaluated in the BERA with the exception of a select few. Constituents lacking screening values are listed in Table 7-4—those constituents that had TRVs developed despite the lack of screening values are also noted. Some of these constituents are never or rarely detected at the majority of the Site or in a specific medium. Table 7-4 also includes Site-wide and media-specific detection frequencies for each constituent, which is used to designate the likelihood of originating from Site-related activities. Constituents with a detection frequency of 0 percent are classified as Unlikely, less than 10 percent as Unknown, and greater than or equal to 10 percent as Plausible. The results are summarized below.

In soil, a total of 33 constituents lack a benchmark:

- One metal (iron) was designated as a COPEC in PRIs where Site concentrations exceeded background levels. As all samples for iron were detects, the likelihood of it being related to Site activities is plausible. As dietary TRVs were developed for birds and mammals, uncertainty associated with lack of TRVs is limited to plants and invertebrates.
- Twenty-two are SVOCs, with three not detected in soil samples from any PRI or media, making them unlikely to be related to Site activity. Five have detection frequencies below 10 percent making the potential Site-related origin unknown. The remaining 14 constituents are plausibly related to Site activity. One of the PAHs (naphthalene) had dietary TRVs developed for birds and mammals.
- Nine are VOCs, which were only sampled for soil in 10 of the 16 PRIs. Two VOCs were designated as unlikely to be related to Site activity, two are unknown, and five are plausibly linked to Site activity; one of these VOCs (m,p-xylene) had dietary TRVs developed for birds and mammals.
- The remaining constituent (perchlorate) was detected in 14 percent of soil/sediment and 74 percent of water samples. Thus, it is plausibly related to Site activity.

In sediment, 39 constituents lack a benchmark:

- Nineteen are VOCs, which were analyzed in sediment in seven of the 16 PRIs. Six VOCs were unlikely related to Site activity, five were unknown, and eight were plausibly linked to Site activity. Of the VOCs detected in at least one PRI, three had dietary wildlife TRVs developed for at least one receptor group (Table 7-4).
- Seventeen are SVOCs, which were sampled for sediment in eight of the 16 PRIs. Eleven SVOCs were unlikely to be related to Site activity, one was unknown and five are plausibly linked to Site activity. Additionally, dietary TRVs were developed for HMW PAHs for both birds and mammals.
- Two metals (beryllium and molybdenum) were designated as a COPEC in PRIs where Site concentrations exceeded background. Based on detection frequencies, the two metals are plausibly linked to Site activity. Beryllium dietary TRVs were developed for mammals, leaving uncertainty associated with a lack of benchmarks/TRVs to birds, plants, and invertebrates. Dietary TRVs for molybdenum were developed for both birds and mammals, as well as direct contact benchmarks for plants. Uncertainty associated with a lack of benchmarks for molybdenum is limited to invertebrates.
- The remaining constituent (perchlorate) was sampled for sediment in eight PRIs and was plausibly linked to Site activity.

In surface water, 46 constituents lack a benchmark/TRV:

- Sixteen are SVOCs, with ten unlikely to be related to Site activity, one unknown, and five plausibly linked to Site activity. Additionally, dietary TRVs were developed for HMW PAHs for both birds and mammals.
- Seventeen are VOCs, with six unlikely to be related to Site activity, five unknown, and six plausibly linked to Site activity. Additionally, two of the VOCs designated as plausible had dietary TRVs developed for mammals.
- Five are HAAs, which are plausibly linked to Site activities, as they are process byproducts.
- Perchlorate was designated as plausible.
- The remaining seven analytes are conventional water quality parameters and anions that are frequently detected, as they are present in GSL water.

Overall, the constituents lacking a benchmark/TRV are present in a limited number of PRIs, and a significant portion are NDs. A majority of the constituents are also VOCs or SVOCs. Absence of toxicity

values for these analytes could result in an underestimate of risk. However, given the relatively low detection frequency of these chemicals and that they are generally not bioaccumulative, it is likely these chemicals do not contribute a level of risk that would approach the risks that have been identified for well characterized COPECs. Consequently, they are not considered a significant source of uncertainty in the risk characterization of the Site.

7.1.2.4 Lack of Toxicity Reference Values for Amphibians and Reptiles

Given the hypersaline conditions, amphibians are not observed living in the GSL. In addition, the lack of freshwater aquatic habitat further limits amphibians in the Site. Moreover, consistent with the likely limited occurrence, amphibians are generally considered to play a relatively minor ecological role in arid/playa habitats (Heatwole 1982). Accordingly, a quantitative risk assessment was not conducted for amphibians. The omission of a quantitative evaluation of potential risk for amphibians may result in underestimates of potential overall risk to aquatic community; however, this omission is considered likely to have a negligible effect on overall risk characterizations reported in this BERA.

Quantitative evaluations of potential risk were also not performed for reptiles due to the lack of data on exposure and toxicity. The lack of TRVs for reptiles is considered a data gap in this BERA. However, there is no clear reason to suspect that the level of risk to amphibians would exceed those identified for other aquatic and semi-aquatic receptors. Consequently, this data gap is not likely to be a significant limitation to risk management decision-making at the Site.

7.1.2.5 Threatened and Endangered Species

The American kestrel was used as a surrogate for the golden eagle, which is a special status species that nests in the PRI 16 mountains. In this exposure unit, only TEQ Category 1 NOAEL HQs were greater than 1 only for the horned lark and tree swallow (Section 3.2.1.1), and none of the LOAEL-based HQs exceeded 1 for any avian receptor. Given that neither NOAEL-based nor LOAEL-based HQs for the American kestrel exceed 1 in this PRI, the golden eagle is not considered to be at risk from Site-related COPECs and this is not a significant source of uncertainty in the BERA.

7.1.2.6 Cumulative Effects Due to Exposure to Multiple COPECs

Receptors are expected to be exposed to chemical mixtures at the Site. However, single-chemical HQs do not account for potential changes in toxicity due to the presence of chemical mixtures, rather than single chemicals, at the Site (Burton et al. 2002). Some chemicals are known to have toxicological interactions (e.g., additive, antagonistic, synergistic, or potentiating), which makes the single-chemical HQ an oversimplification.

For this BERA, cumulative effects of multiple COPECs were assessed for chemicals that were chemically related or are known to have the same mode of action,[18] as per standard practice in ERA (USEPA 2003a). The COPECs for which cumulative effects of similar-acting constituents were assessed are total PCBs, D/F and HCB (using TEQs), and HMW/LMW PAHs. In the case of D/F, TEFs not only accounted for cumulative effects, but also the relative difference in toxicity among congeners.

For all other COPECs, where the chemicals are not related or there is no known similar mode of action, HQs were calculated for each chemical singularly. In the absence of a known toxicological interaction that is well characterized across a range of concentrations, attempting to calculate a cumulative effects HQ would increase, rather than decrease, uncertainty.

[18] Frequently, on the same target organ.

7.2 Site-Specific Toxicity Studies Line of Evidence Uncertainties

Uncertainties associated with the Site-specific toxicity studies LOE are described below, for both exposure- and effects-related uncertainties.

7.2.1 Exposure-Related Uncertainties

For both the Parametrix (2004) and Hooper et al. (2008) studies, one sample each of acidic wastewater was collected from the Site and used for the toxicity studies. It is unknown how representative these single samples may be of conditions in the waste ponds across all seasons, as both water levels and freshwater inputs fluctuate seasonally. The measured pH of the samples for both studies was approximately 1, which is typical of the measured range of pH in PRIs 5 and 6 (see Section 2.2.1.3). Thus, the samples used for the Site-specific toxicity studies are considered representative of highly acidic wastewater in the CWP/OWP.

For both studies, pH was measured in the sample, but most other COPECs were not analyzed (see Section 3.2.3). Thus, it is uncertain whether results seen in the toxicity studies were due entirely to pH or may have been partially due to other, unmeasured COPECs. This uncertainty is mitigated by the fact that negligible toxic responses were observed in the studies, thus neither pH nor other COPECs in acidic wastewater are expected to lead to acute adverse effects in birds with avoidance behaviors.

Exposure conditions in both studies were unrealistic, representing a “worst-case” acute exposure. Dehydrated and fasted birds in cages were offered acidic wastewater, whereas at the Site, birds have the freedom to forage and drink from other, more palatable sources. With a 2-hour constant exposure, the dermal (eye, skin, and foot) exposures were also unrealistic. Birds that experience discomfort, such as the tearing observed in the study, would be expected to avoid the source of that discomfort. The egg dermal exposure is relevant to birds at the Site, as “belly-soaking” behavior in adult nesting birds directly exposes eggs to water and is performed during incubation by two shoreline species observed at the Site (snowy plover and American avocet). However, the exposure regime (1-minute immersion, followed by 20 minutes of drying, up to four times) may not be realistic for eggs in nests at the Site.

One of the Hooper et al. (2008) experiments used wild-caught house finches as test subjects. The previous exposures and life histories of these finches were unknown. This introduces potential for confounding, due to unknown prior injuries, diseases, or susceptibilities that may have been present in the test subjects before the experiment.

Overall, these exposure-related uncertainties are more likely to overestimate than underestimate the potential for adverse effects from acute oral and dermal exposure of birds to acidic pond water. Since effects were minimal, this is not a significant source of uncertainty in the BERA.

7.2.2 Effects-Related Uncertainties

The main effects-related uncertainty for the Site-specific toxicity studies LOE is the limited number of test species and test subjects utilized. The two studies used two bird species (mallard duck and house finch) to assess acute oral exposures, and two bird species (mallard ducks and Japanese quail eggs) to assess dermal exposures. The mallard duck was selected as they are the USEPA’s preferred species to assess the toxicity of a test substance to waterfowl. Finches are present in Utah statewide and have bioenergetics similar to other smaller birds potentially exposed at the Site. Japanese quail have little relevance to the Site, but their eggs have speckling similar to that observed in other species. Thus, the test species have relevance to birds that utilize lakebed habitats at the Site, but may not represent all the variable responses that might be seen in bird species at the Site. In addition, sample sizes for the different experiments were as low as n = 4, which decreases the statistical power for detecting statistically significant differences between treatment groups and the control group.

While house finch treatment groups ingested significantly less water within the first hour compared to the control, no differences in water ingestion were observed between any study group for the remainder of the study. Based on the findings of the study, finches demonstrate limited avoidance behaviors toward acidic pond water compared to mallards, potentially related to needs associated with increased bioenergetics. Birds with similar bioenergetics as house finches may also display limited avoidance behaviors at the Site, and it is uncertain the degree to which limited avoidance behaviors may increase exposure to acidic wastewater.

Overall, these effects-related uncertainties may over- or underestimate the potential for adverse effects.

7.3 Ecological Field Surveys Line of Evidence Uncertainties

The exposure-related and effects-related uncertainties associated with the ecological field surveys LOEs are described below. Studies that form the ecological field surveys LOEs fall into one of two broad categories: those that performed a quantitative comparison between the Site and an appropriate reference, and those that quantitatively compared Site conditions against a normal or typical condition for that species. Of the available studies, only Cavitt (2008, 2010) performed a quantitative comparison to reference, which increases the usefulness of this evidence. The remaining studies (Thompson 1983; Glover 1983; Halford et al. 1999; BIO-Logic 2006; and Beltman and Stackhouse 2007) provide and qualitative assessments of condition. In the following uncertainty discussion, the qualitative surveys are discussed first as a group, followed by a more detailed analysis of the quantitative Cavitt (2008, 2010) studies.

7.3.1 Exposure-Related Uncertainties

Uncertainty as to the degree of exposure for plants, invertebrates, and small home range receptors such as mice and rats is low for the surveys that qualitatively noted the condition of biota at the Site compared to a normal condition. For these biota, it is likely that they have had continuous exposure to Site COPECs and conditions throughout their lifespan. For wildlife with larger home ranges, such as migratory birds and larger mammals, there is higher uncertainty as to their use of habitat at the Site. The observed wildlife during these surveys may have been local residents with intense Site use, may have been transients moving through the Site, or may have short intense periods of Site use during the breeding season. Thus, there is higher confidence that observations of healthy or robust body condition represent actual Site exposures for plants, invertebrates, and small mammals, rather than for birds or larger mammals. In addition, these surveys were each representative of a snapshot in time. However, this uncertainty is not expected to be substantial, as the numerous surveys provide documentation of biota across the Site across approximately three decades, at different times of the year, and during different times of the day.

7.3.1.1 Cavitt 2008, 2010

The Cavitt (2008, 2010) studies monitored nests in portions of PRIs 5, 6, 7, 13, and 14, as well as an area east of PRIs 13 and 14 beyond the Site boundary. Results from all the Site nests were pooled before statistical comparisons against reference. This method introduces uncertainties as to the relevance of the results across the entirety of each exposure units, and also introduces potential confounding from the area east of PRIs 13 and 14 that is not part of the Site. This uncertainty is mitigated by a scrutiny of the nest success in each of the exposure units; nests in PRIs 6, 7, and 14 all performed better than the nests in the area east of PRIs 13 and 14. Therefore, the nests outside the Site boundary are not masking poor performance of nests at the Site. In addition, only one nest each was monitored in PRIs 5, 6, and 13. It is uncertain how applicable the results of the ecological field surveys LOE are to PRIs 5, 6, and 13.

An additional uncertainty is the location of the exposure for the breeding adults of the above nests. The study author notes that foraging distance varied for the adults, with an average distance of 47 meters or

192 meters, and a maximum of 689 meters away from the nest. Home ranges, calculated in 2010, averaged 0.83 ha with a maximum of 3.1 ha. Thus, most exposures are expected to occur within 200 meters of the nest. For many of the nests surveyed by Cavitt, exposures may have been from the neighboring PRI(s), rather than just the PRI in which the nest was located. For example, nests along the northern border of PRI 14 may represent breeding adult exposures from PRIs 5 and 7.

Interpreting the results of the Cavitt (2008, 2010) studies is challenging because of the lack of COPEC chemistry measurements in abiotic (solids or water) or biotic (breeding adults or eggs) media during the study. No chemical analysis was performed on the eggs or adults monitored in the study, which means that any correlations between specific COPECs and measured endpoints cannot be determined. The reference areas also may have had non-Site-related sources of chemical stressors that may have impacted nesting success (see Section 3.2.4.1).

Three species were monitored during the Cavitt (2008, 2010) studies: American avocet, snowy plover, and horned lark. Two of these species, the avocet and the snowy plover, are migratory, and the horned lark is a year-round resident. Results from these three species were applied to all avian receptors, as a reasonable representation of exposures at the Site for all locally breeding avian species.

Overall, the exposure-related uncertainties associated with the ecological field surveys LOE may under- or overestimate the potential for adverse effects.

7.3.2 Effects-Related Uncertainties

The major uncertainty with the surveys that qualitatively documented body condition is the lack of a quantitative comparison between the Site and an appropriate reference condition. Without such a comparison, the true measure of effects at the Site is unknown, particularly for chronic effects. Thus, these surveys do not specifically answer the question as to whether COPECs at the Site are impacting individual biota, populations, or communities at the Site.

7.3.2.1 Cavitt 2008, 2010

The Cavitt (2008, 2010) studies represent a snapshot in time of the reproductive success at the Site during the breeding seasons of 2008 and 2010. If high annual variability in reproductive success exists for these species, the results from these 2 years may not be representative of reproductive success across multiple years.

The only measured endpoints analyzed using statistical tests were for reproductive success (e.g., hatchability, daily survival rate) and adult size (e.g., mass, wing length). Both of these endpoint types are susceptible to natural variability, from causes such as predation, disease, and weather. Predation was the primary cause of nest failure, for both Site and reference area nests. Weather, disease, and other non-measured biotic or abiotic stressors may also have impacted reproductive success or adult size.

- **Reproductive Success**. There were no statistically significantly different measures of reproductive success in 2008, and in 2010 only hatchability was close to statistical significance ($p = 0.07$). It is uncertain why hatchability varied between the two study years, with a hatchability of 0.95 ± 0.13 (standard error) in 2008 and 0.75 ± 0.12 in 2010. In contrast, hatchability within reference areas ranged from 0.94 to 1 (± 0 to 0.18) in 2008 and 0.93 to 0.98 (± 0.02 to 0.03) in 2010. The study author notes that a number of factors may influence hatchability, including: (1) toxic effects of contaminants, (2) age or experience of breeding adults, (3) parental condition, and (4) high ambient temperatures. The co-occurrence of smaller adults and low hatchability in 2010 suggests that the low hatchability may have been due to the inexperienced breeding adults or adults in poor body condition (see below). In addition, the survey area that presumably has the highest contamination, PRI 7, had the highest hatchability at the Site for both years, suggesting that contamination was not the cause of

the low hatchability at the Site. However, the possibility that low hatchability in 2010 may have been due to contamination from COPECs at the Site cannot be ruled out. While hatchability was low in 2010, the mean number of young produced per successful nest was comparable between Site and reference areas, with 2.57 ± 0.20 (standard error) at the Site and reference areas ranging from 2.61 to 2.87 (± 0.09 to 0.14) in 2010. Thus, the number of young produced at the Site did not appear to be impacted by the low hatchability in 2010.

- **Adult Size**. Adults at the Site were the same as at reference areas in 2008, but significantly smaller in 2010. Adults may have been smaller due to several reasons, including (1) selection of the Site's poorer quality nesting habitat (see Section 2.2.1.4) by younger, inexperienced breeders or breeders in poor body condition; (2) natural variability; (3) later arrival by breeders with more strenuous migratory routes with higher energetic costs; or (4) exposure to COPECs at the Site while foraging. The most logical interpretation is that the Site is poor quality nesting habitat for these birds (see Section 2.2.1.4), which means it is likely that younger, inexperienced breeding adults or adults in poor body condition selected the Site for their nests. However, there is uncertainty in this interpretation.

Overall, the effects-related uncertainty associated with the ecological field surveys LOE may under- or overestimate the potential for adverse effects.

8. CONCLUSIONS

The BERA presents results for up to five LOEs for birds, mammals, terrestrial plants, soil invertebrates, benthic invertebrates, and aquatic biota. The LOEs were integrated into a WOE analysis for each ecological receptor resulting in a determination of potential risk for each exposure unit at the Site. A summary of the COPECs that may potentially result in risk for each receptor and exposure unit is presented in Table 8-1 and described below.

In summary, the WOE analysis finds that risks to birds and mammals are mostly due to intake of TEQ, although two bioaccumulatives (HCB and total PCBs) may also present potential risk. The upland habitats of PRIs 5, 6, and 8, which are in the areas surrounding the waste ponds, may present risk to individual birds from exposure to bioaccumulative COPECs. Birds in lakebed habitats of PRIs 7 and 14, also located around the waste ponds, may be at risk of potential adverse effects due to intake of TEQ. Risk to mammals is limited to the upland habitat in PRIs 5 and 8 and the lakebed habitat in PRI 7 from exposure of TEQ. The WOE analysis finds no conclusive evidence for risks to plants or invertebrates.

The above areas may pose a risk to individual birds, which may be of concern for the snowy plover in lakebed habitats of PRIs 7 and 14 since the snowy plover is a species of Utah Greatest Conservation Need. For other birds and mammals, it is unclear whether these risks for individual organisms may be of sufficient severity and magnitude to lead to population-level impacts. Populations are typically more resistant to stress than organisms; the loss of a few sensitive organisms is not likely to significantly affect the population. In turn, communities are typically more resistant to stress than populations; the loss of a few organisms is not likely to significantly affect the community (Ricklefs 1990). Moreover, each of the above areas with potential risk is composed of poor quality habitat that is unlikely to support the minimum number of individuals necessary to sustain a population. Thus, it is considered unlikely that impacts to individuals in these areas would elicit changes in the populations utilizing habitat at the Site. Additionally, the prediction of risks to birds and mammals is likely overestimated due to the conservative assumptions used to calculate the HQ LOEs.

Based on these findings, it is concluded that ecological risks are not of significant concern to plants or invertebrates and are unlikely to be of concern to the majority of bird and mammal populations, although individual organisms, such as snowy plover, may be impacted. These conclusions are applicable to current and future conditions of all exposure units with the following exceptions: exposure units in the RWP Area (PRIs 4, 5, 6, and 7) are evaluated as current conditions only and hypothetical future scenarios are evaluated in Appendix D; and the SVDD is evaluated as current conditions only since the ditch will cease to exist after construction of the RWP.

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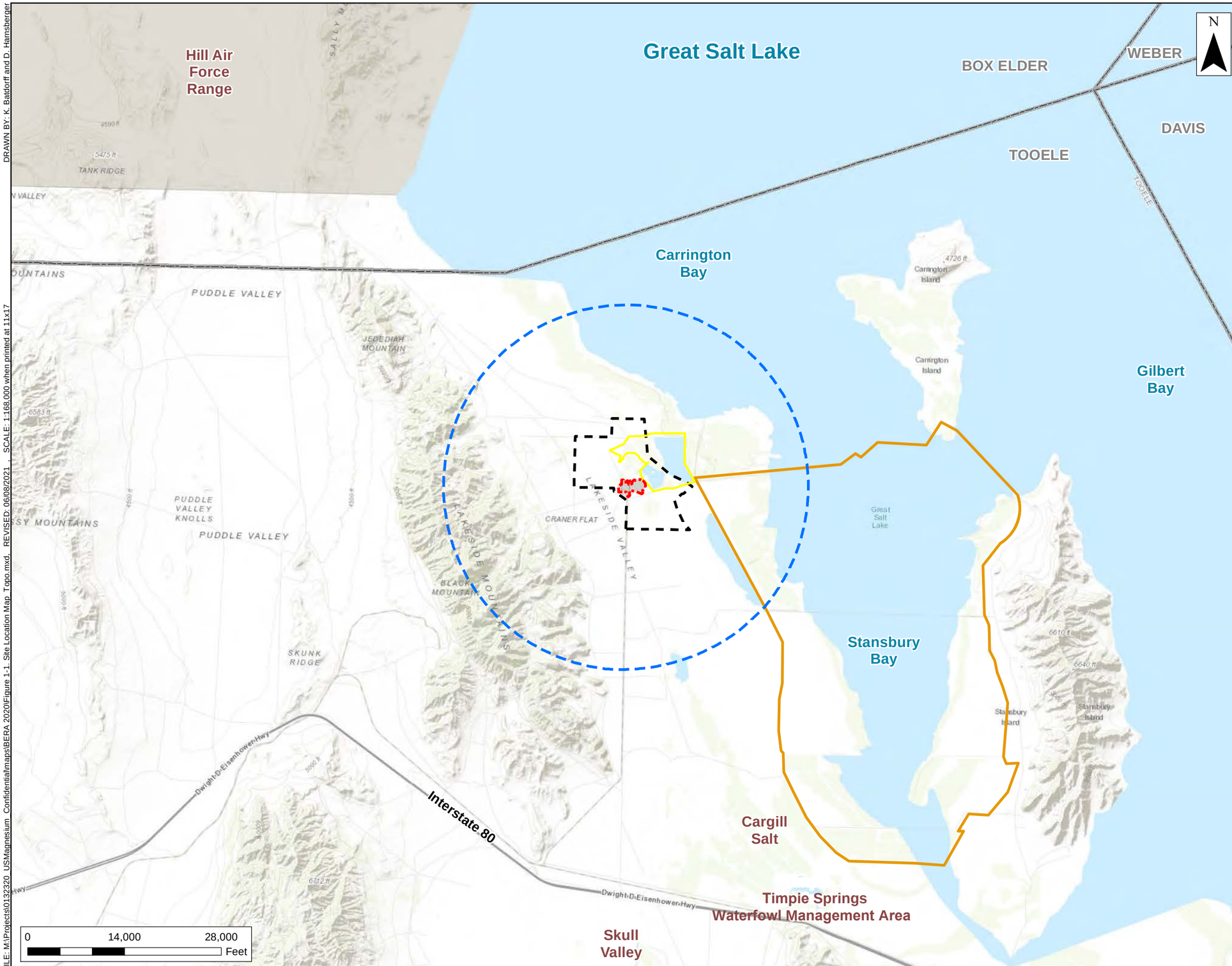
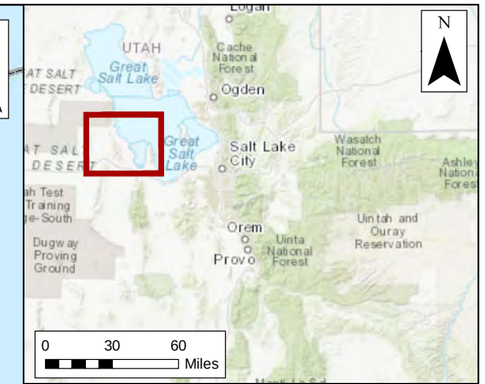
FIGURES





Legend

- Operating Facility
- US Magnesium Property
- US Magnesium Wastewater Ponds
- US Magnesium Solar Evaporation Ponds
- RI/FS Study Area Boundary
- County Boundary
- Operating Facility

Figure 1-1
Site Location Map
OU-1 BERA Report
US Magnesium LLC
Tooele County, Utah

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Portland, Oregon 97204
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Source: Utah AGRC Imagery Webservice, NAIP 2016; NAD 1983 UTM Zone 12N

FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\Figure 1-1. Site Location Map_Topo.mxd, REVISED: 06/08/2021 , SCALE: 1:168,000 when printed at 11x17
DRAWN BY: K. Batdorff and D. Harnsberger

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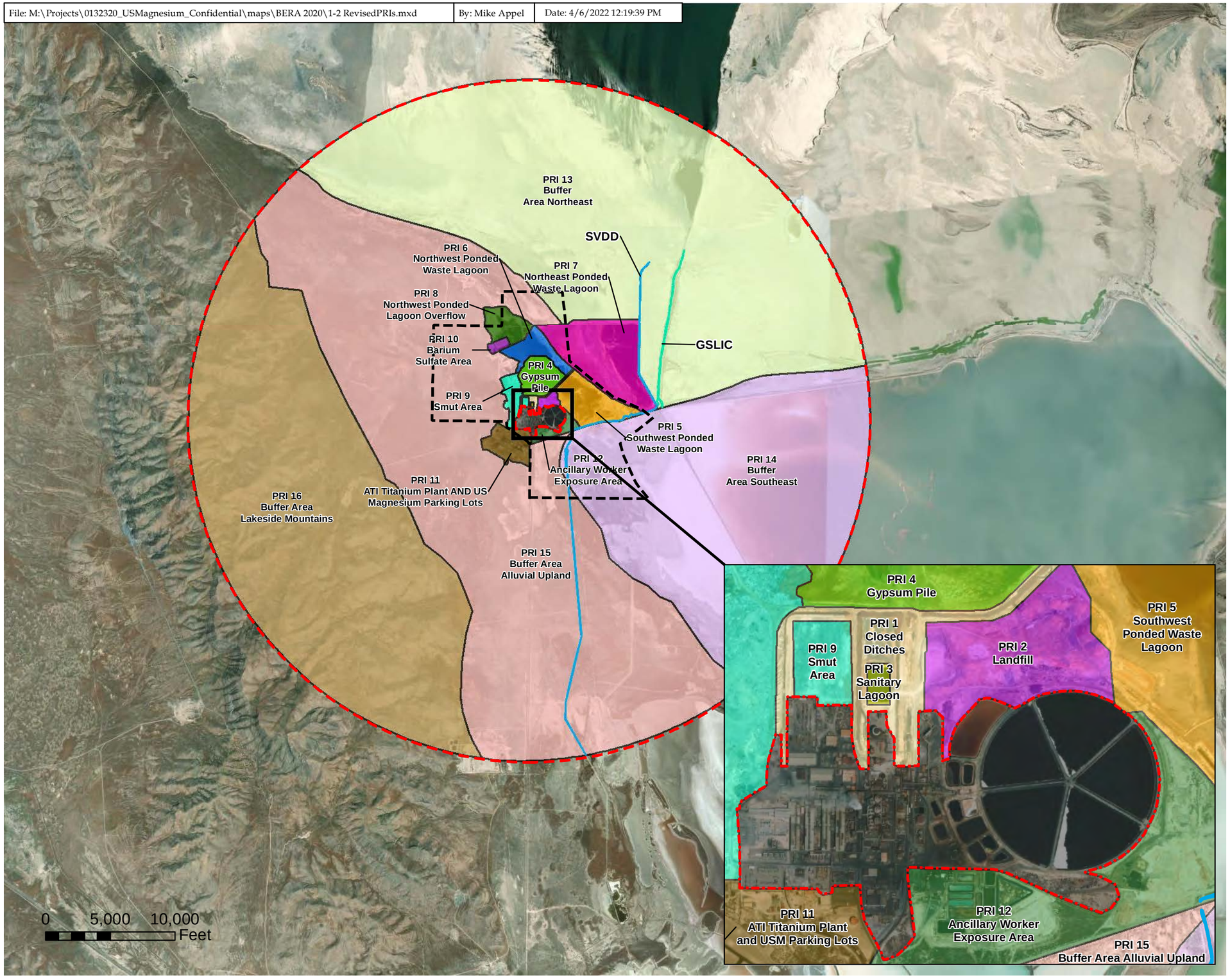

Operating Facility

RI/FS Study Area Boundary

US Magnesium Property

Preliminary Remedial Investigation Areas

- PRI 1: Closed Ditches
- PRI 2: Landfill
- PRI 3: Sanitary Lagoon
- PRI 4: Gypsum Pile
- PRI 5: Southwest Ponded Waste Lagoon (CWP)
- PRI 6: Northwest Ponded Waste Lagoon (CWP)
- PRI 7: Northeast Ponded Waste Lagoon (OWP)
- PRI 8: Northwest Lagoon Overflow
- PRI 9: Smut Area
- PRI 10: Barium Sulfate Disposal Area
- PRI 11: ATI Titanium and USM Parking Lots
- PRI 12: Ancillary Worker Exposure Area
- PRI 13: Buffer Area Northeast
- PRI 14: Buffer Area Southeast
- PRI 15: Buffer Area Alluvial Uplands
- PRI 16: Buffer Area Lakeside Mountains

Great Salt Lake Intake Canal (GSLIC)

Skull Valley Diversion Ditch (SVDD)

PRI 17: Site-Wide Surface Water and Groundwater (Not Shown)

PRI 18: Site-Wide Ambient Air (Not Shown)

Notes:
SVDD – Skull Valley Diversion Ditch
GSLIC – Great Salt Lake Intake Canal
All boundaries approximate, originally provided by USEPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA) June 29, 2009

N

Figure 1-2
Revised Preliminary Remedial Investigation Areas
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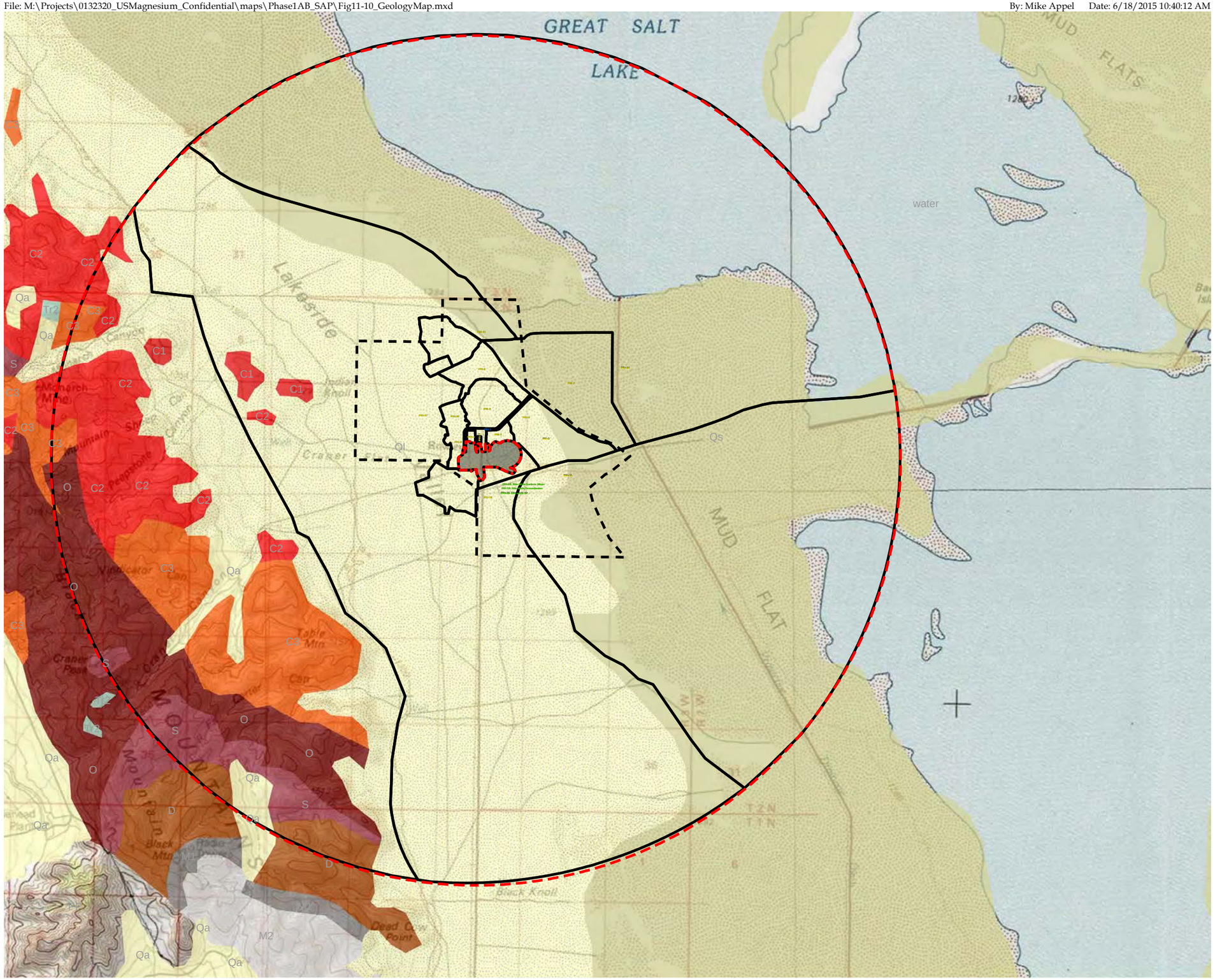

Operating Facility

US Magnesium Property

Preliminary Remedial Investigation Areas

RI/FS Study Area Boundary

Surface Geology

- Qs - surficial mud and salt flat deposits
- Ql - surficial Lake Bonneville deposits
- Qa - surficial alluvium and colluvium
- Tr2 - Chinle, Ankareh Fms
- S - Laketown, Bluebell Dolomite
- O - Fish Haven, Swan Peak, Garden City, Eureka and other Fms
- M2 - Great Blue, Humbug, Deseret and other Fms
- M1 - Redwall, Madison, Gardison, Ludgepole and other Fms
- D - Devonian Formations
- C3 - St. Charles, Nounan, Bloomington and other Upper Cambrian Fms
- C2 - Middle Cambrian Fms
- C1 - Prospect Mountain, Tintic, Ignacio, Geertsen Canyon and other Fms

Notes:
All boundaries approximate, provided by EPA.
Geology information from the Utah Geological Survey.

N

0 6,000 12,000 Feet

Figure 2-1
Surface Geology Map
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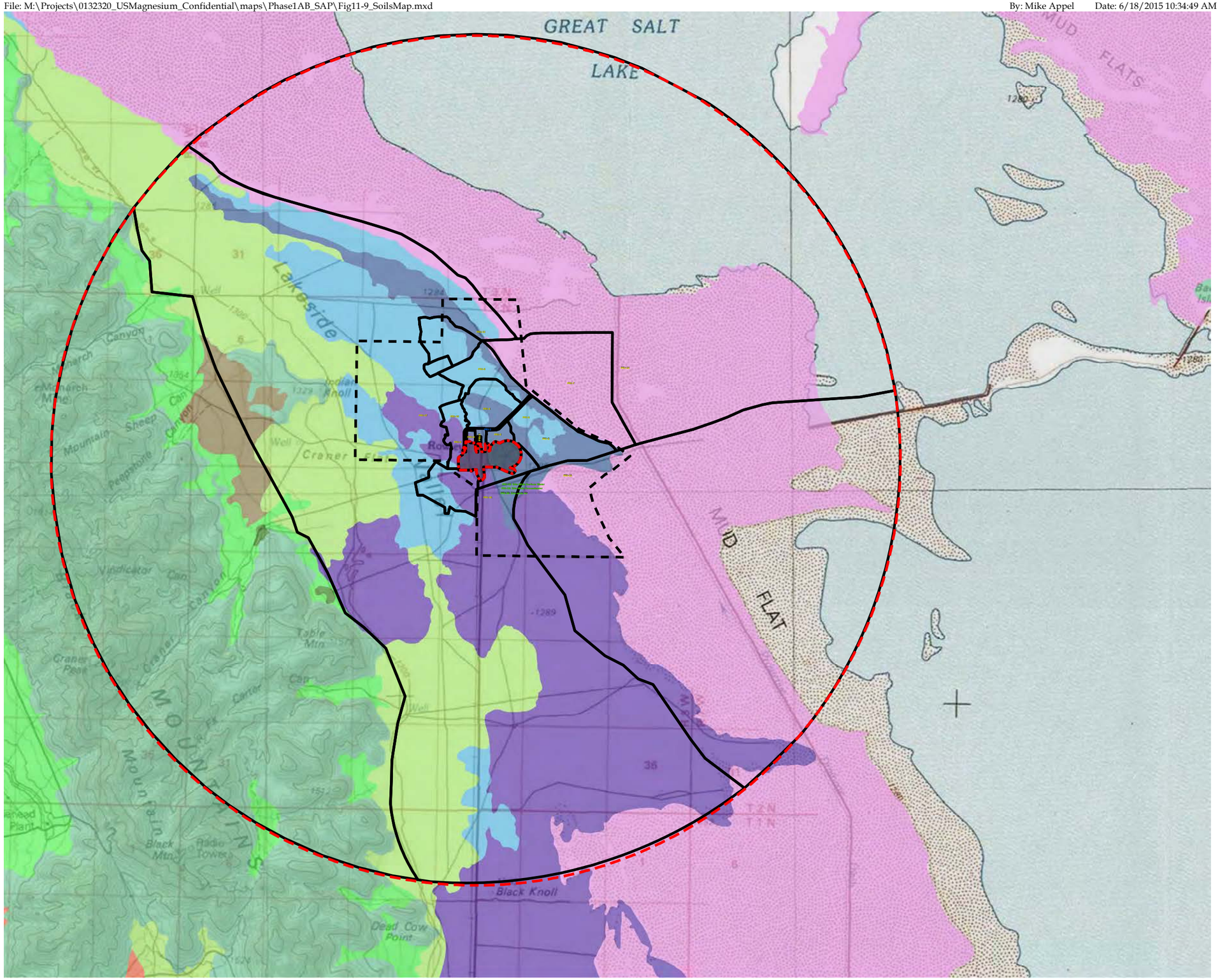

Operating Facility

US Magnesium Property

Preliminary Remedial Investigation Areas

RI/FS Study Area Boundary

General Soil Class

- Amtoft-Rock
- Checkett
- Cliffdown
- Dynal
- Hiko Peak
- Medburn
- Pits
- Playas-Saltair
- Skumpah
- Timpie-Tooele
- Yenrab

Notes:
All boundaries approximate, provided by EPA.
Soil information from the Natural Resource Conservation Service.

N

0 6,000 12,000 Feet

Figure 2-2
General Soil Class Map
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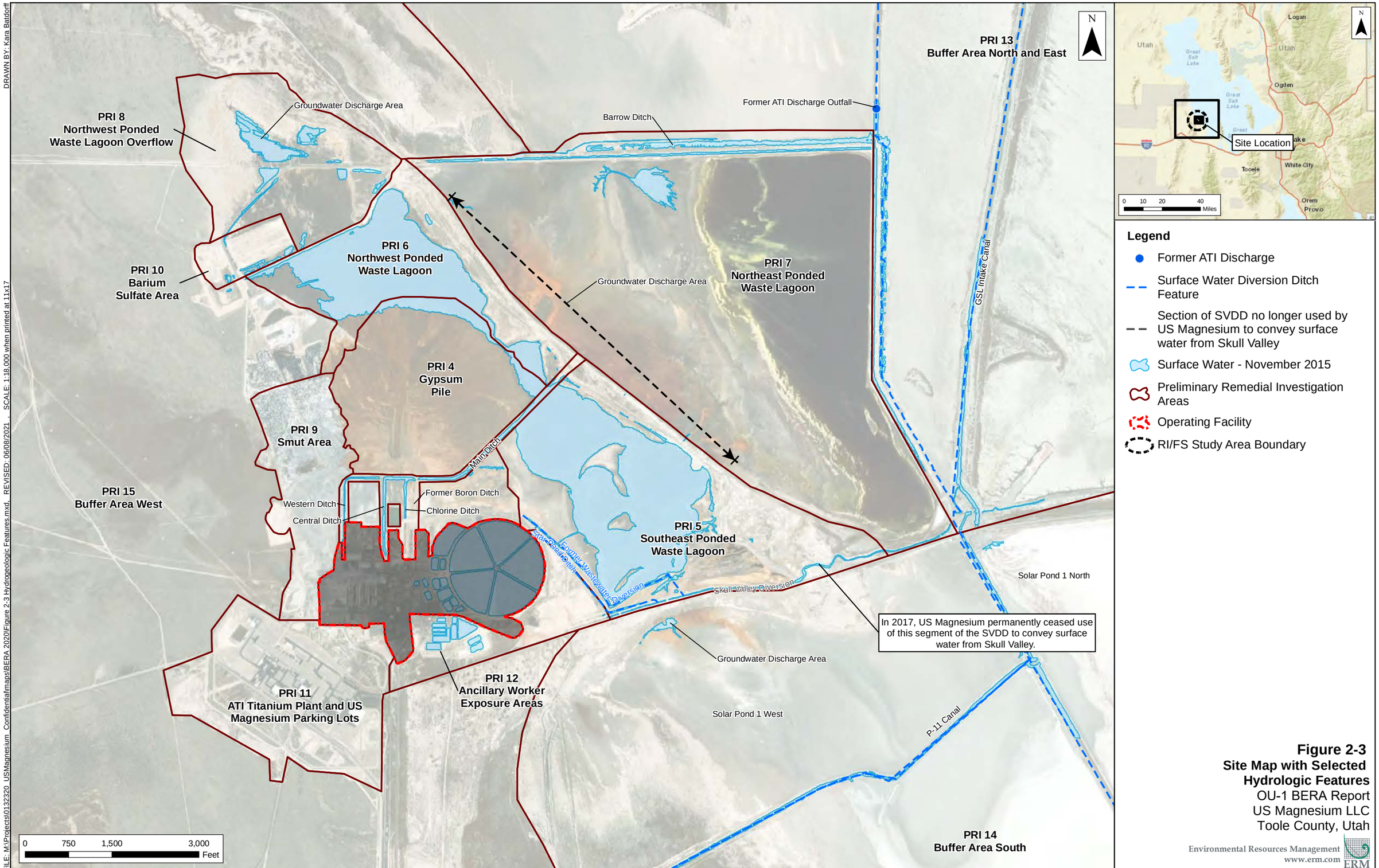

Figure 2-3
Site Map with Selected Hydrologic Features
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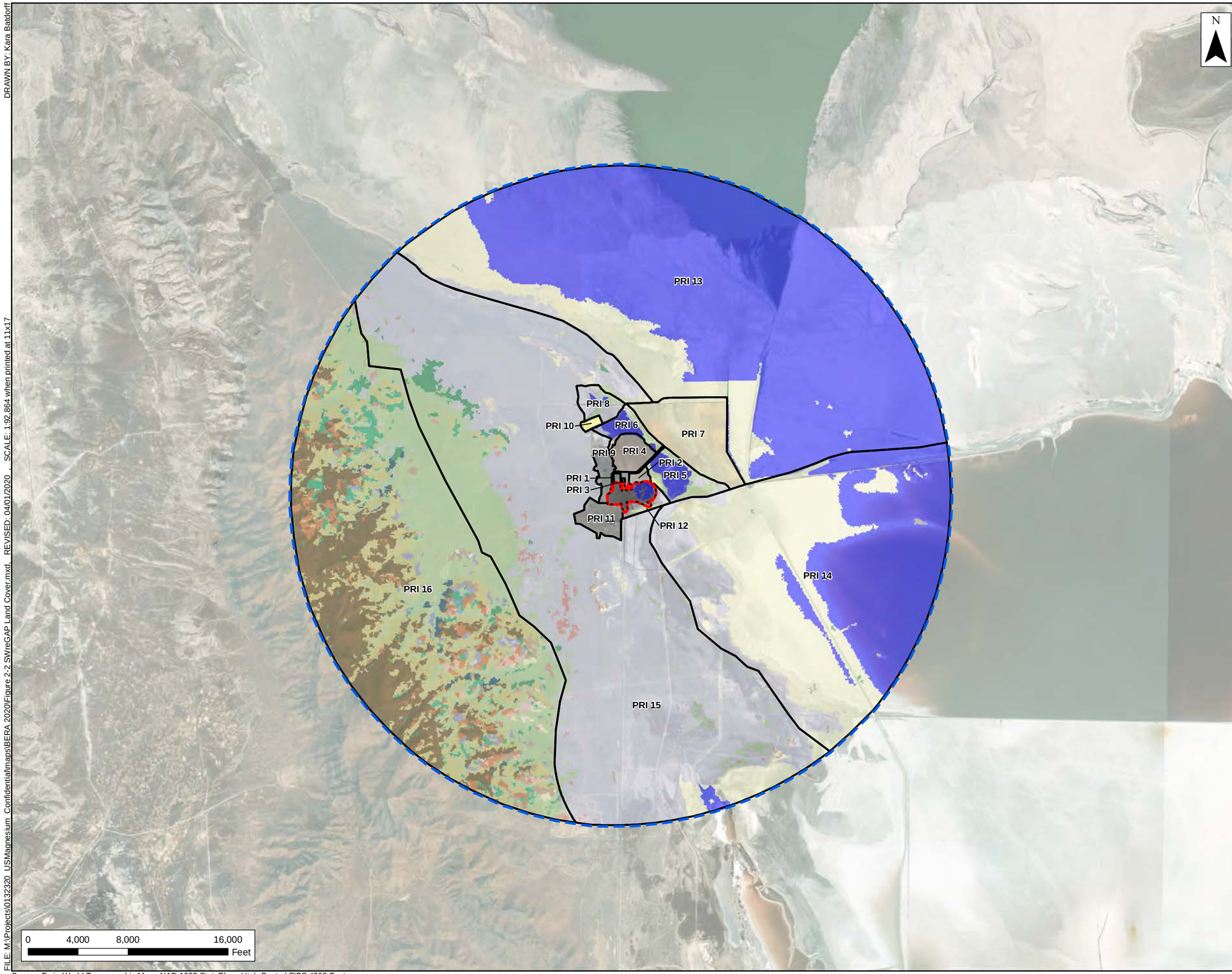
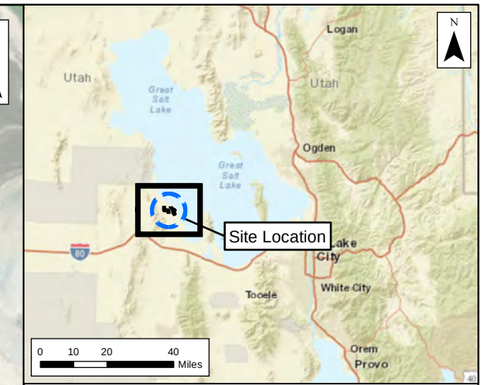
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Utah Central FIPS 4302 Feet

FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\Figure 2-3 Hydrogeologic Features.mxd REVISED: 06/08/2021 SCALE: 1:18,000 when printed at 11x17 DRAWN BY: Kara Batdorff





Legend

- Developed, Medium - High Intensity
- Developed, Open Space - Low Intensity
- Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
- Great Basin Pinyon-Juniper Woodland
- Great Basin Xeric Mixed Sagebrush Shrubland
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Cliff and Canyon
- Inter-Mountain Basins Greasewood Flat
- Inter-Mountain Basins Mixed Salt Desert Scrub
- Inter-Mountain Basins Montane Sagebrush Steppe
- Inter-Mountain Basins Playa
- Inter-Mountain Basins Semi-Desert Grassland
- Inter-Mountain Basins Semi-Desert Shrub Steppe
- Invasive Annual and Biennial Forbland
- Invasive Annual Grassland
- Invasive Perennial Grassland
- North American Arid West Emergent
- Open Water
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland
- Ruderal
- Preliminary Remedial Investigation Areas
- Operating Facility
- RI/FS Study Area Boundary

Figure 2-4
Modified SWReGAP Land Cover
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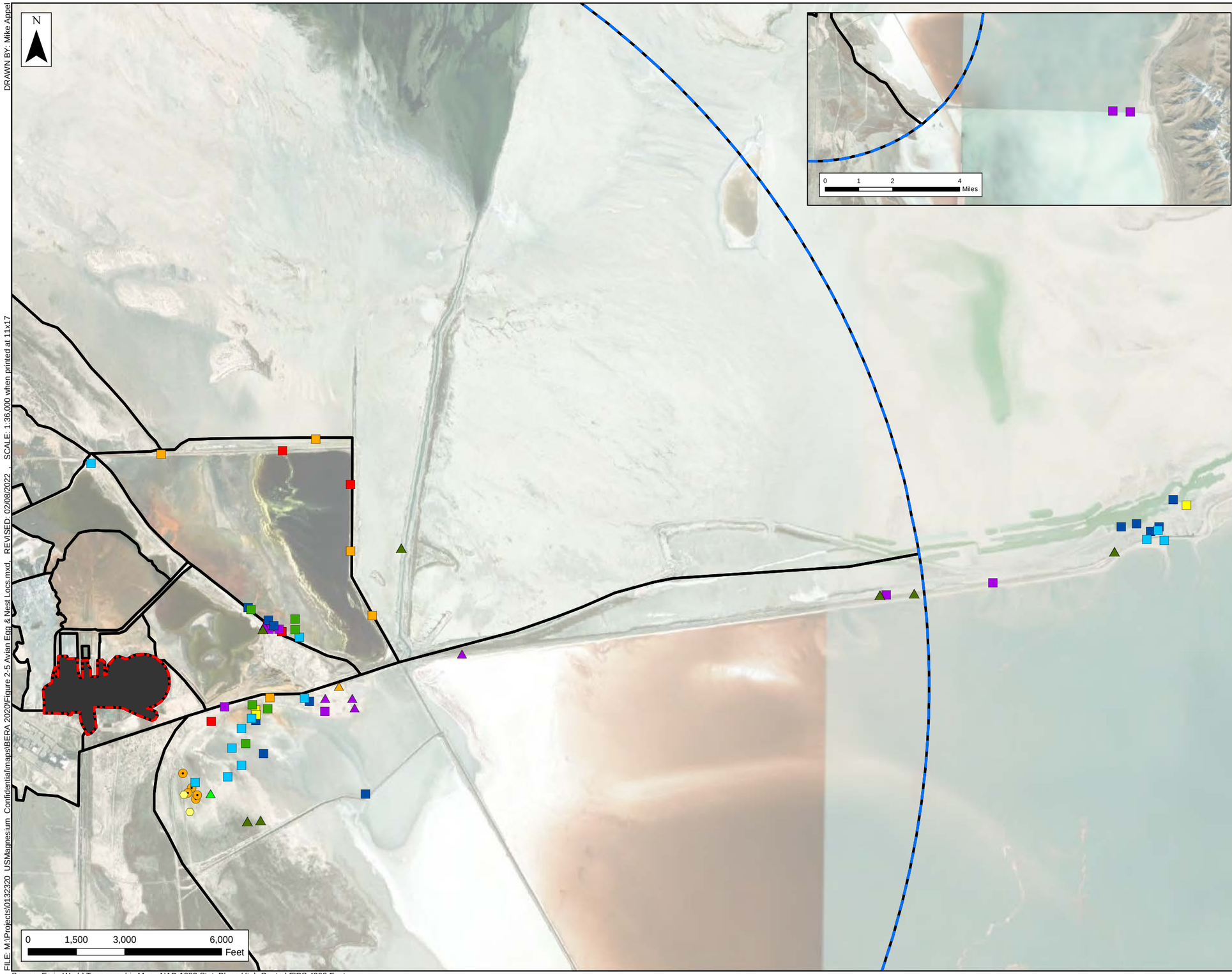
FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\Figure 2-2 SWreGAP Land Cover.mxd, REVISED: 04/01/2020 , SCALE: 1:92,864 when printed at 11x17

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Utah Central FIPS 4302 Feet



Legend

Cavitt Egg Collection Location, 2010
- Snowy Plover

Cavitt Nest Observation Location, 2010
- American
- Snowy Plover
- Horned lark

Cavitt Egg Collection Location, 2008
- Snowy Plover

Cavitt Nest Observation Location, 2008
- Snowy Plover
- Horned Lark

USEPA Egg Collection Location 2006
- Horned Lark
- Snowy Plover

USEPA Egg Collection Location 2005
- Horned Lark
- American
- Snowy Plover

USEPA Egg Collection Location 2004
- Snowy Plover

- RI/FS Study Area
- Preliminary Remedial Investigation
- Operating Facility

Figure 2-5
Avian Egg Sampling and Nest Locations 2004 to 2016
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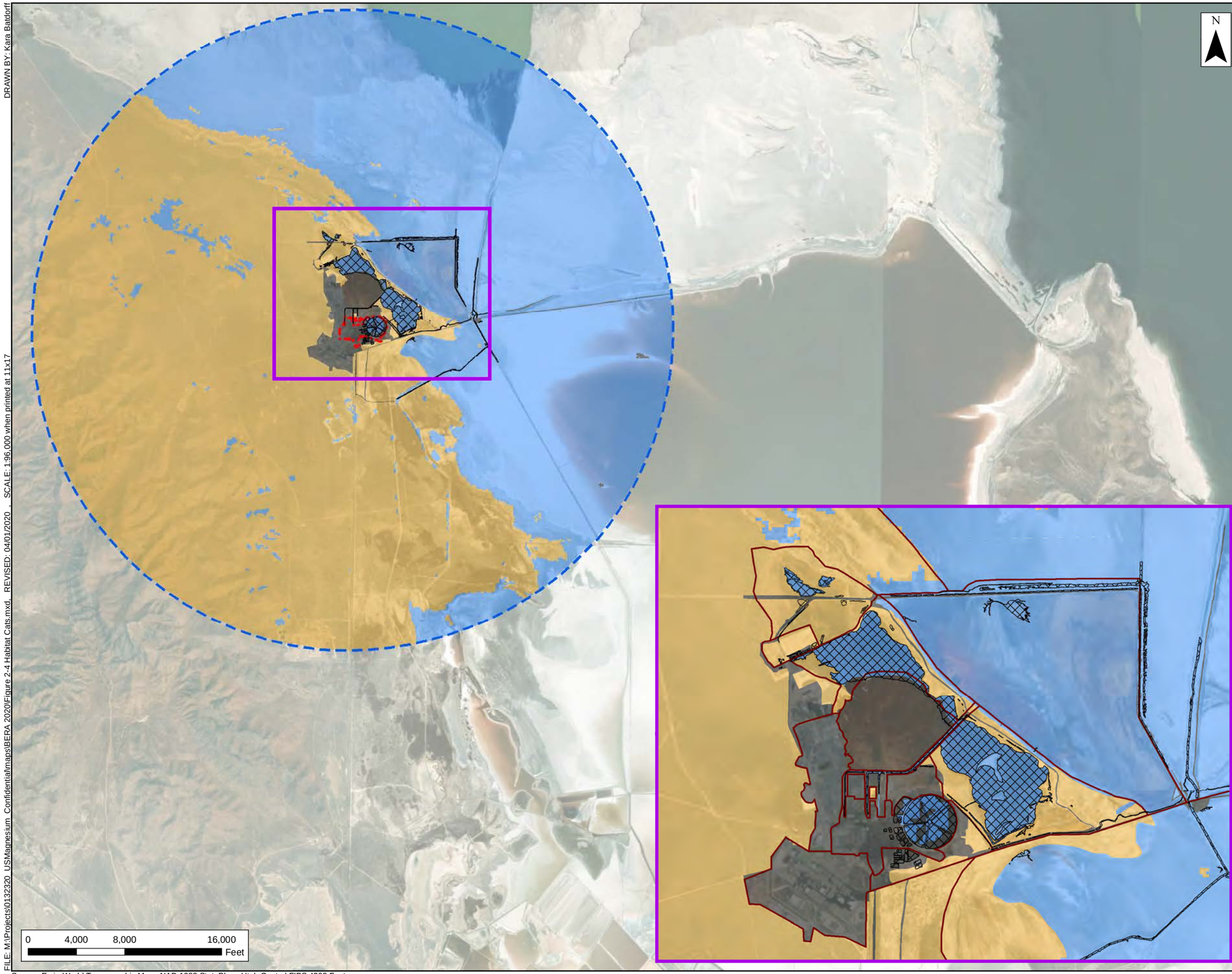
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Utah Central FIPS 4302 Feet

FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\Figure 2-5 Avian Egg & Nest Locs.mxd REVISED: 02/08/2022 SCALE: 1:36,000 when printed at 11x17 DRAWN BY: Mike Appel



Legend

- Upland Habitat
- Lakebed Habitat
- Developed Area
- Surface Water - November 2015
- Preliminary Remedial Investigation Areas
- Operating Facility
- RI/FS Study Area Boundary

Figure 2-6

Habitat Categories

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Utah Central FIPS 4302 Feet

File: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\Figure 2-5 RCRA Cleanup.mxd By: Mike Appel Date: 5/10/2021 1:56:22 PM

Legend

- Proposed Wastewater Transfer Pipe to Filtration Plant Area
- Proposed Wastewater Sump
- Proposed Filtration Plant Equipment Pad
- RCRA Carve-out Cleanup Project Area

Notes:
All new boundaries and facilities are tentative and subject to change.
Aerial Photo: November 18, 2015; 6 inches per pixel

N

0 300 600 Feet

Figure 2-7

RCRA Carve-Out Cleanup Project
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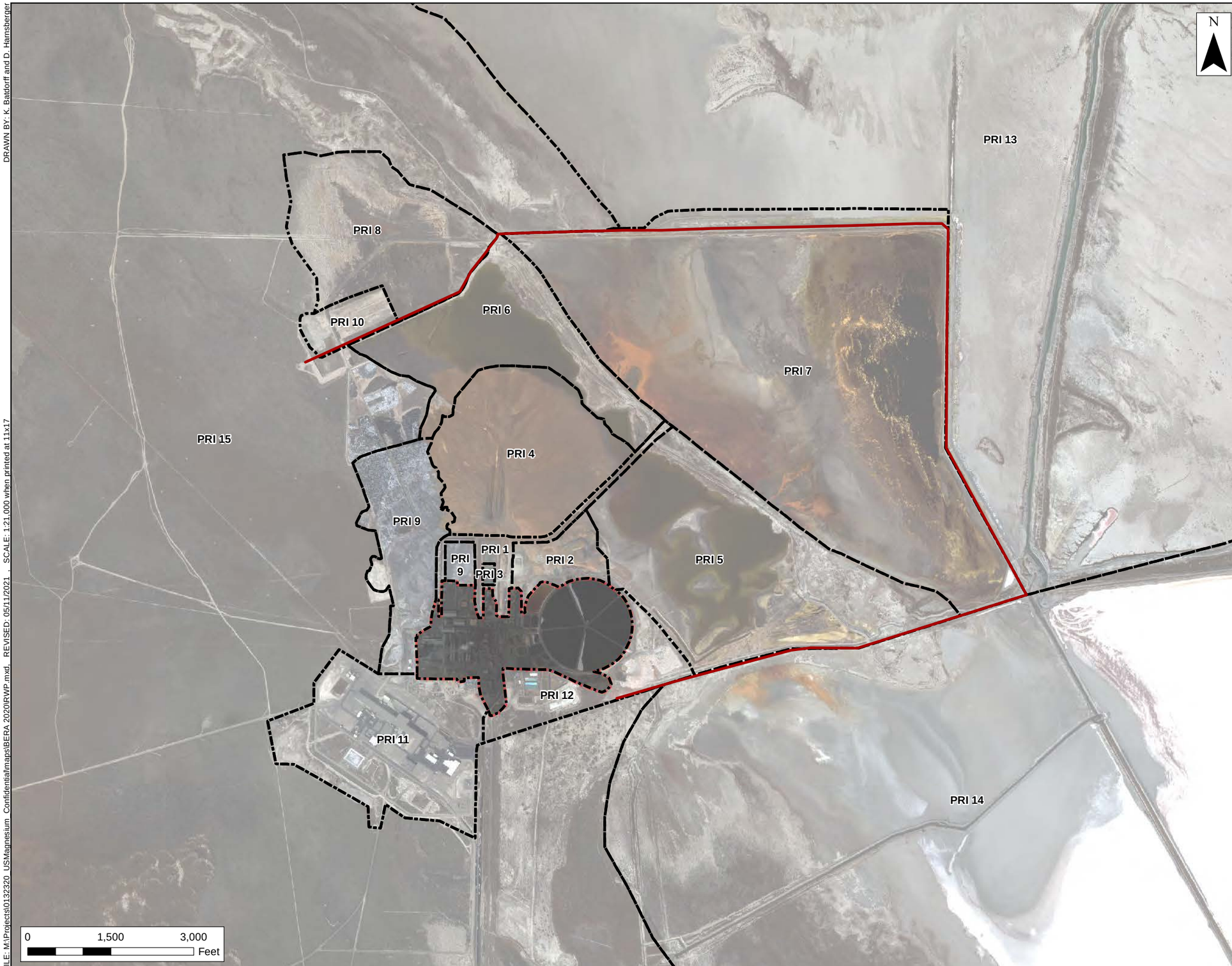

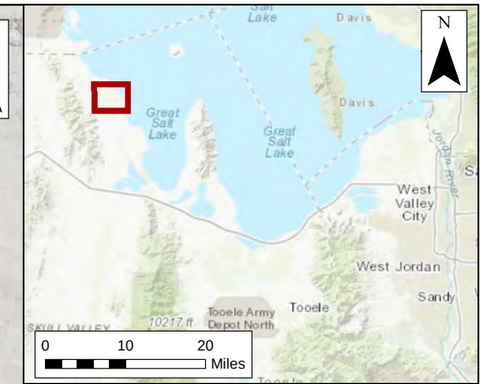

Legend

- Approximate Retrofitted Wastewater Pond (RWP) Barrier Wall Alignment
- Preliminary Remedial Investigation Areas
- Operating Facility

Figure 2-8

Retrofitted Waste Pond
OU-1 BERA Report
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Source: Utah AGRC Imagery Webservice, NAIP 2016; NAD 1983 UTM Zone 12N

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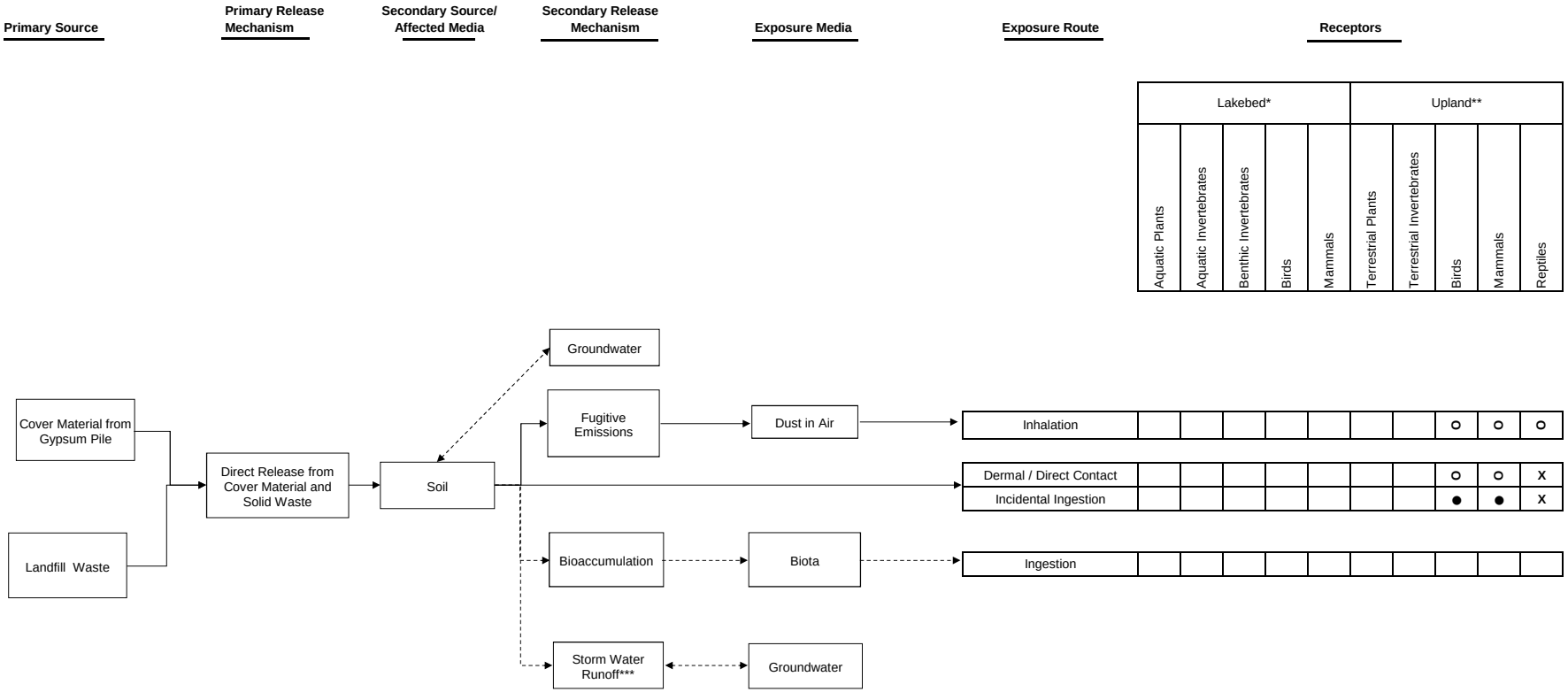

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

- - - → incomplete exposure pathway

* Lakebed habitat is not present in this PRI.

** This PRI does not support plant and invertebrate communities. Exposure to birds and mammals is transient.

*** Runoff drains to the current waste lagoon and wastewater ditches under current conditions. Runoff management under future scenarios is to be determined.

Figure 2-9
Conceptual Site Model for PRI 2
Current and Future Land Use Scenarios
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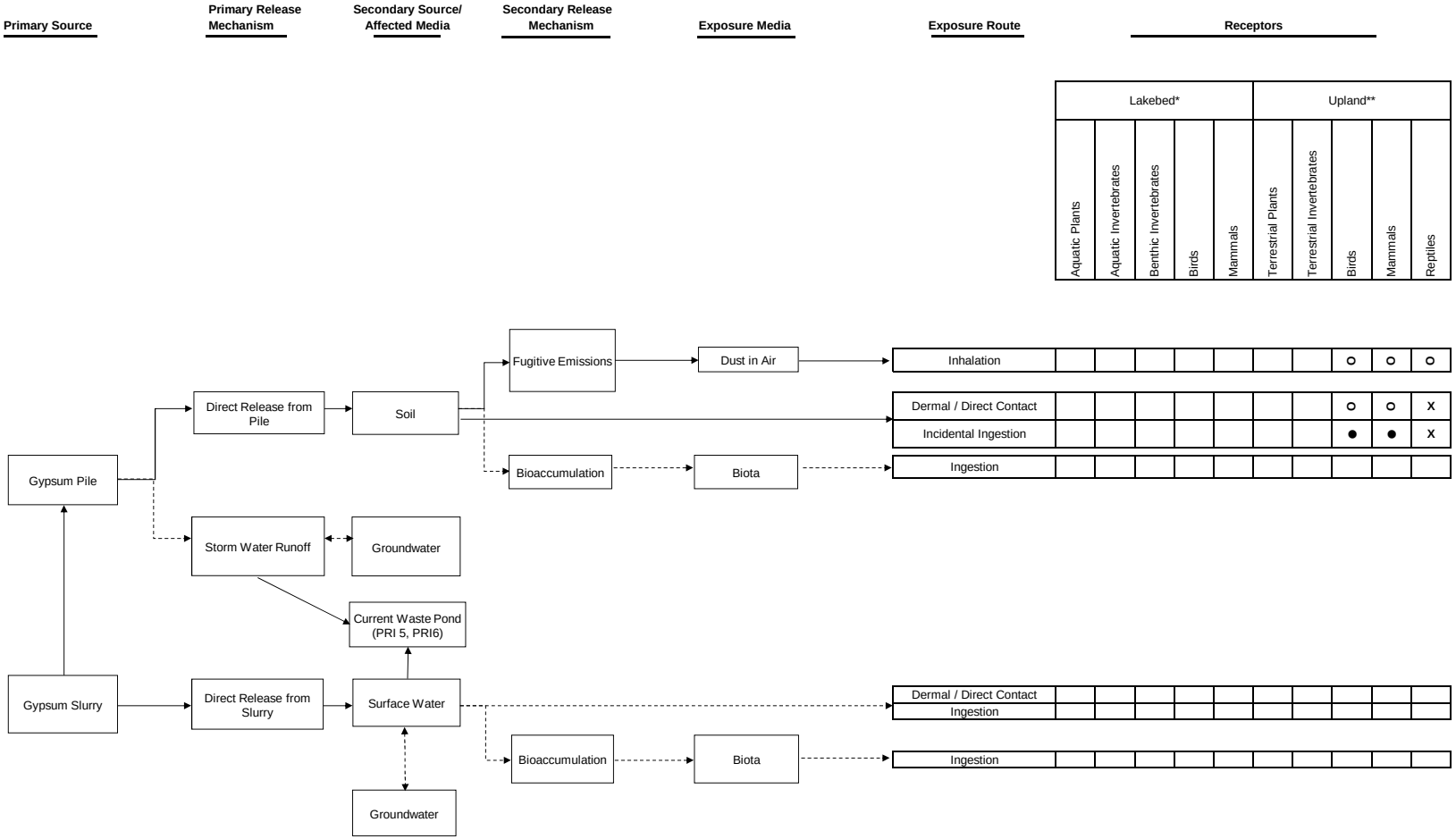

● Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
- - → incomplete exposure pathway
* Lakebed habitat is not present in this PRI.
** The majority of this PRI does not support plant and invertebrate communities. Exposure to birds and mammals is transient.

Figure 2-10
Conceptual Site Model for PRI 4
Current Land Use Scenario
OU-1 BERA Report
US Magnesium LLC
Tooele, Utah

Environmental Resources Management
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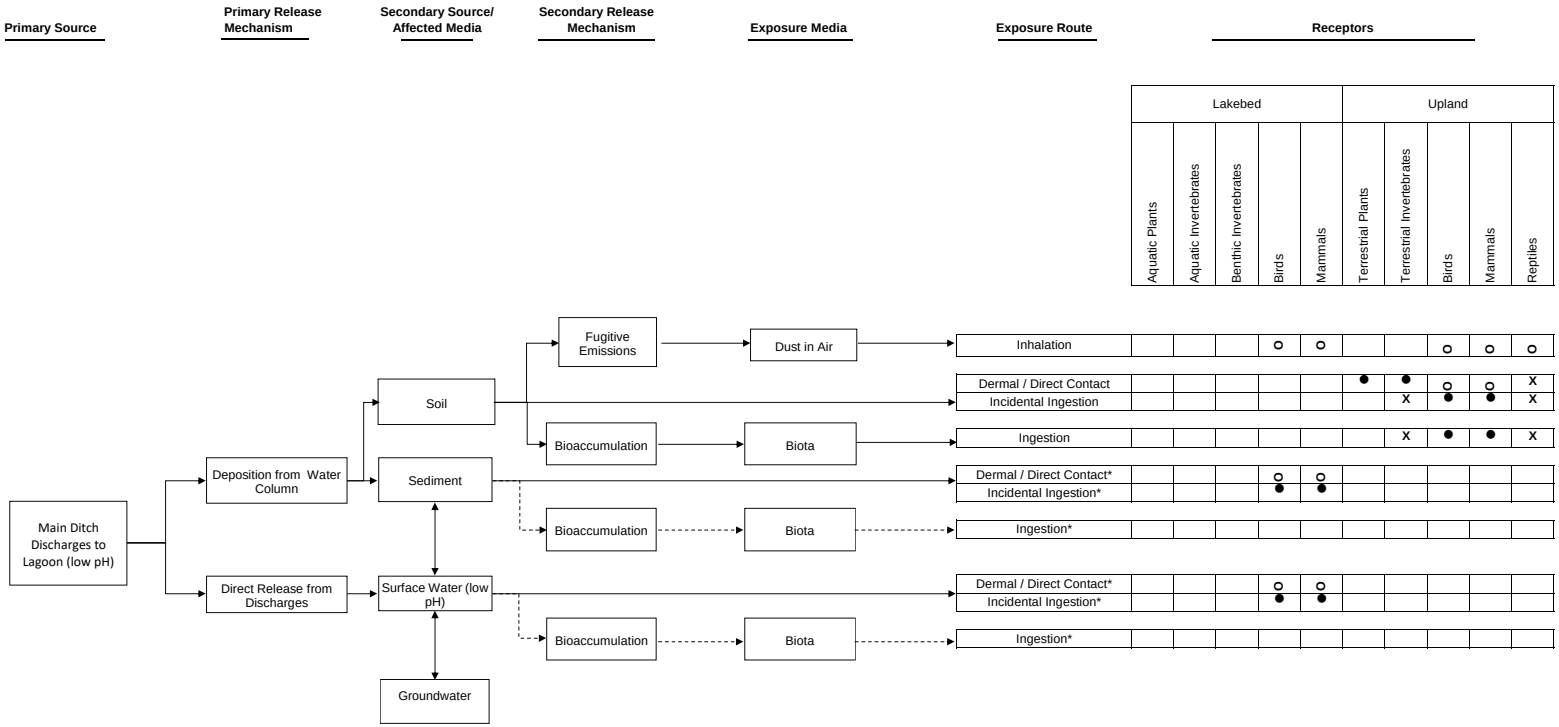

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

- - → incomplete exposure pathway

* Assume acute exposure and intermittent longer-term exposure to wildlife in lakebed habitat due to surface water that is always highly acidic. A chronic exposure was also evaluated as a hypothetical possibility but is not reflected in this CSM.

Figure 2-11
Conceptual Site Model for PRI 5
Current Land Use Scenario
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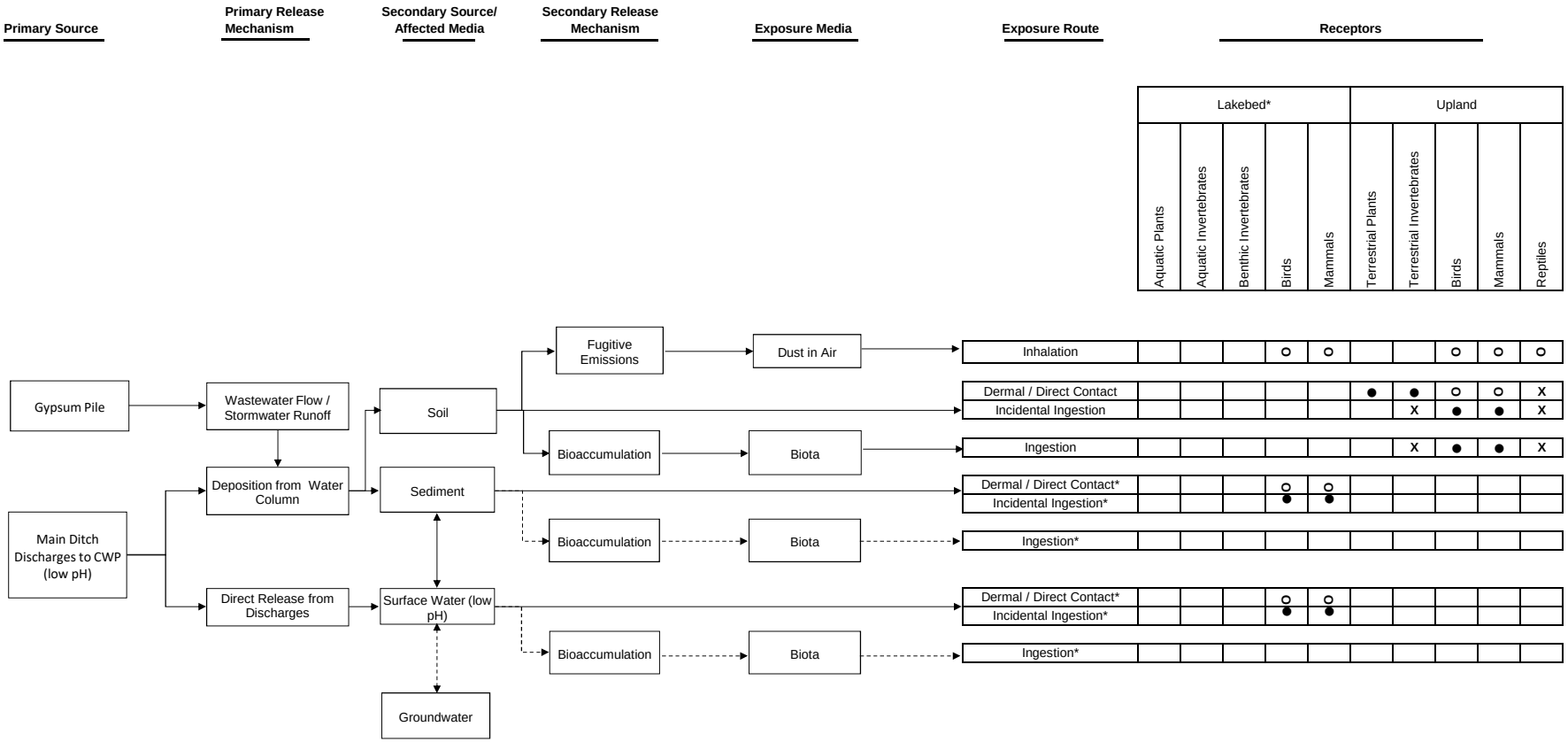

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

- - → incomplete exposure pathway

* Assume acute exposure and intermittent longer-term exposure to wildlife in lakebed habitat due to surface water that is always highly acidic. A chronic exposure was also evaluated as a hypothetical possibility but is not reflected in this CSM.

Figure 2-12
Conceptual Site Model for PRI 6
Current Land Use Scenario
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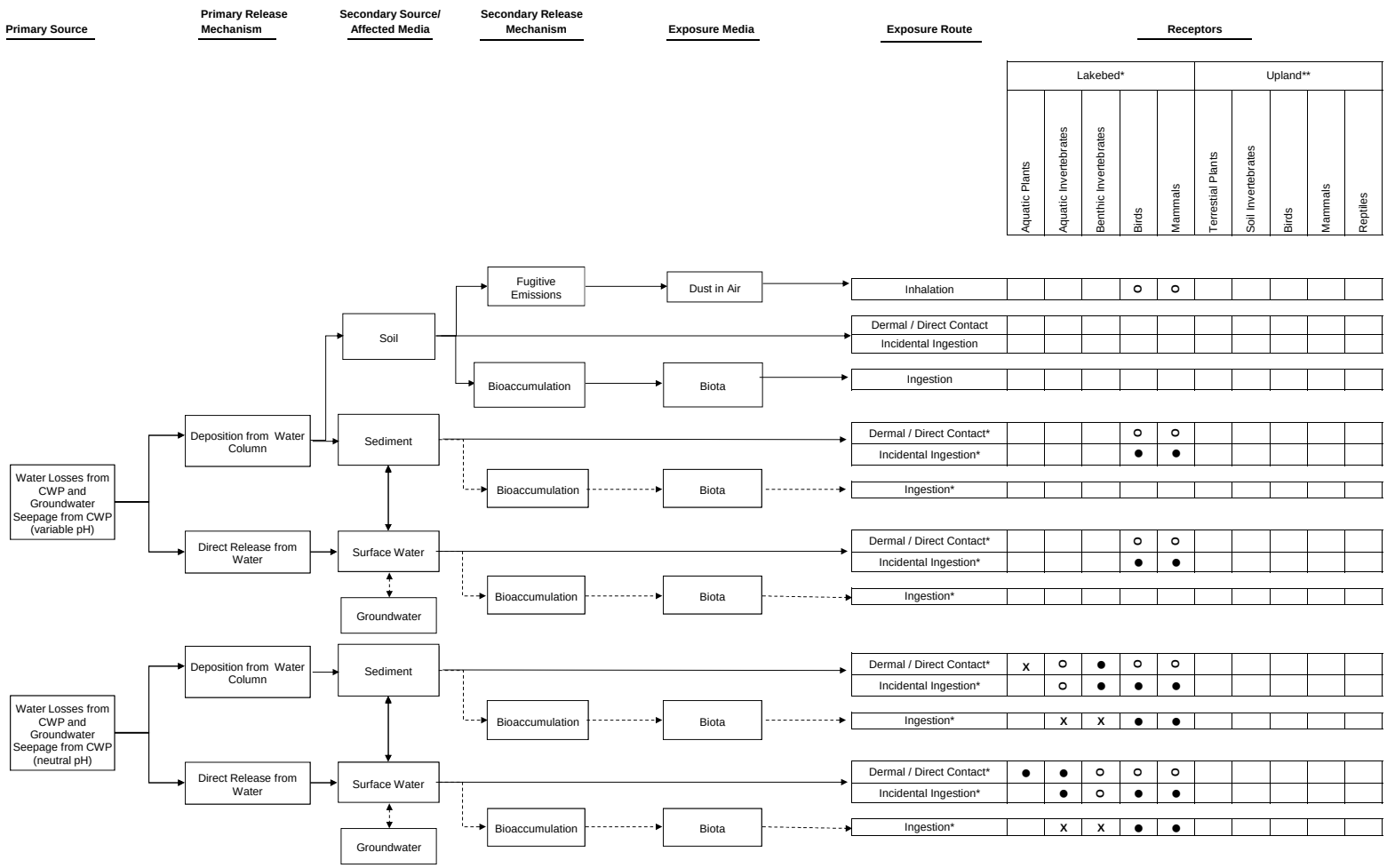

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

--→ incomplete exposure pathway

* Assume acute exposure and intermittent longer-term exposure to wildlife in lakebed habitat due to variable acidity in surface water. A chronic exposure is assumed for neutral acidity surface water.

** Upland habitat is not present in this PRI.

Figure 2-13
Conceptual Site Model for PRI 7
Current Land Use Scenario
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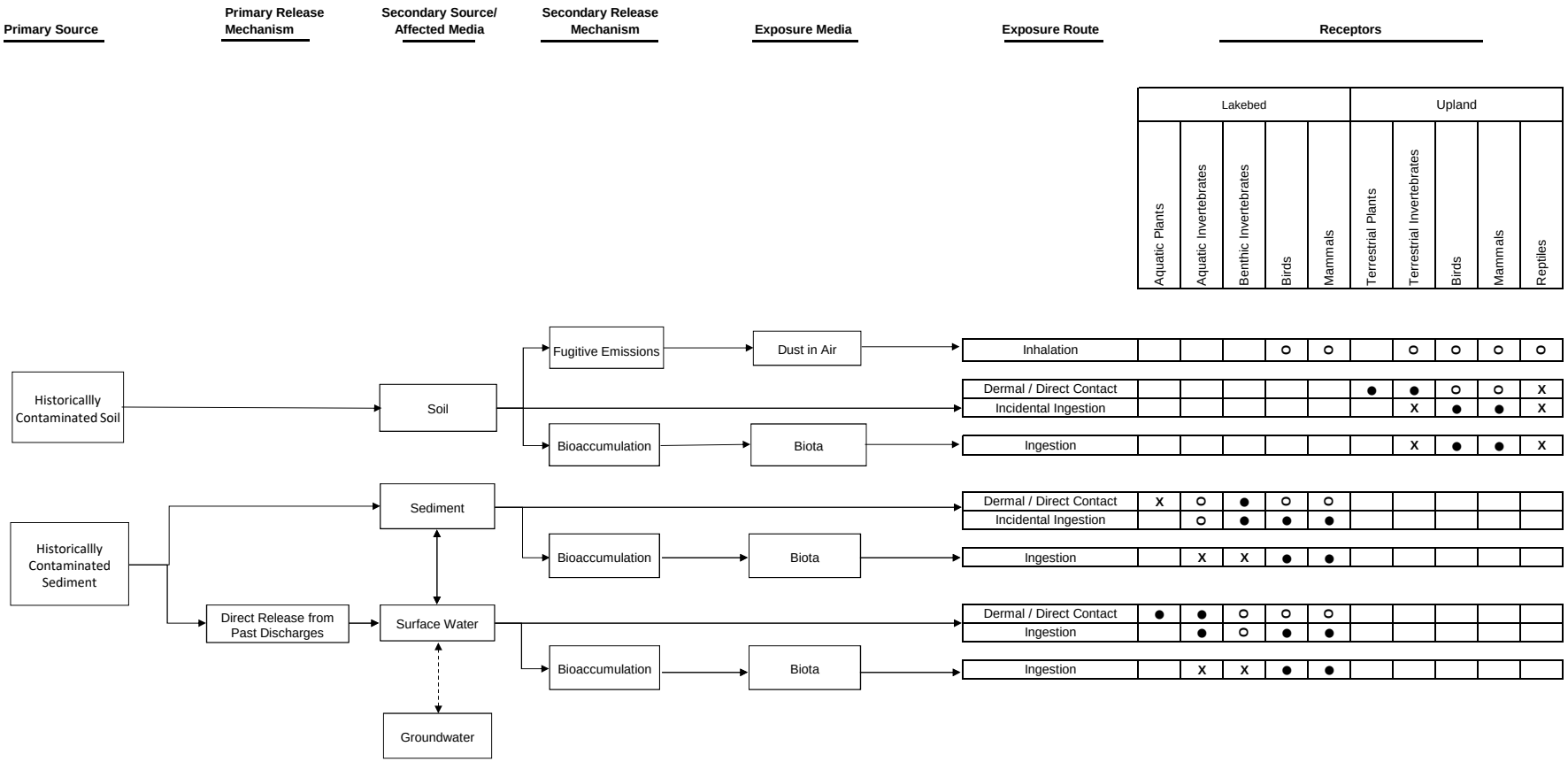

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

- - → incomplete exposure pathway

Figure 2-14
Conceptual Site Model for PRI 8
Current and Future Land Use Scenario
OU-1 BERA Report
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Tooele County, Utah

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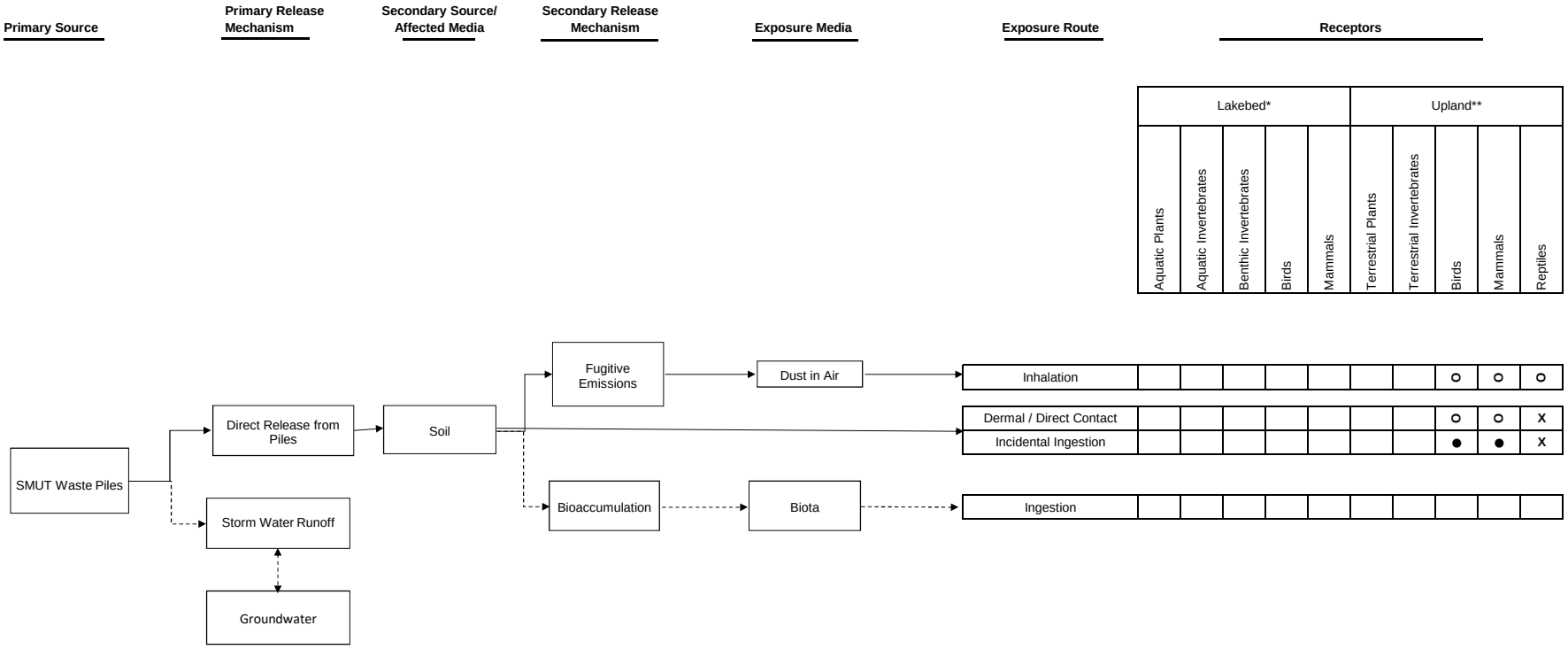

● Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
--→ incomplete exposure pathway
* Lakebed habitat is not present in this PRI.
** This PRI does not support plant and invertebrate communities. Exposure to birds and mammals is transient.

Figure 2-15
Conceptual Site Model for PRI 9
Current and Future Land Use Scenarios
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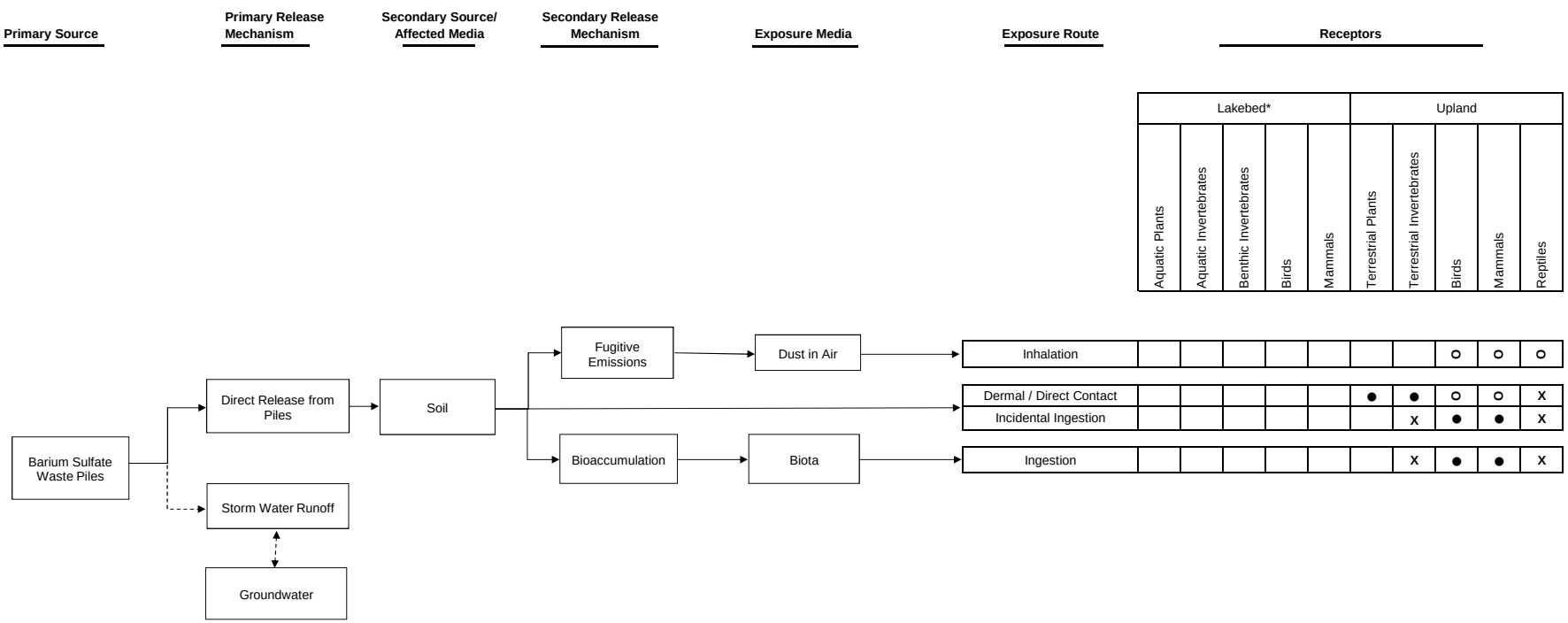

● Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
--→ incomplete exposure pathway
* Lakebed habitat is not present in this PRI.

Figure 2-16
Conceptual Site Model for PRI 10
Current and Future Land Use Scenarios
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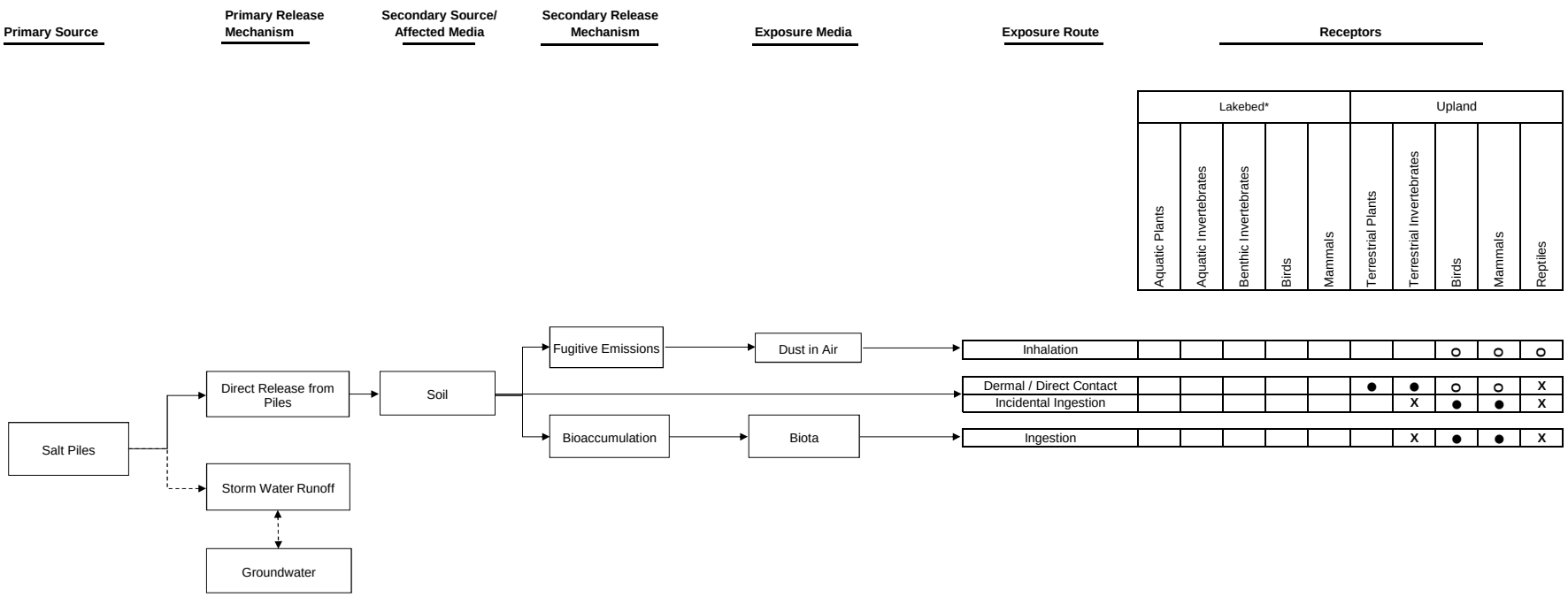

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X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
--→ incomplete exposure pathway
* Lakebed habitat is not present in this PRI.

Figure 2-17
Conceptual Site Model for PRI 12
Current and Future Land Use Scenarios
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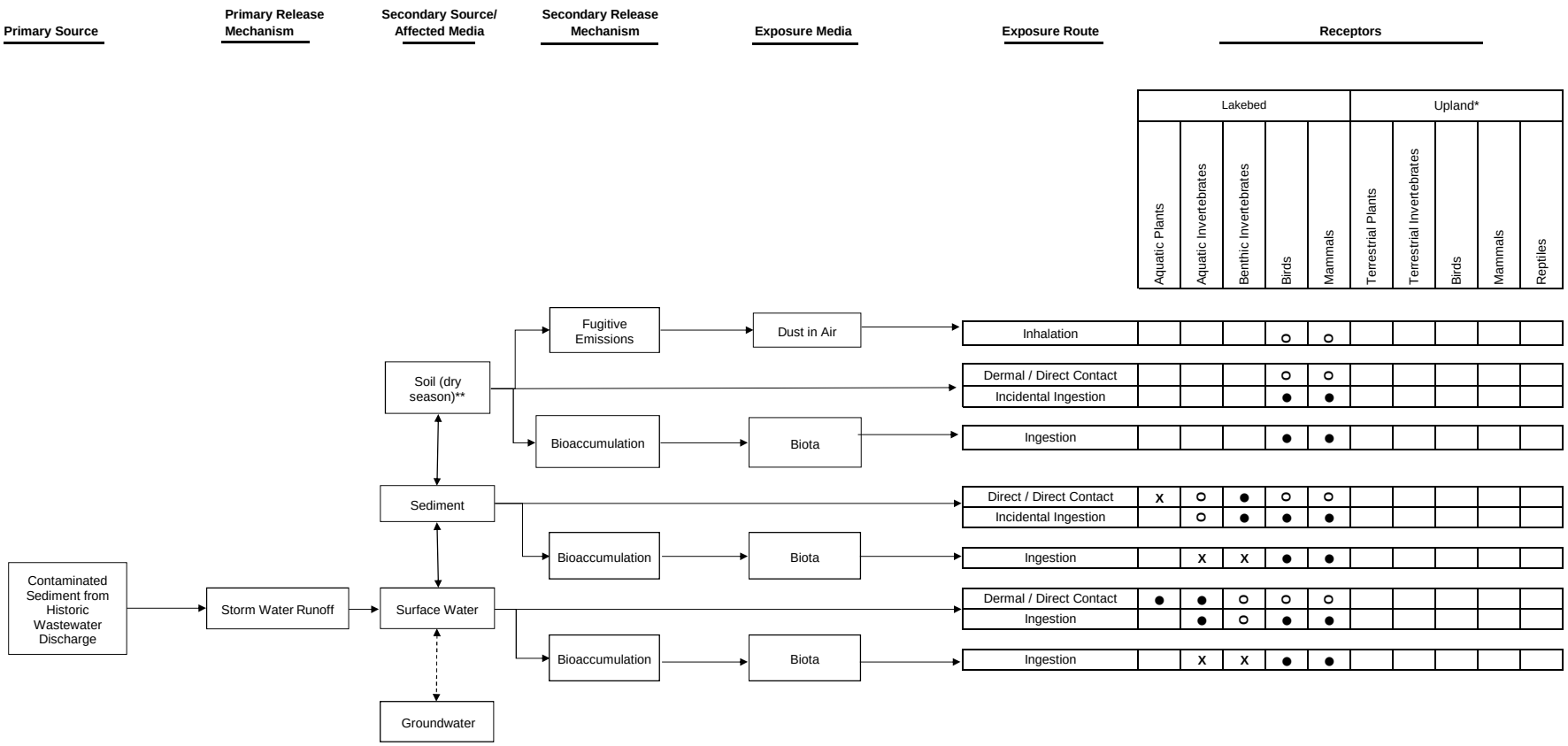

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

- - - → incomplete exposure pathway

* Upland habitat is not present in this PRI.

** In the dry season, the sediment dries out to have characteristics of a salt flat.

Figure 2-18
Conceptual Site Model for PRI 13
Current and Future Land Use Scenarios
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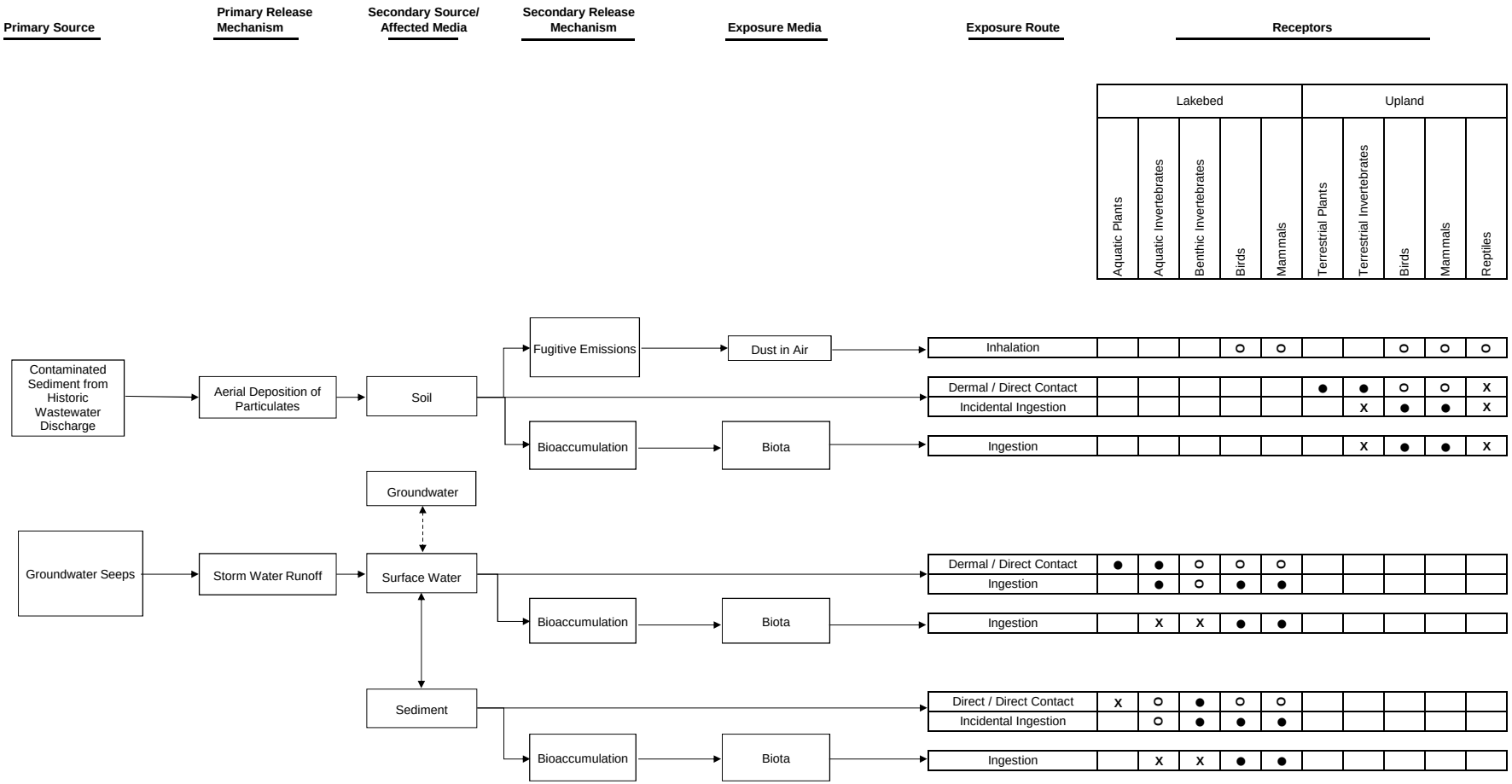

Figure 2-19
Conceptual Site Model for PRI 14
Current and Future Land Use Scenarios
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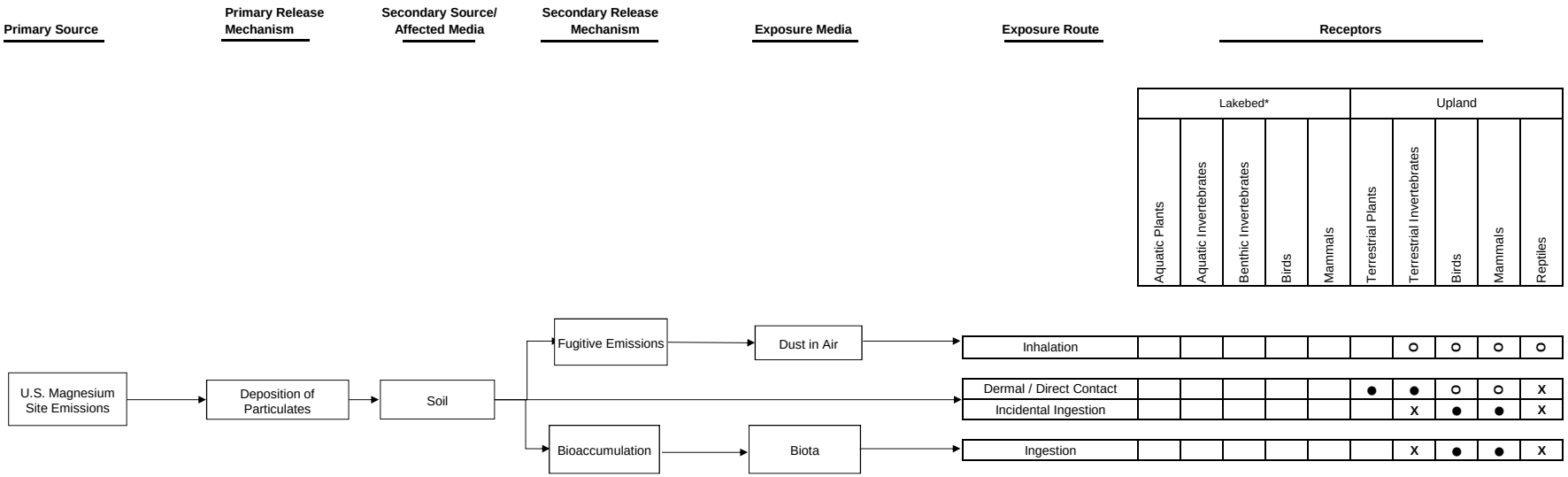

●	Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X	Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O	Pathway is potentially complete but is likely to be minimal; not evaluated.
	Pathway is not complete.

→ potentially complete exposure pathway

- - - → incomplete exposure pathway

* Lakebed habitat is not present in this PRI.

Figure 2-20
Conceptual Site Model for PRI 15
Current and Future Land Use Scenarios
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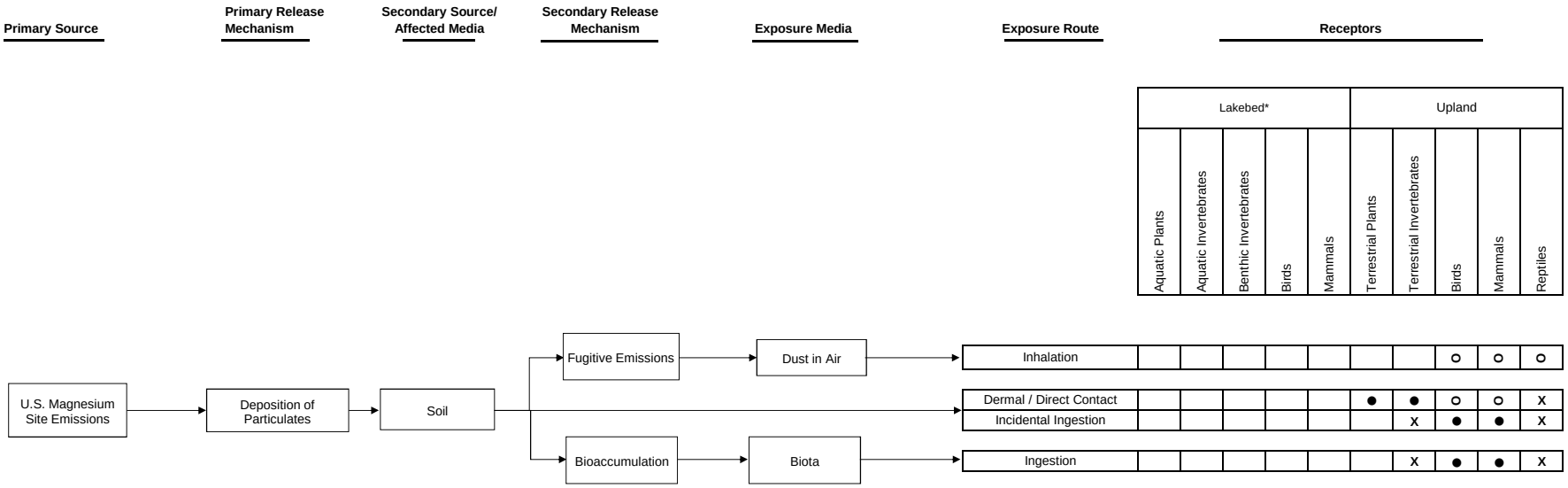

● Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
- - - → incomplete exposure pathway
* Lakebed habitat is not present in this PRI.

Figure 2-21
Conceptual Site Model for PRI 16
Current and Future Land Use Scenarios
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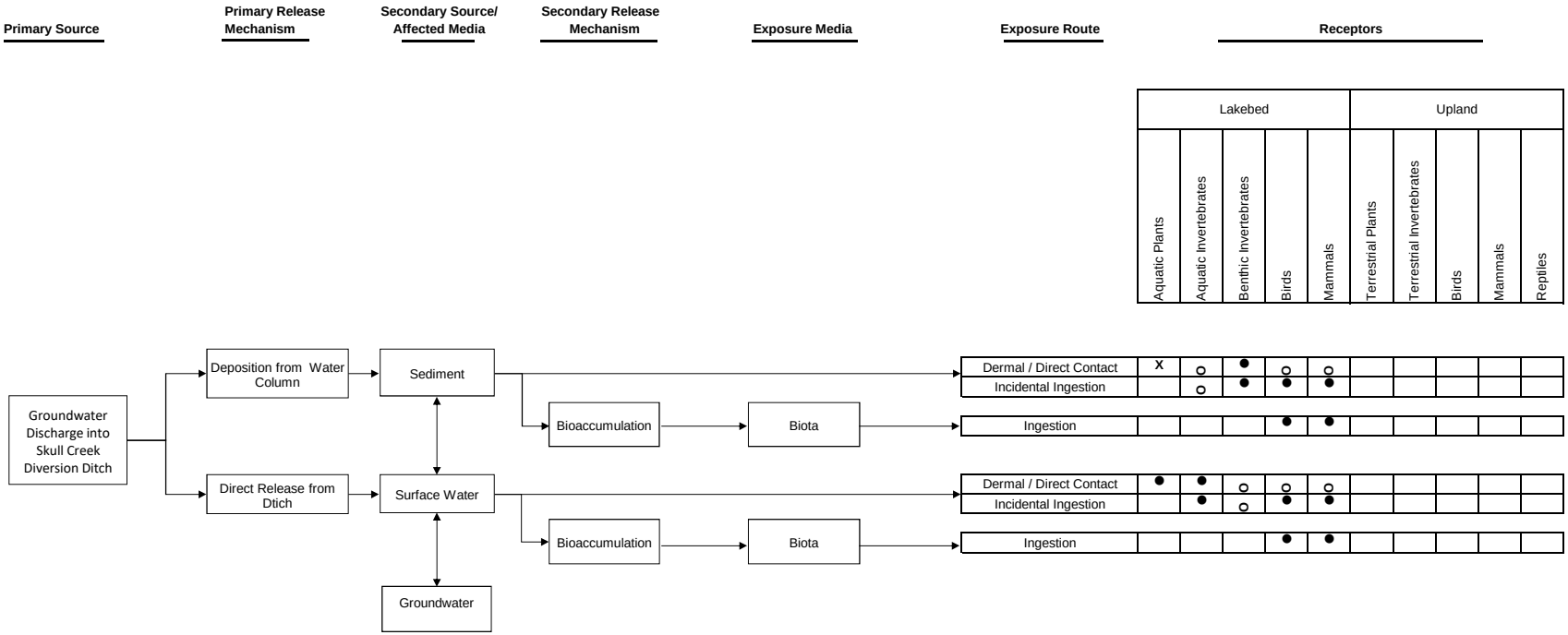

● Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
- - → incomplete exposure pathway

Figure 2-22
Conceptual Site Model for Skull Valley Diversion Ditch
Current Land Use Scenario
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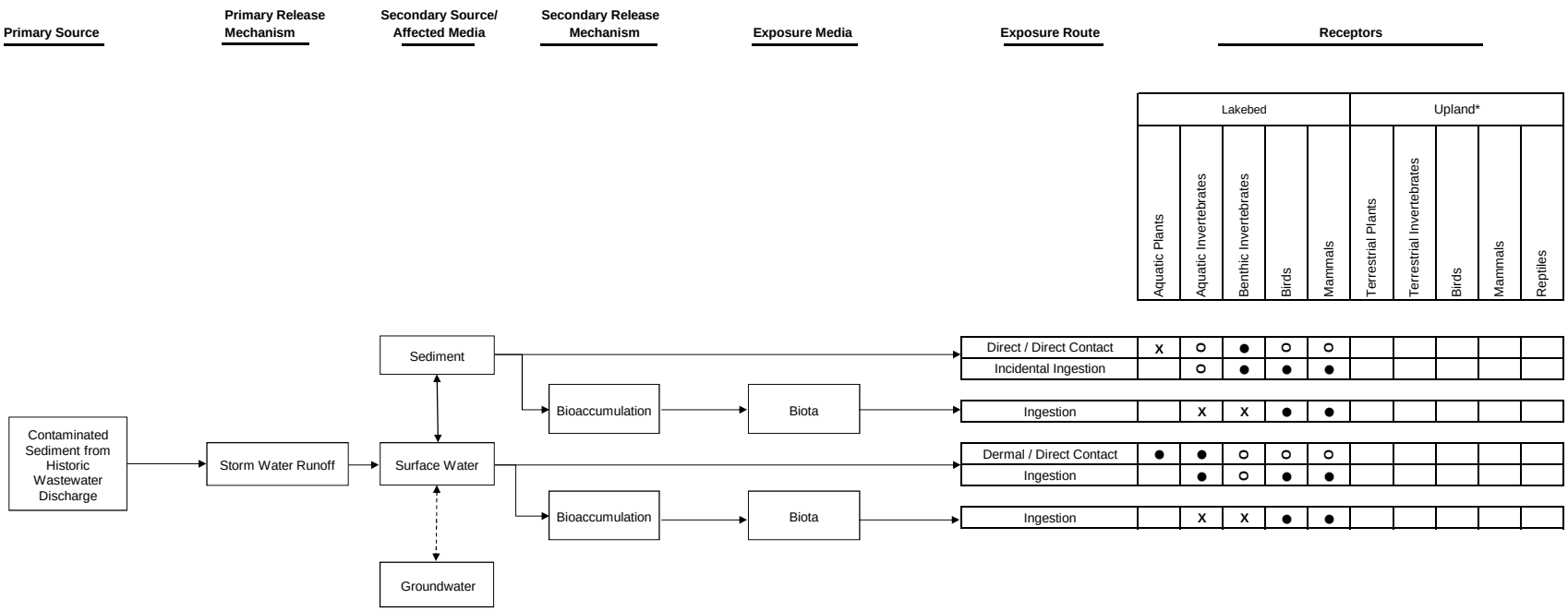

● Pathway is potentially complete and potentially significant; quantitative evaluation when appropriate toxicity factors are available.
X Pathway is potentially complete and potentially significant, but cannot be reliably quantitated; qualitative evaluation only.
O Pathway is potentially complete but is likely to be minimal; not evaluated.
Pathway is not complete.
→ potentially complete exposure pathway
- - - → incomplete exposure pathway
* Upland habitat is not present in this PRI.
** In the dry season, the sediment dries out to have characteristics of a salt flat.

Figure 2-23
Conceptual Site Model for Great Salt Lake Intake Canal
Current and Future Land Use Scenarios
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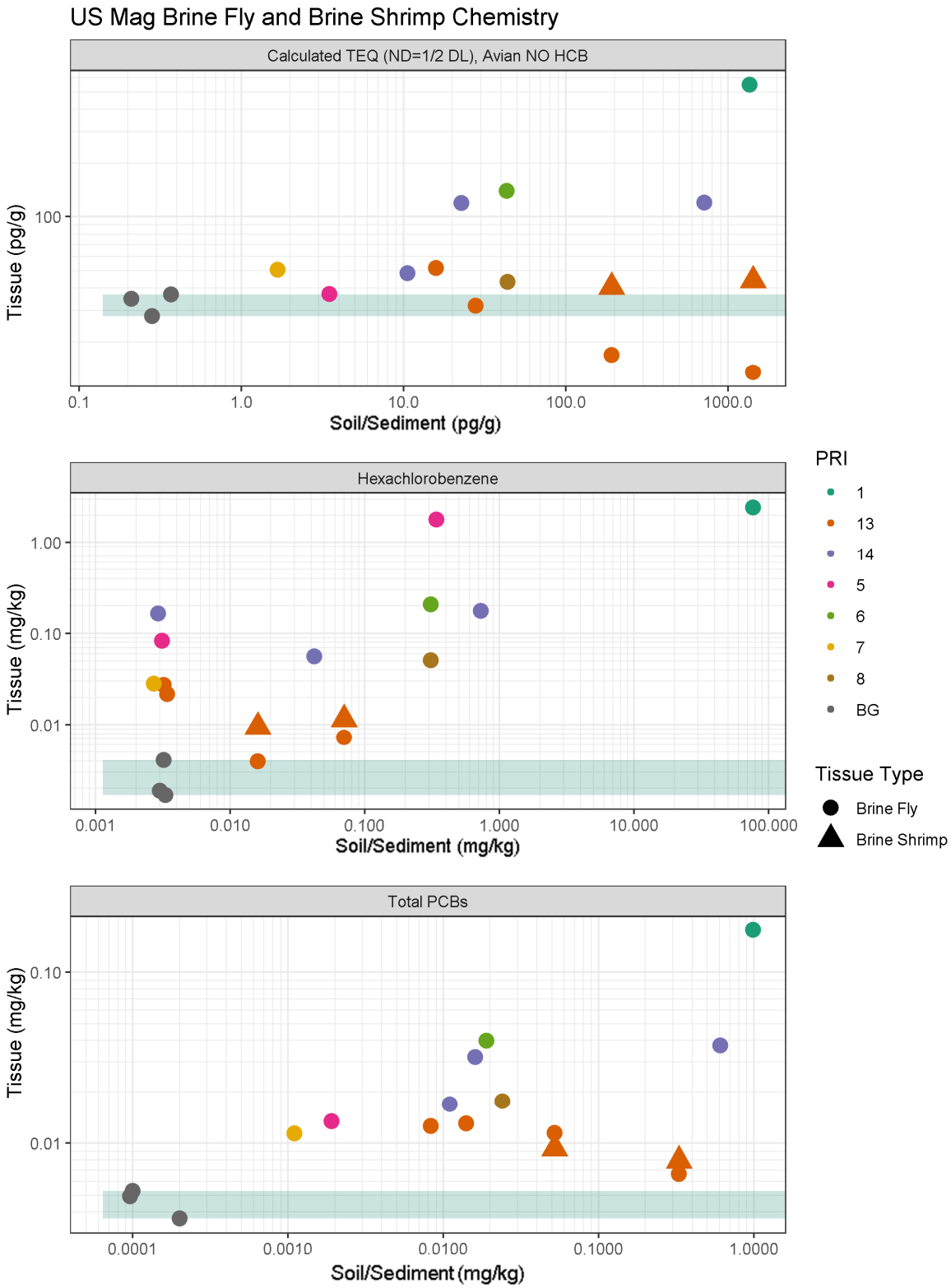

Concentrations of avian TEQ without hexachlorobenzene (top graph), hexachlorobenzene (middle graph), and total PCBs (bottom graph) in brine flies and brine shrimp collected at US Magnesium. Green shading represents the range of background values for brine fly tissue.

Figure 2-24

Tissue Versus Soil/Sediment Concentrations for Brine Flies and Brine Shrimp

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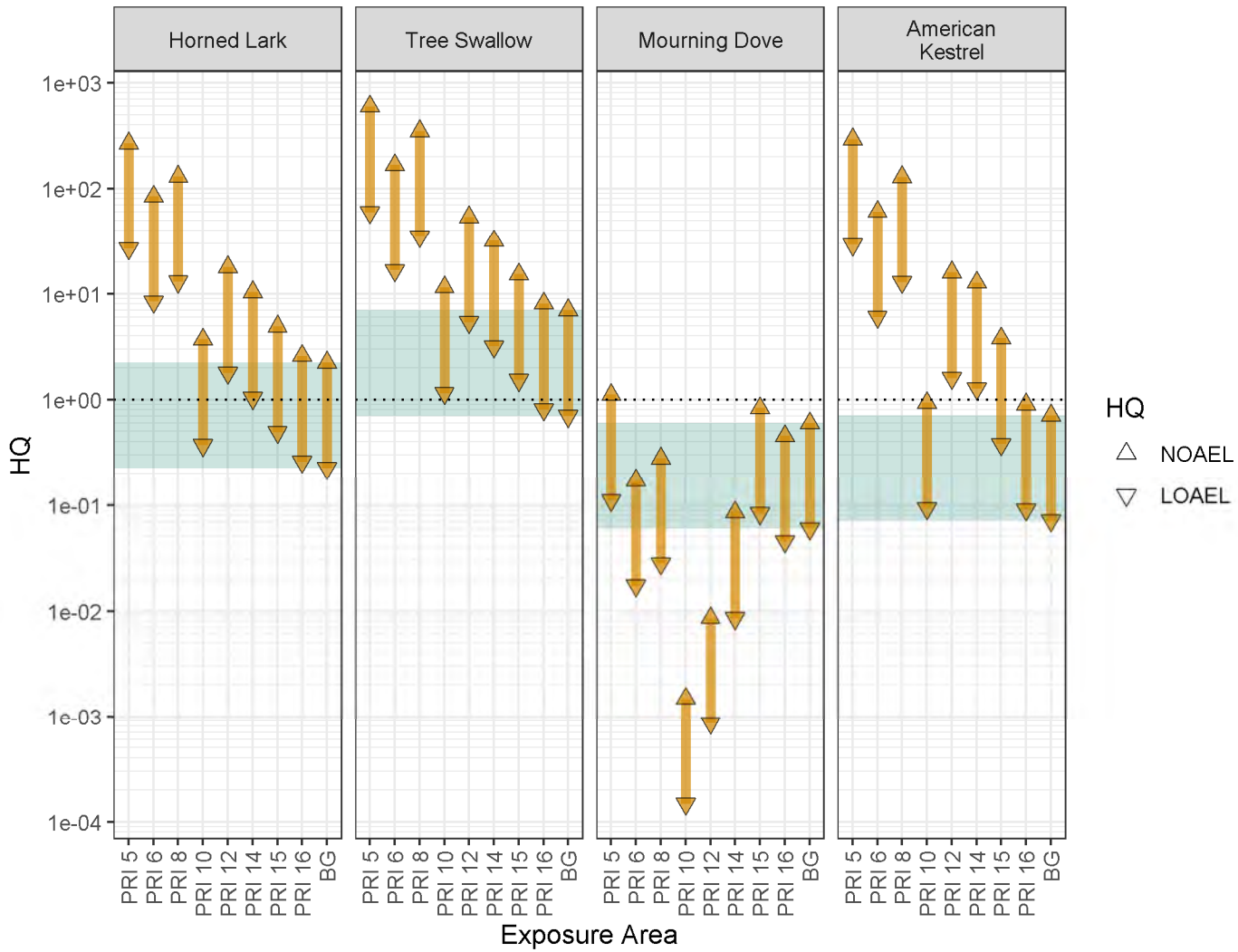

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1a
Avian Chronic Dietary Dose HQs in Upland Habitat
Avian TEQ Category 1 ND=1/2DL

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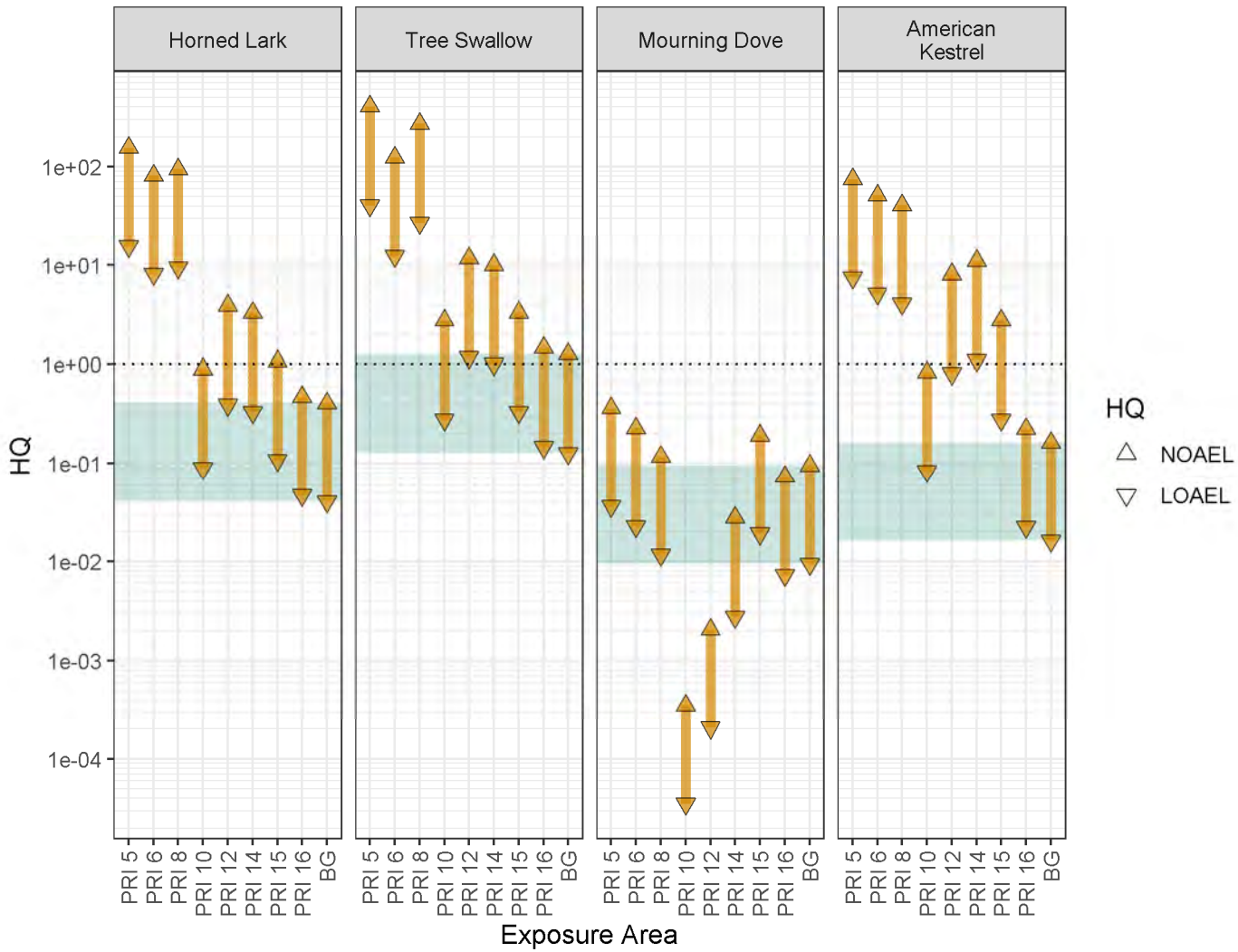

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1b
Avian Chronic Dietary Dose HQs in Upland Habitat
Avian TEQ Category 2 ND=1/2DL

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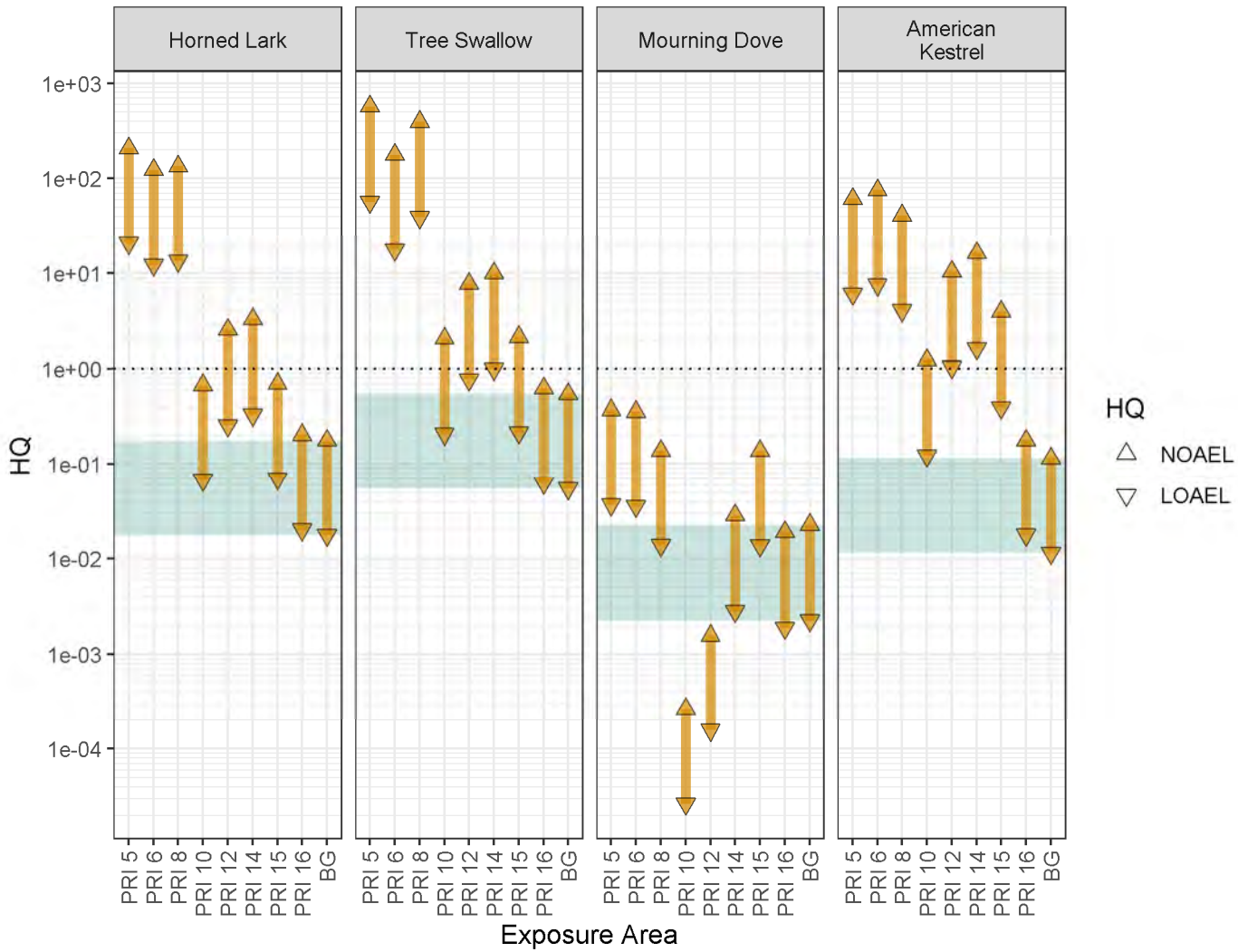

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1c
Avian Chronic Dietary Dose HQs in Upland Habitat
Avian TEQ Category 3 ND=1/2DL

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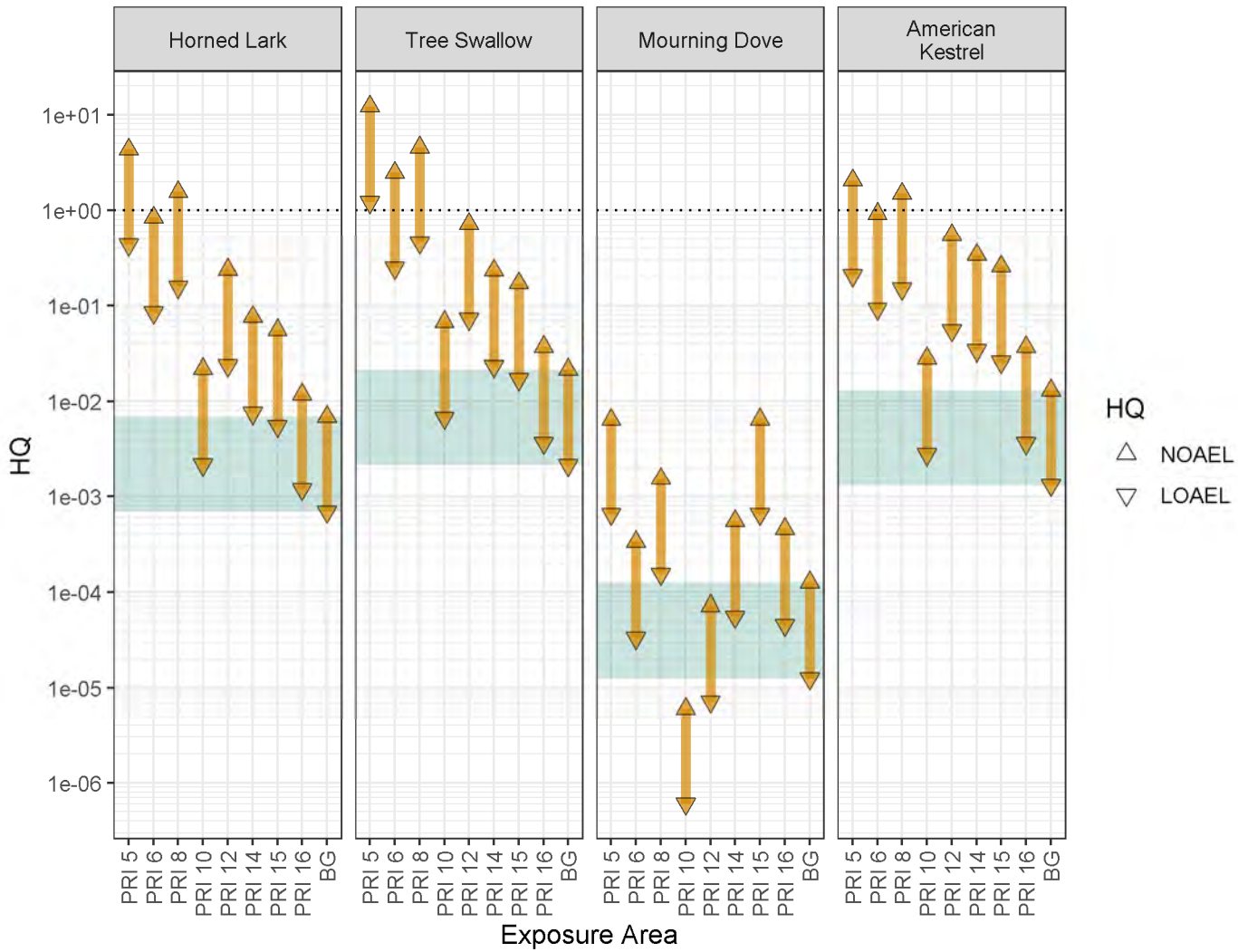

Figure 3-1d
Avian Chronic Dietary Dose HQs in Upland Habitat
Total PCBs

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

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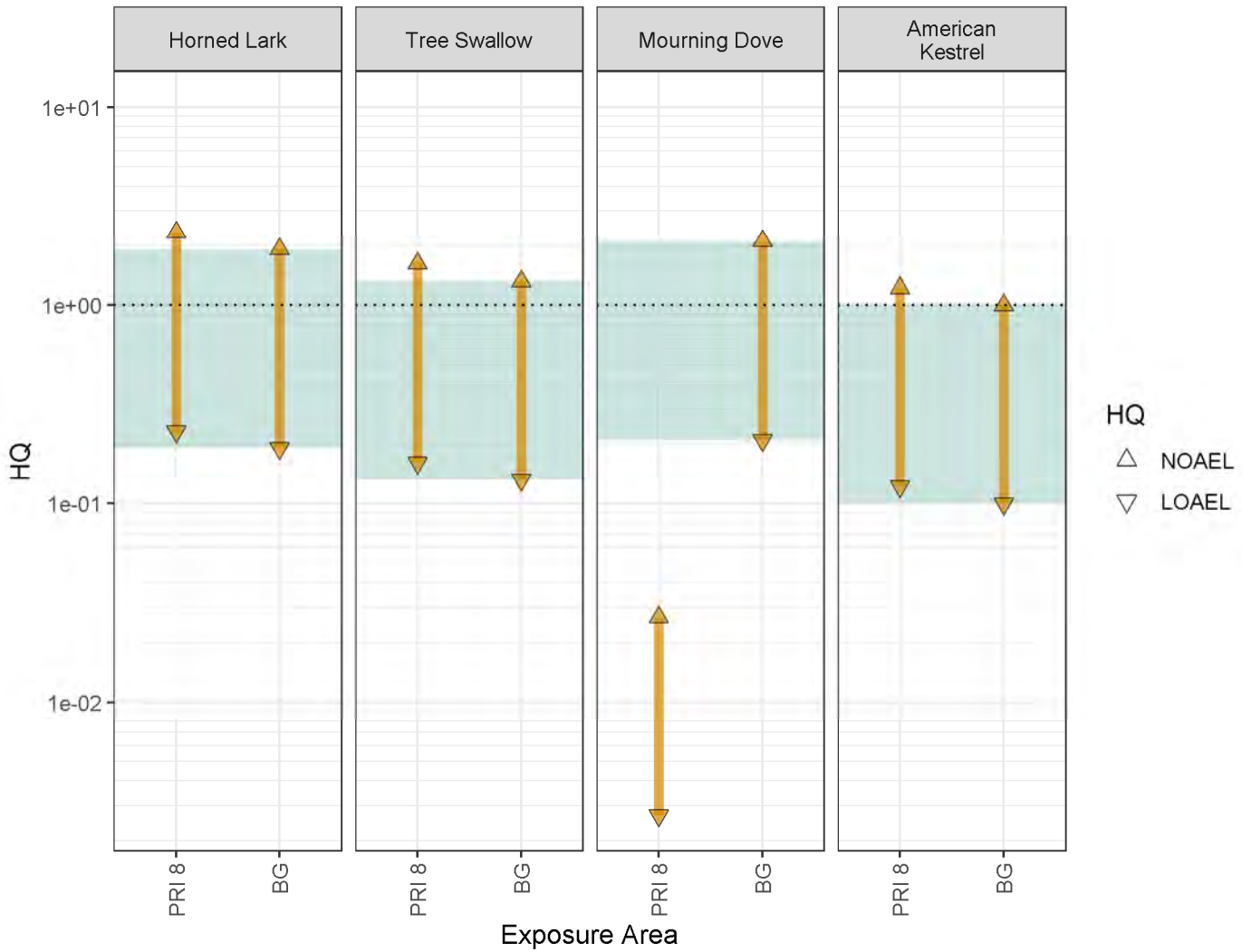

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1e
Avian Chronic Dietary Dose HQs in Upland Habitat
Aluminum

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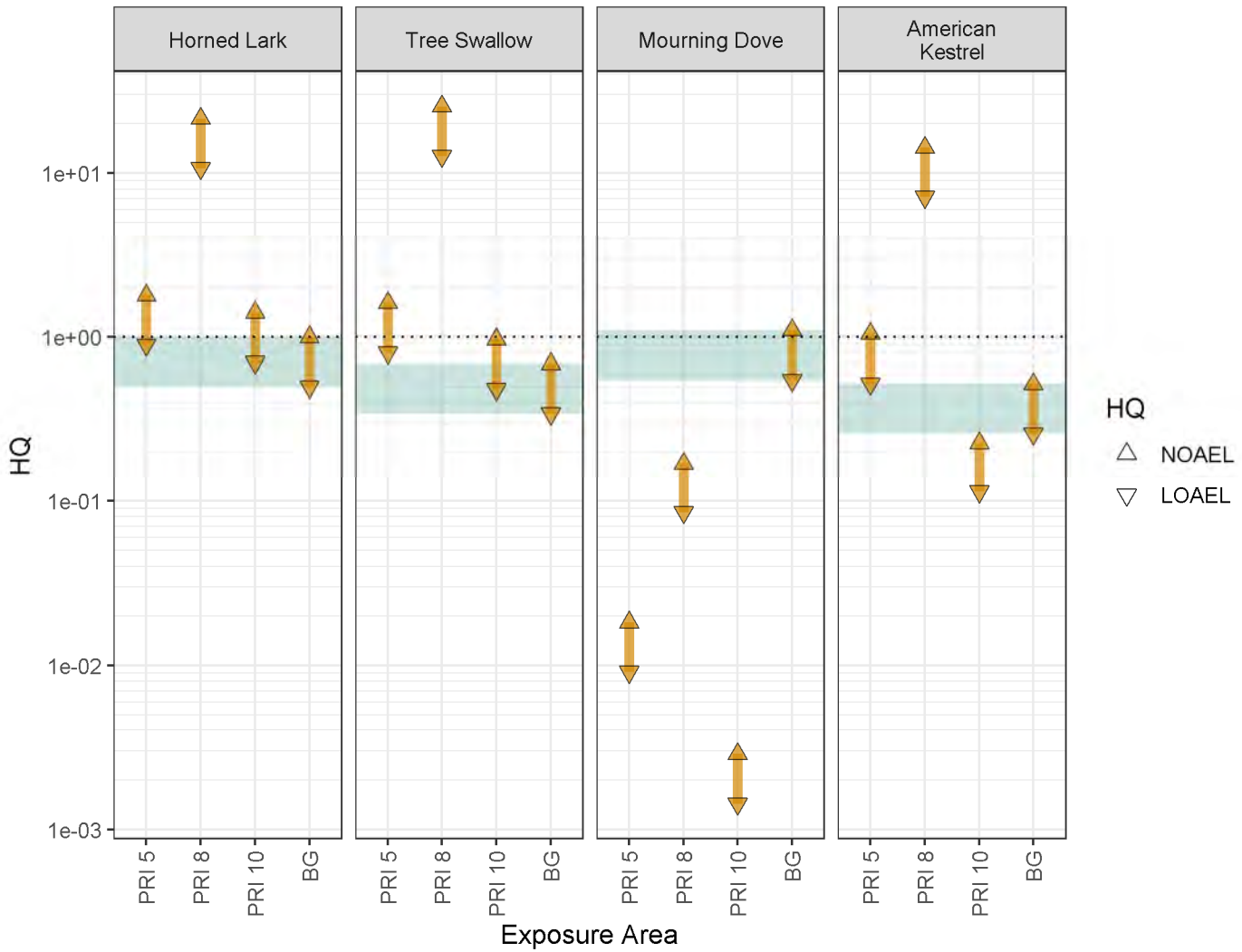

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1f
Avian Chronic Dietary Dose HQs in Upland Habitat
Vanadium

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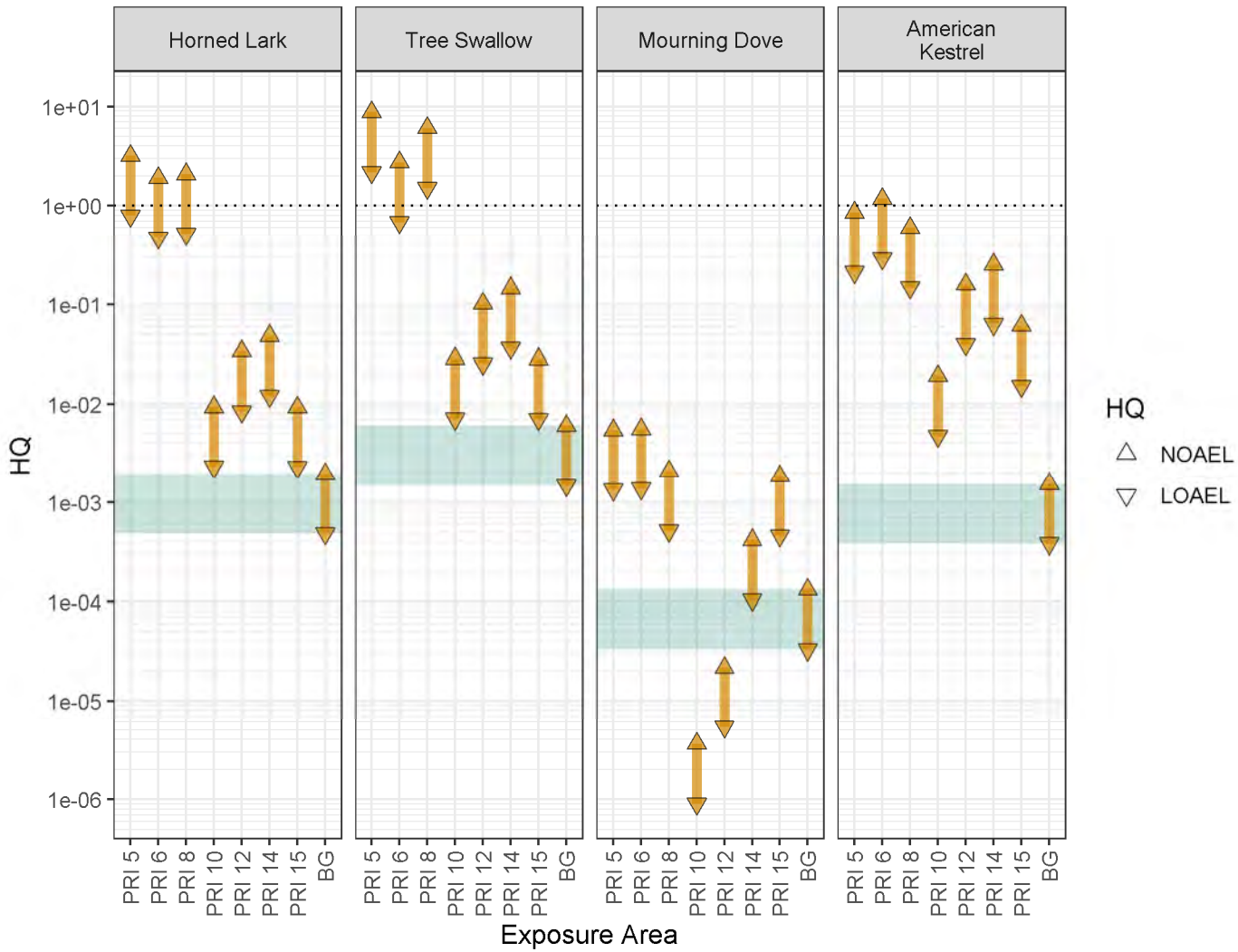

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1g
Avian Chronic Dietary Dose HQs in Upland Habitat
Hexachlorobenzene

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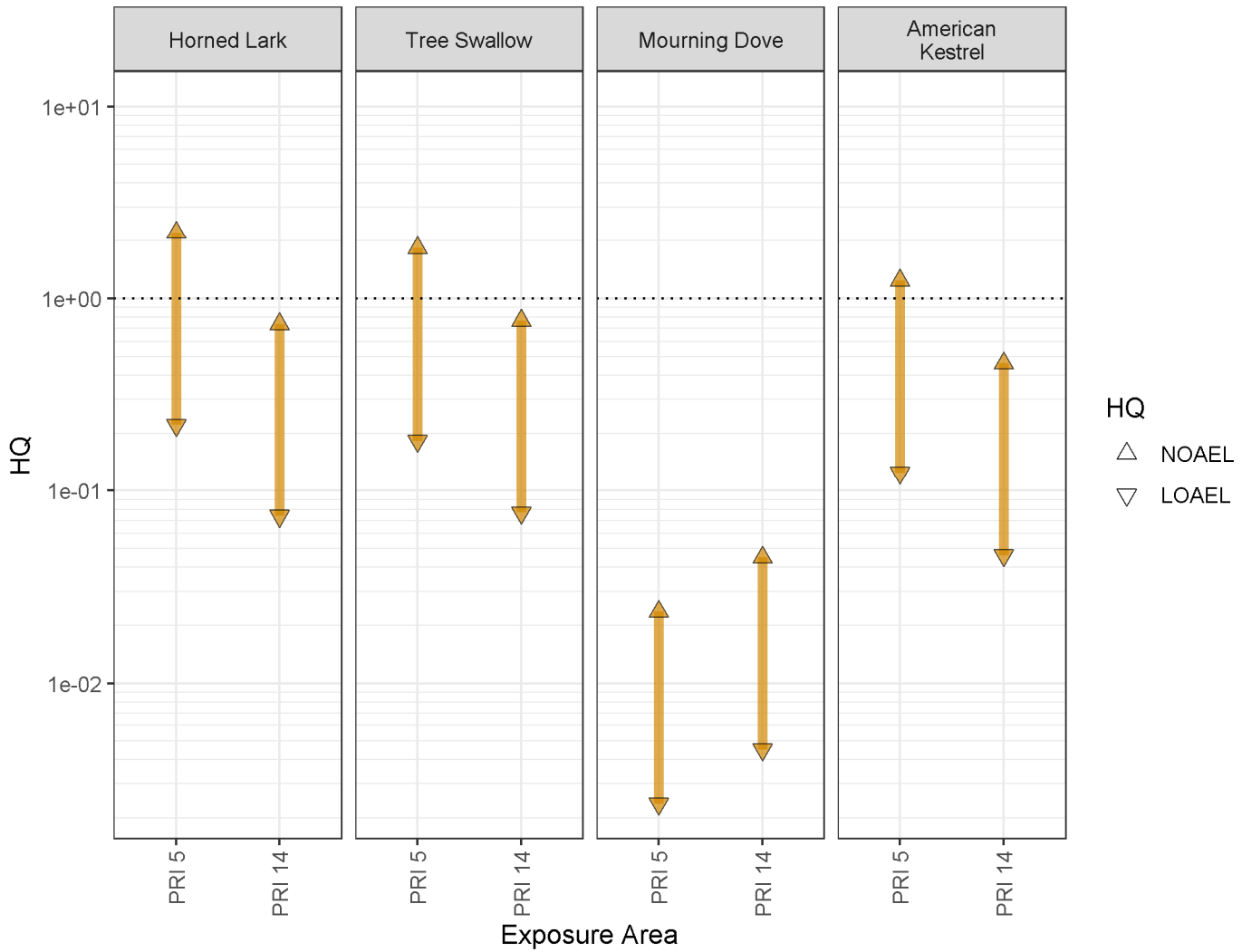

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-1h
Avian Chronic Dietary Dose HQs in Upland Habitat
Total Cyanide

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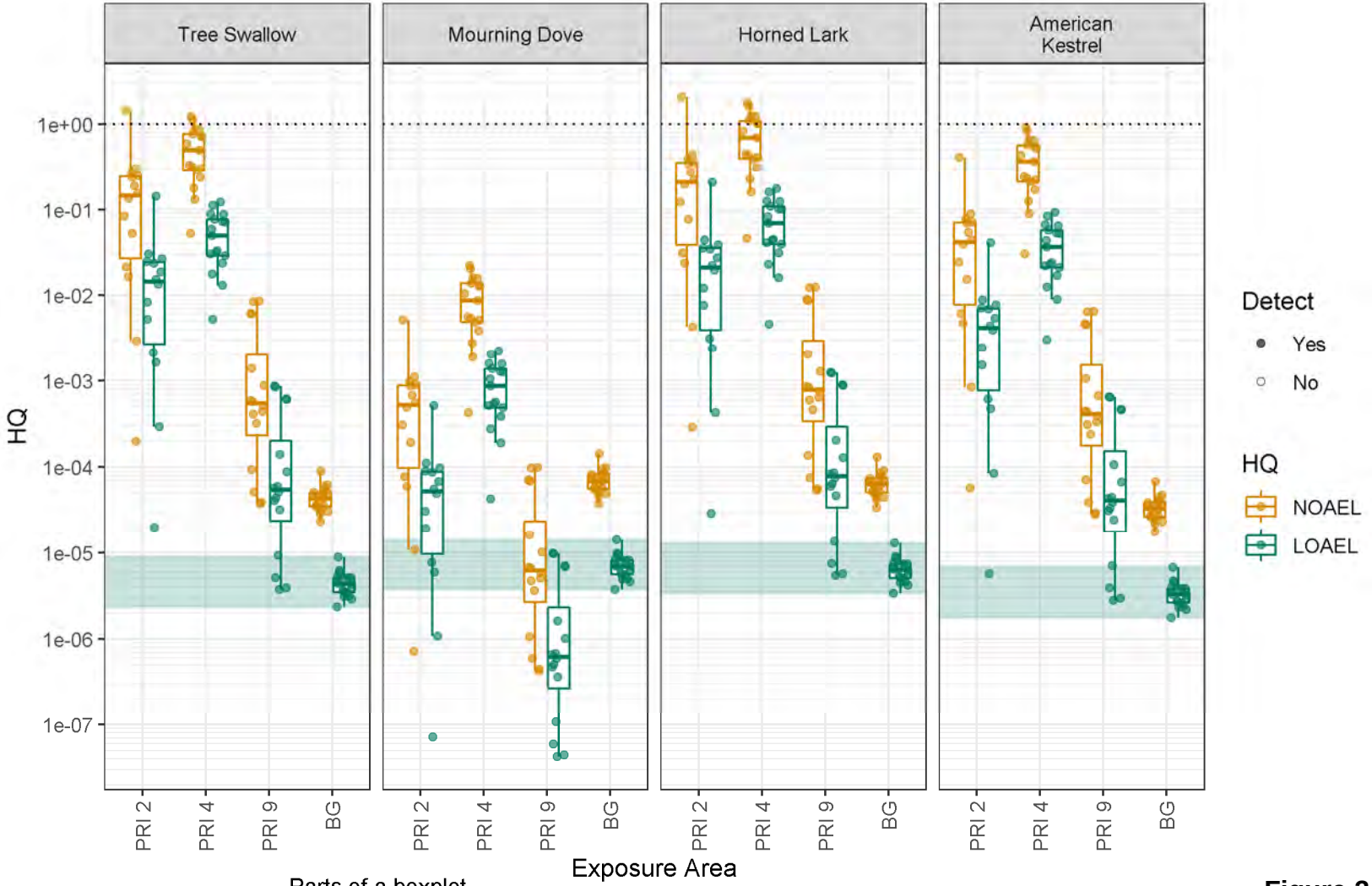
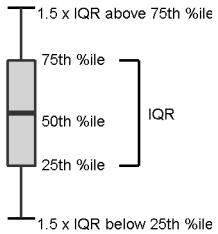


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 3-2a
Avian Acute Dietary Dose HQs in Upland Habitat
Avian TEQ Category 1 ND=1/2DL

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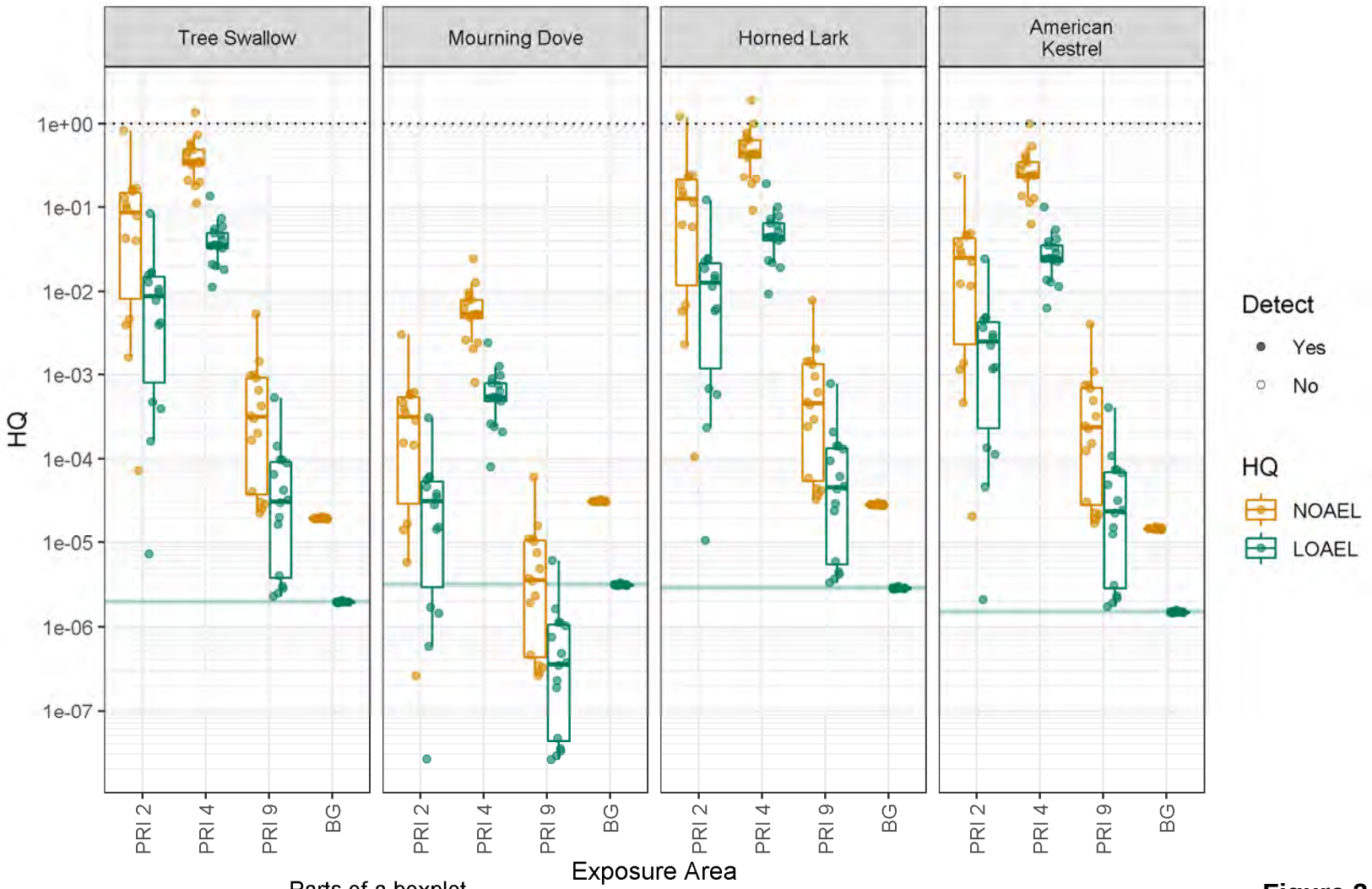
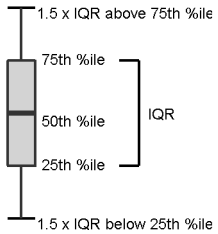


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 3-2b
Avian Acute Dietary Dose HQs in Upland Habitat
Avian TEQ Category 3 ND=1/2DL

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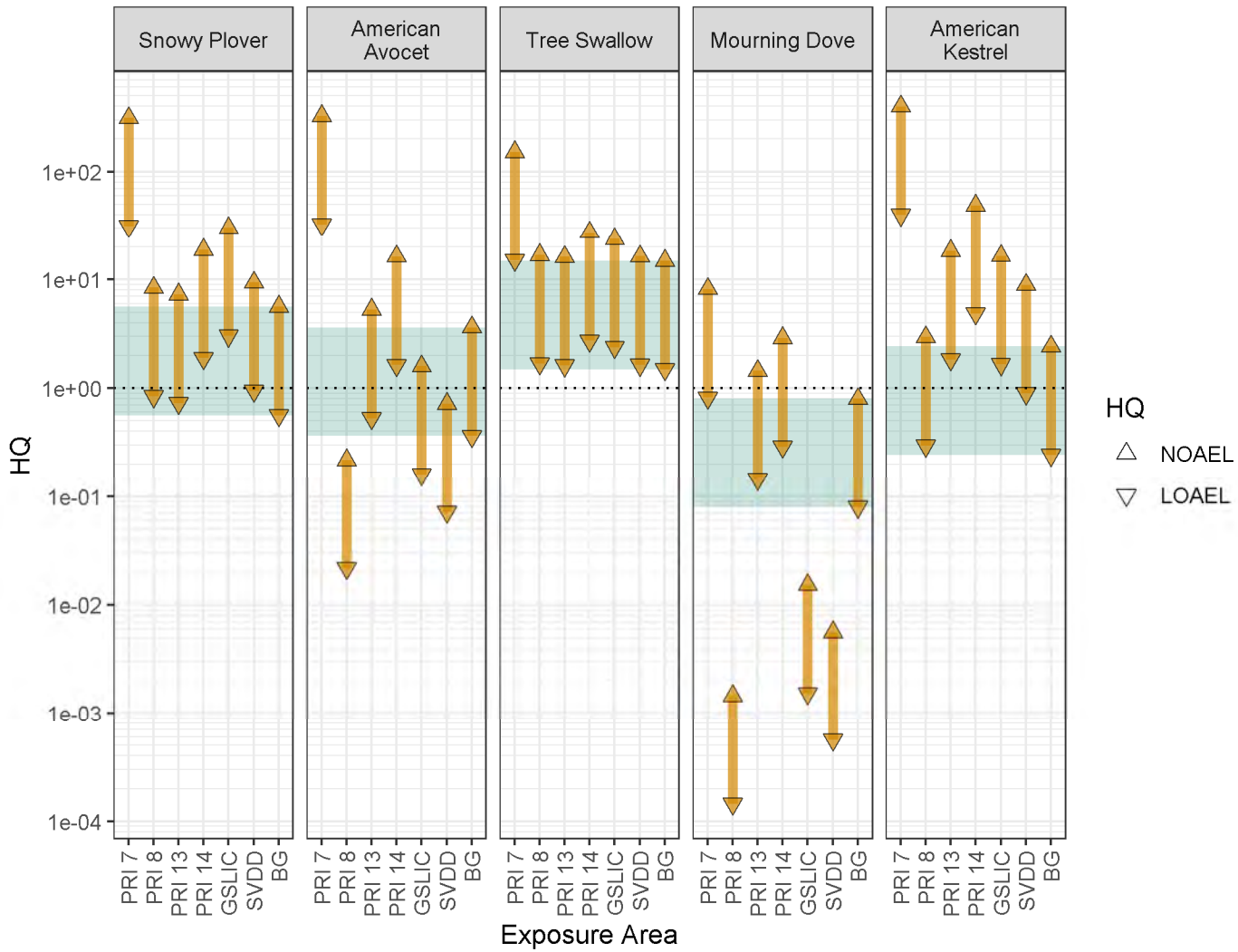

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3a
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Avian TEQ Category 1 ND=1/2DL

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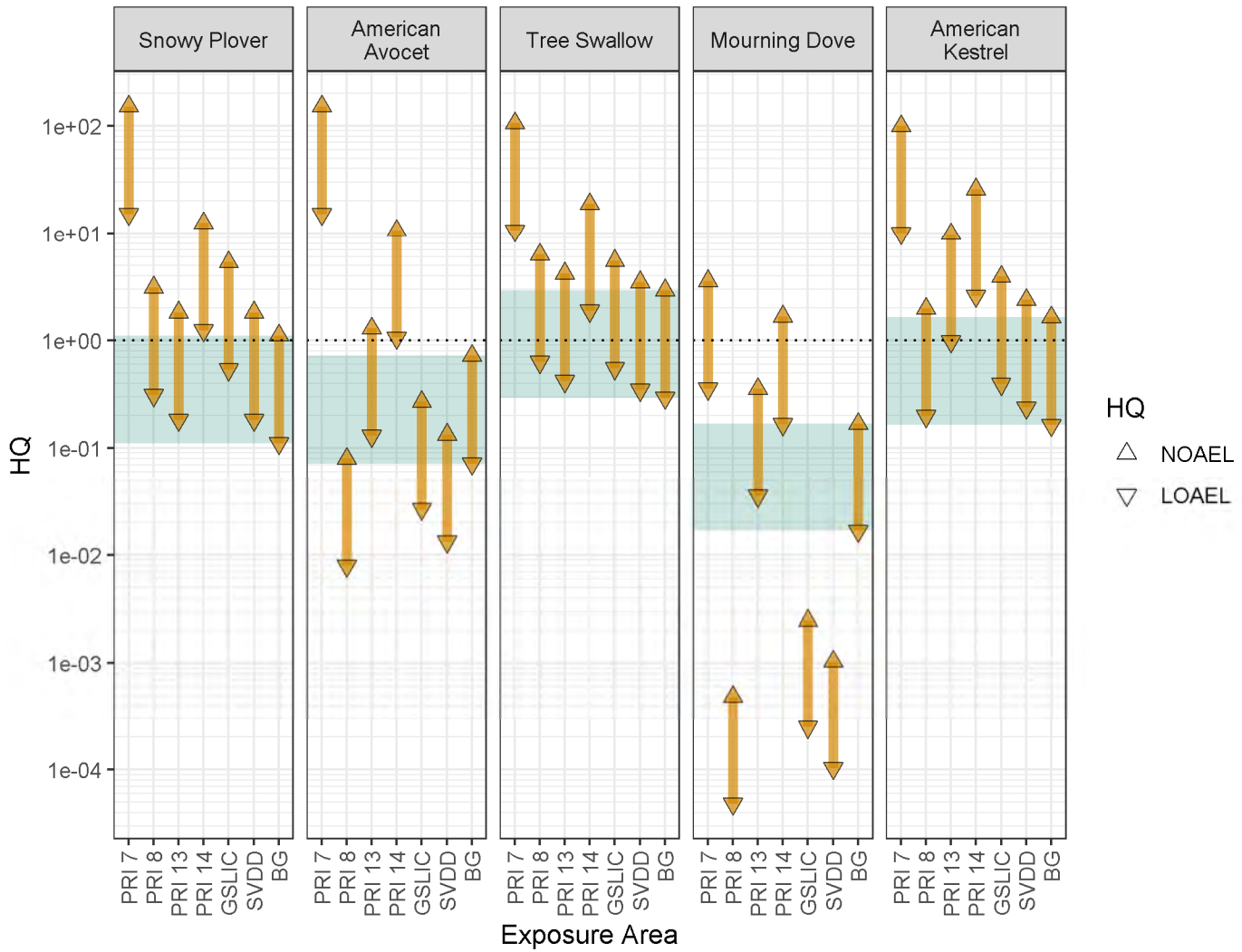

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3b
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Avian TEQ Category 2 ND=1/2DL

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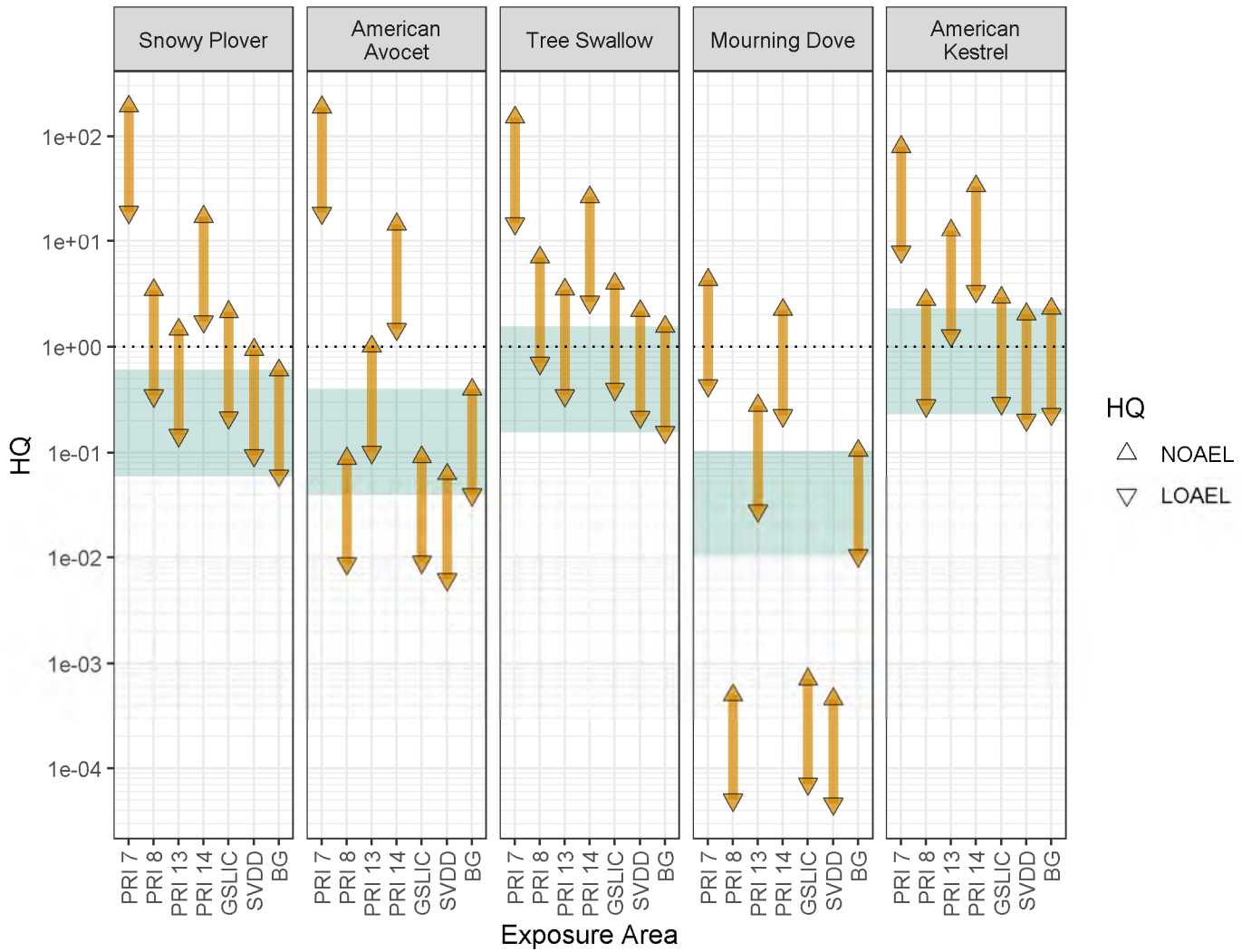

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3c
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Avian TEQ Category 3 ND=1/2DL

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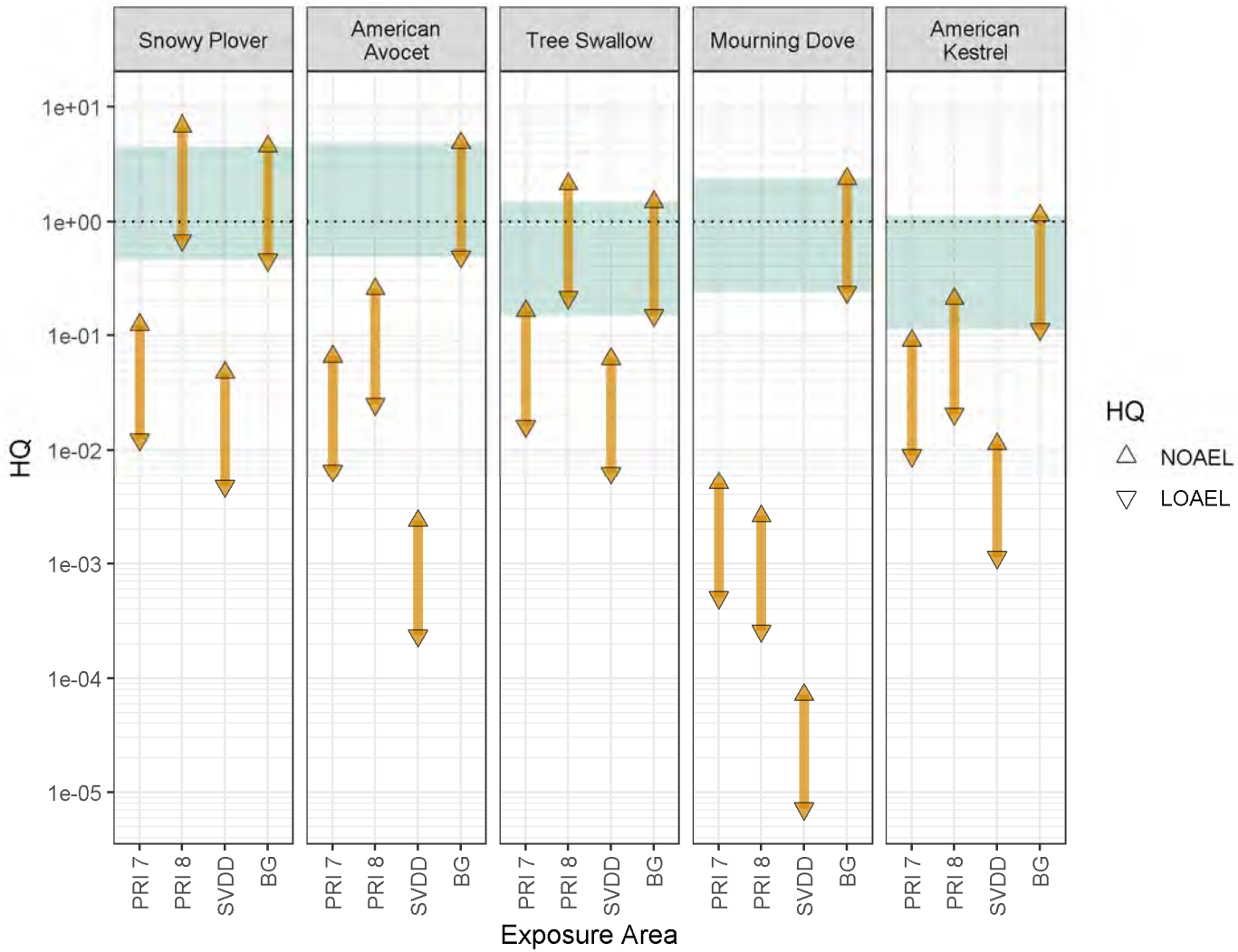

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3d
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Aluminum

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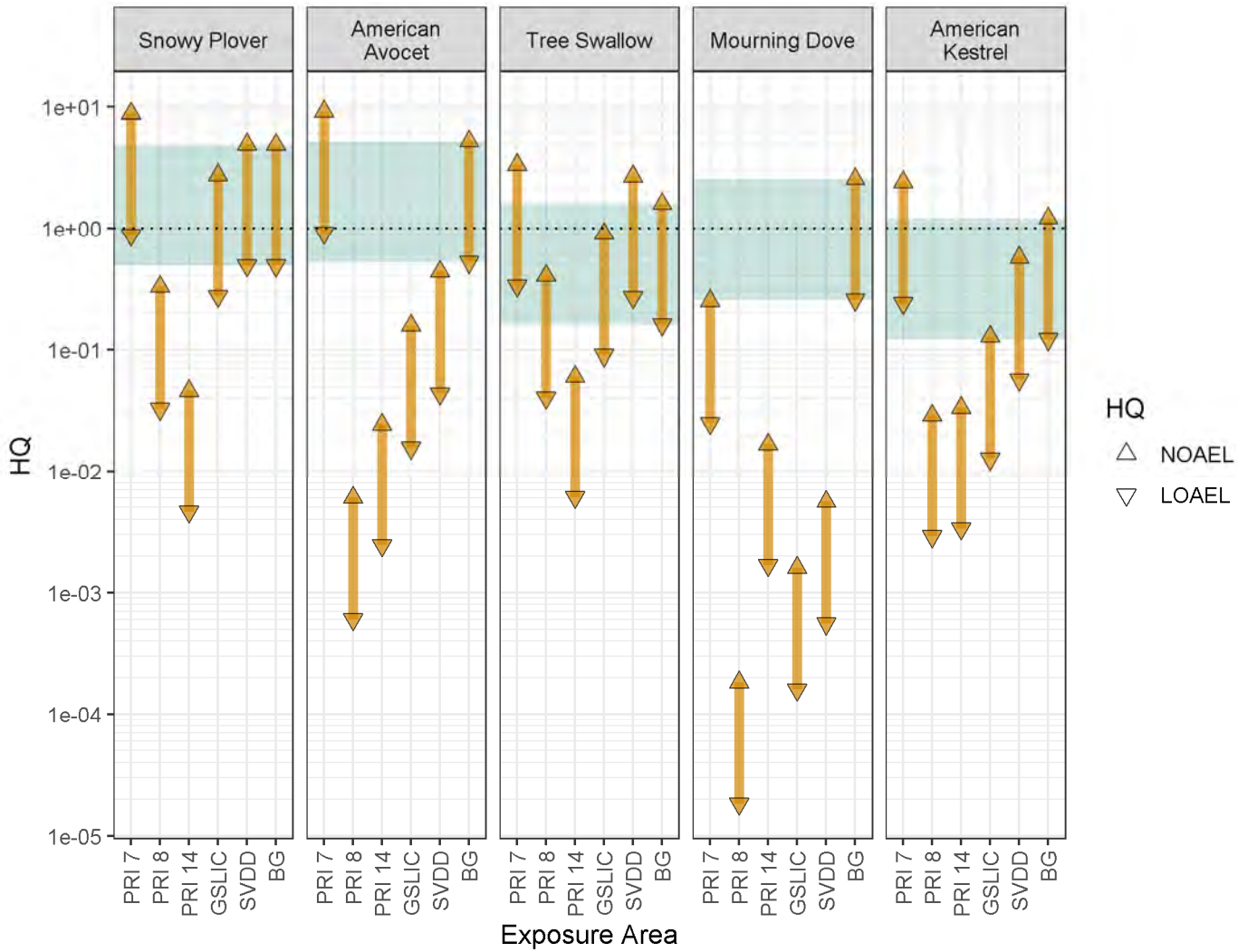

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3e
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Iron

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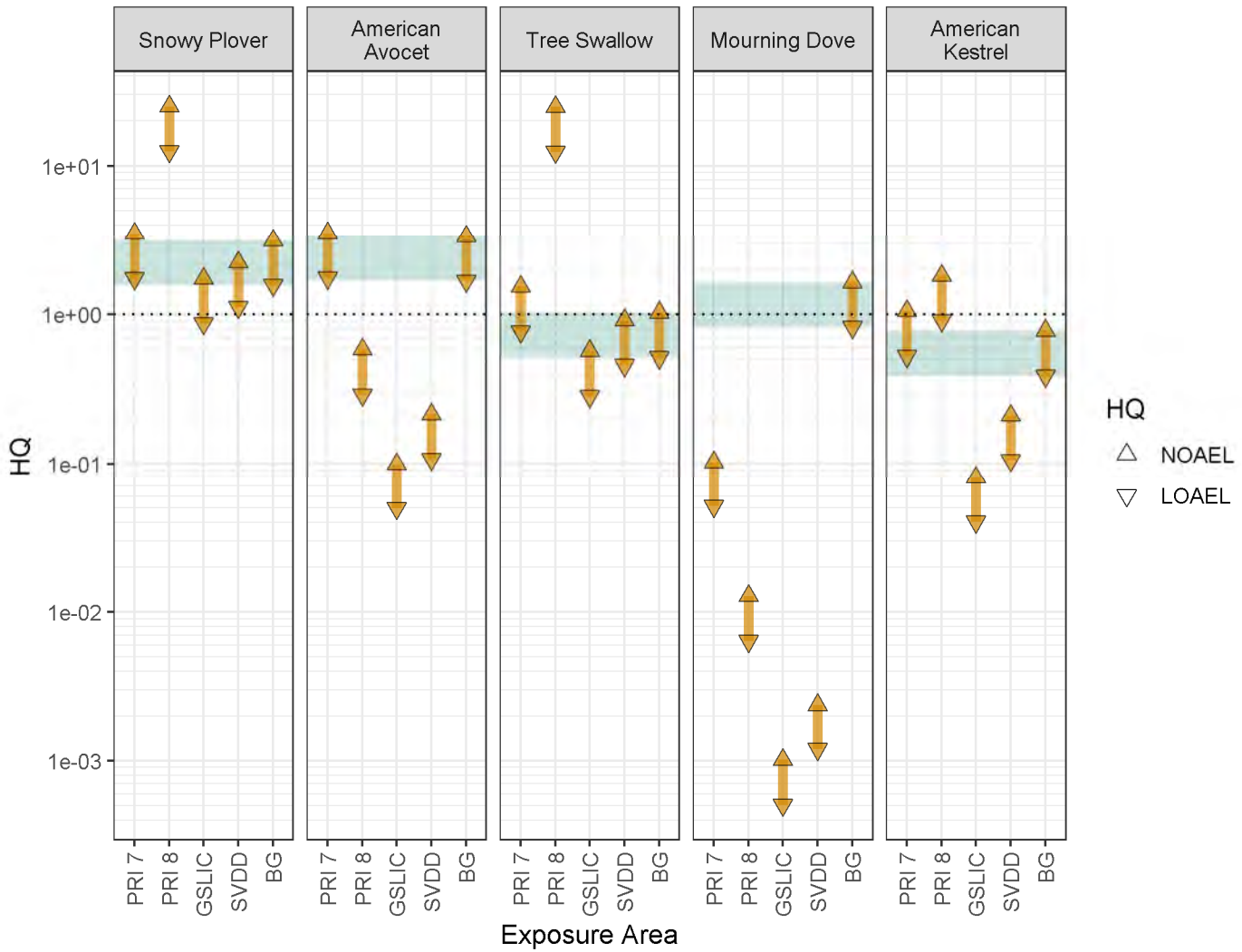

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3f
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Vanadium

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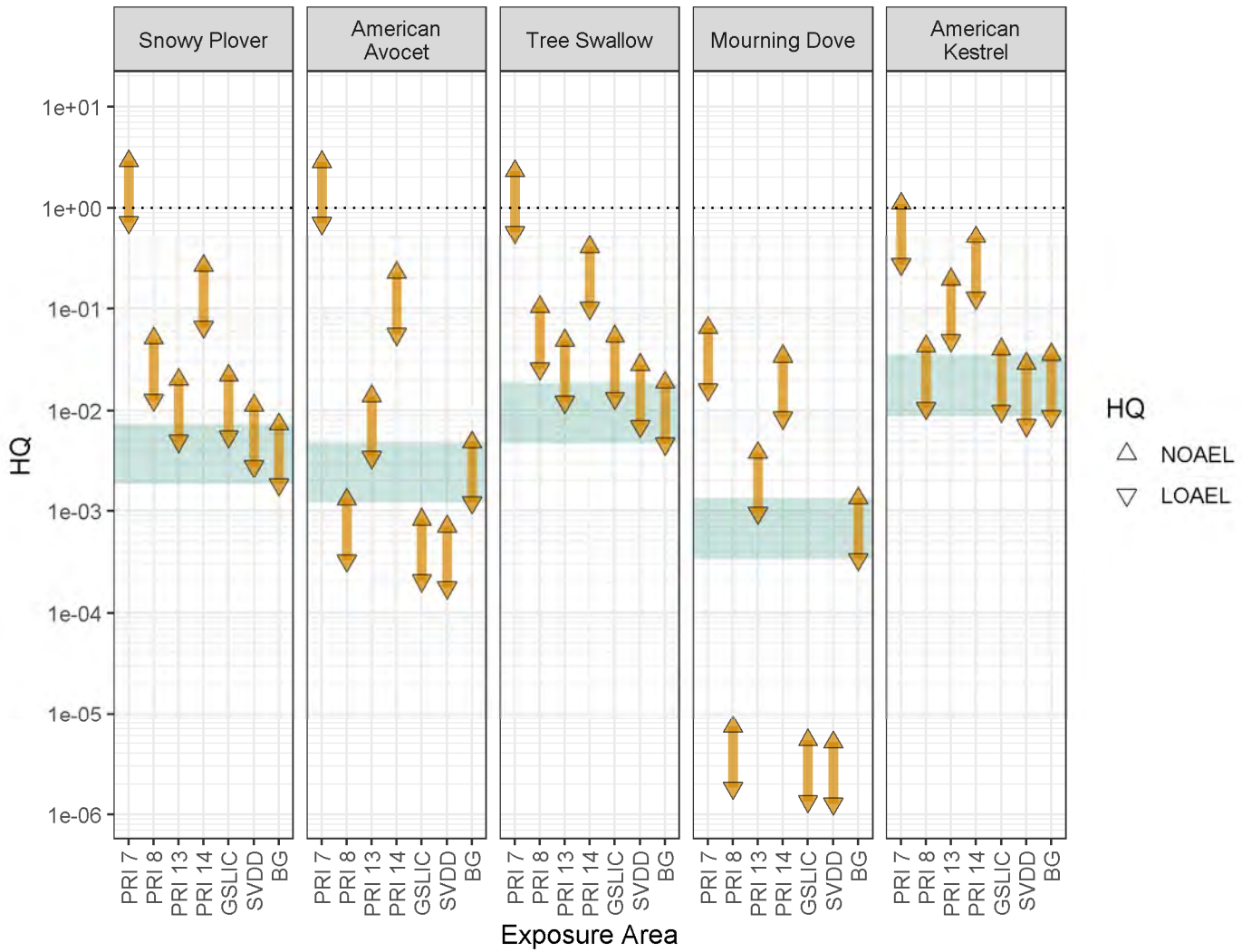

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3g
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Hexachlorobenzene

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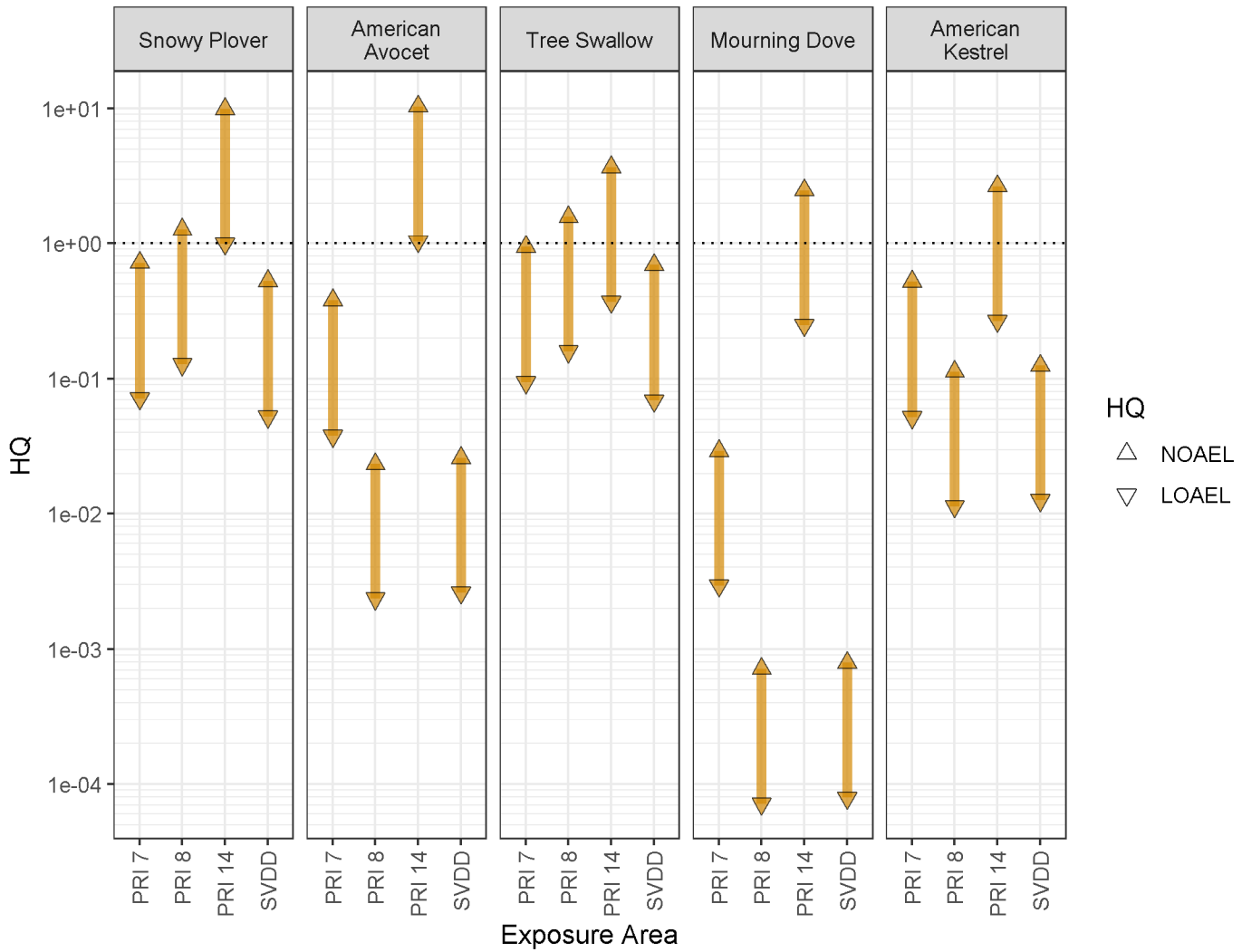

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 3-3h
Avian Chronic Dietary Dose HQs in Lakebed Habitat
Total Cyanide

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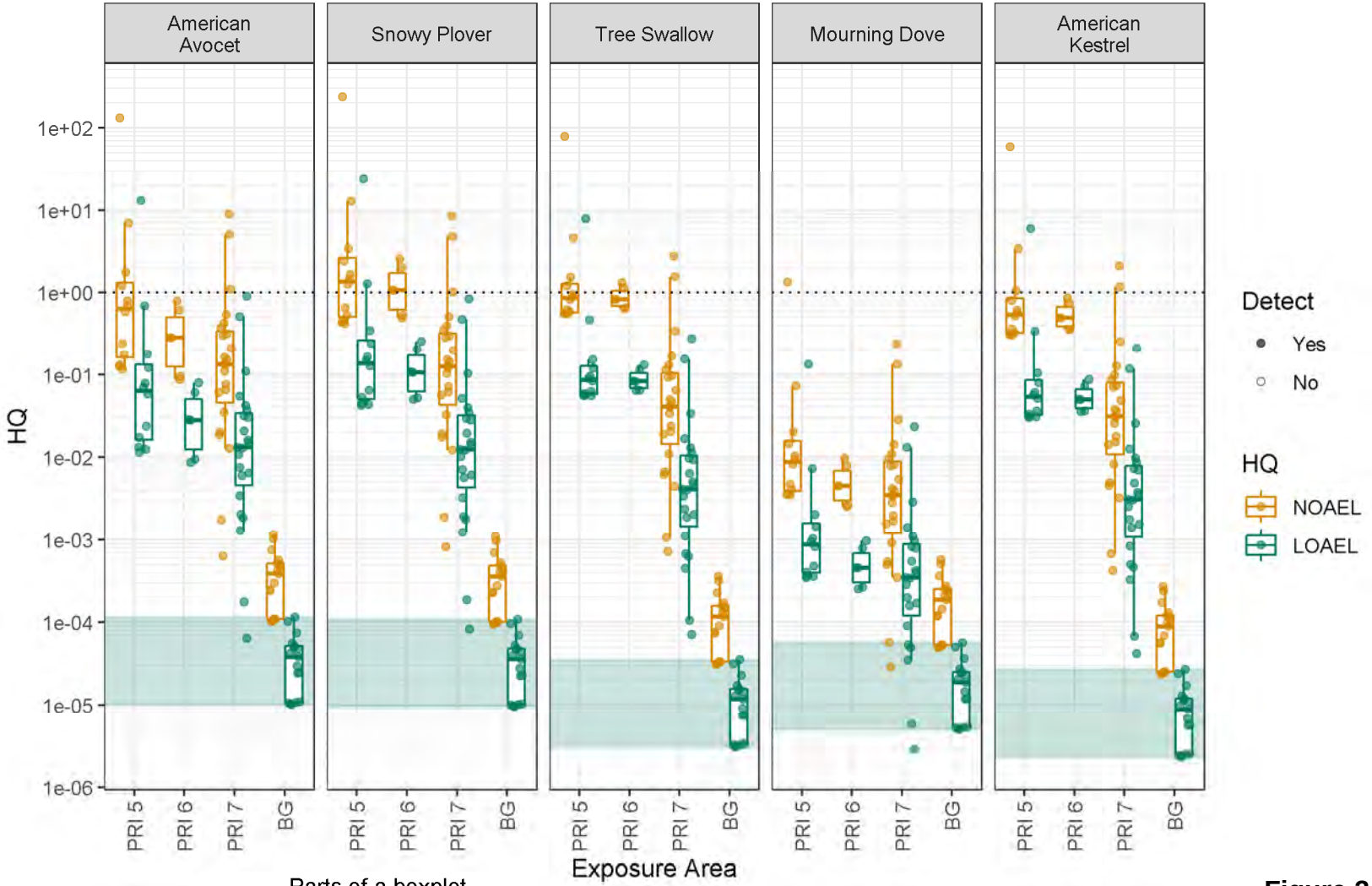
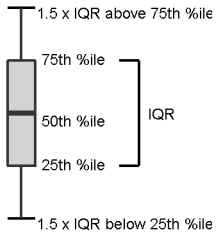


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 3-4a
Avian Acute Dietary Dose HQs in Lakebed Habitat
Avian TEQ Category 1 ND=1/2DL

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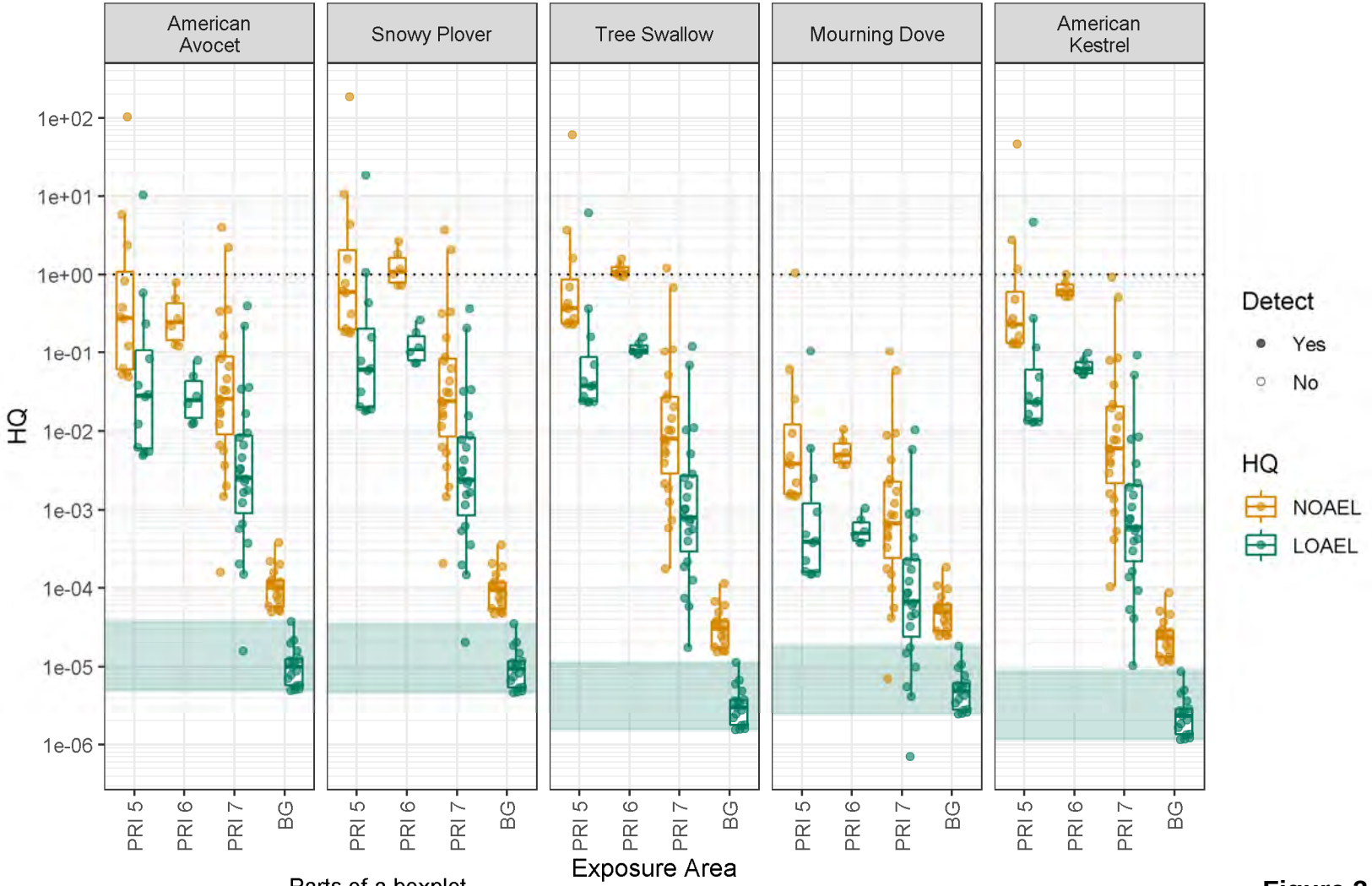

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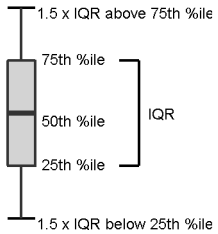

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 3-4b
Avian Acute Dietary Dose HQs in Lakebed Habitat
Avian TEQ Category 2 ND=1/2DL

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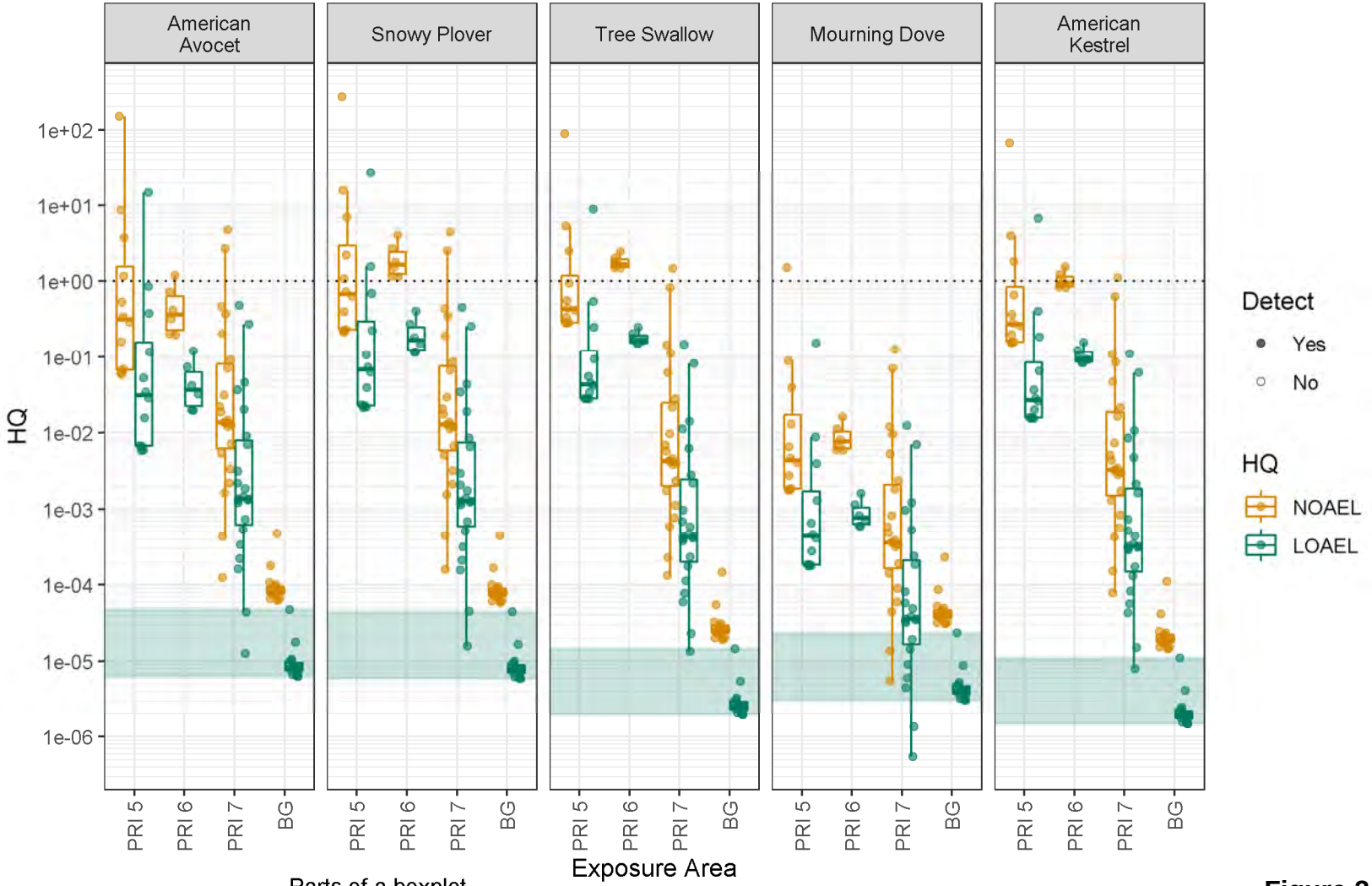

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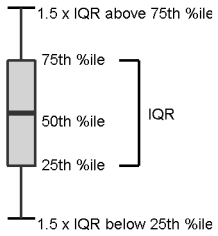

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 3-4c
Avian Acute Dietary Dose HQs in Lakebed Habitat
Avian TEQ Category 3 ND=1/2DL

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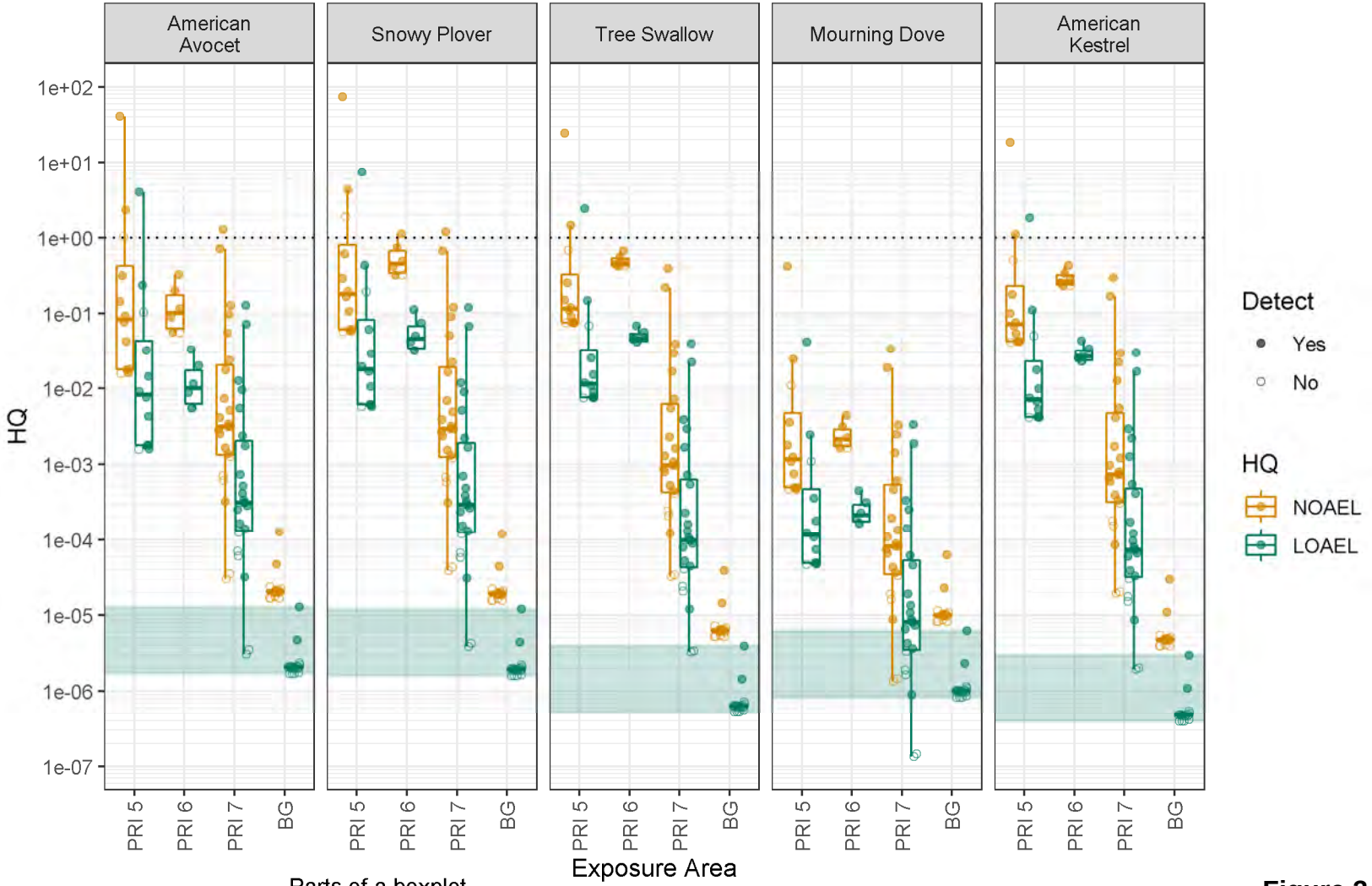
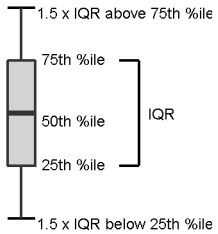


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 3-4d
Avian Acute Dietary Dose HQs in Lakebed Habitat
Hexachlorobenzene

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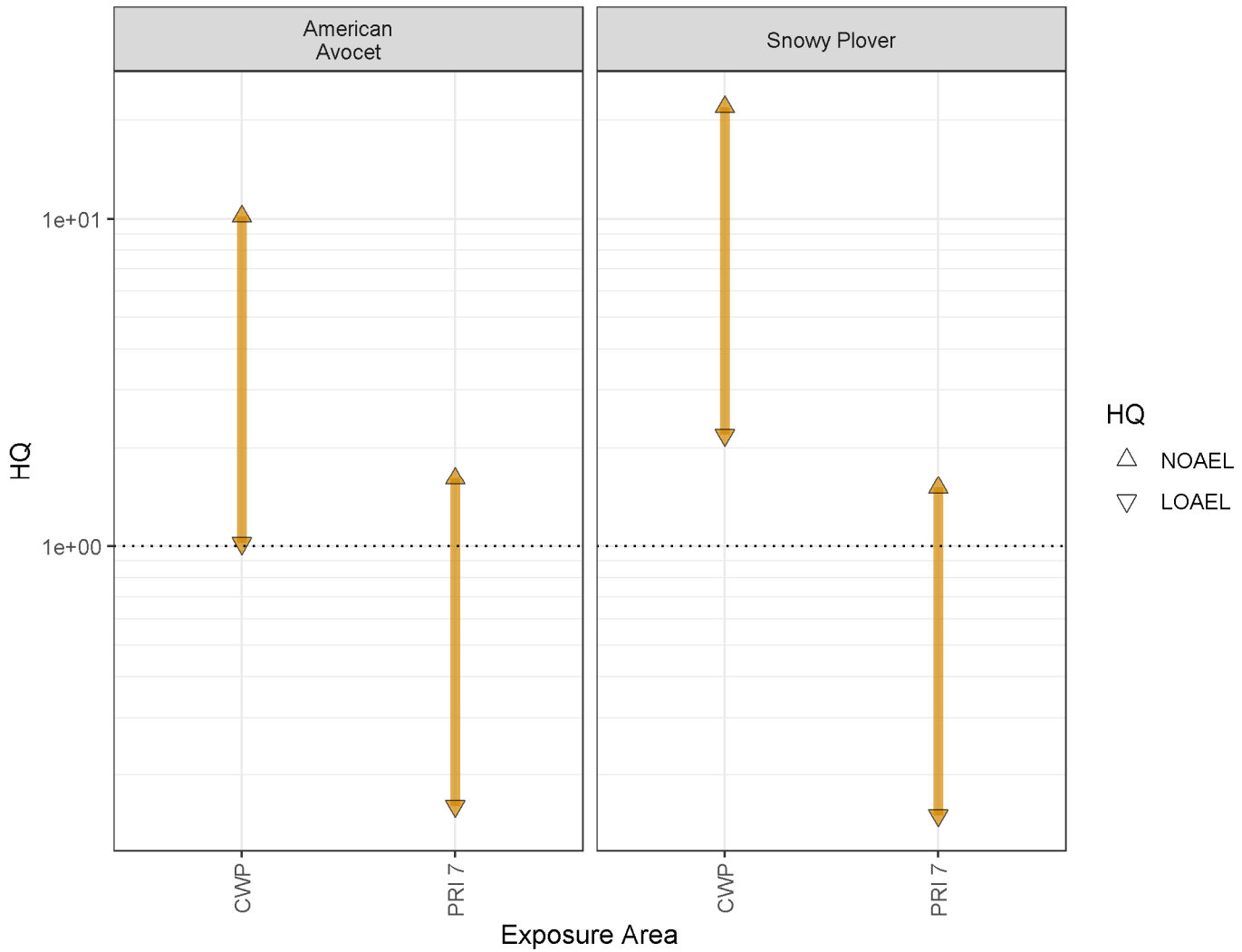

Figure 3-5a
Avian Intermittent Longer-Term HQs in Lakebed Habitat
Avian TEQ Category 1 ND=1/2DL

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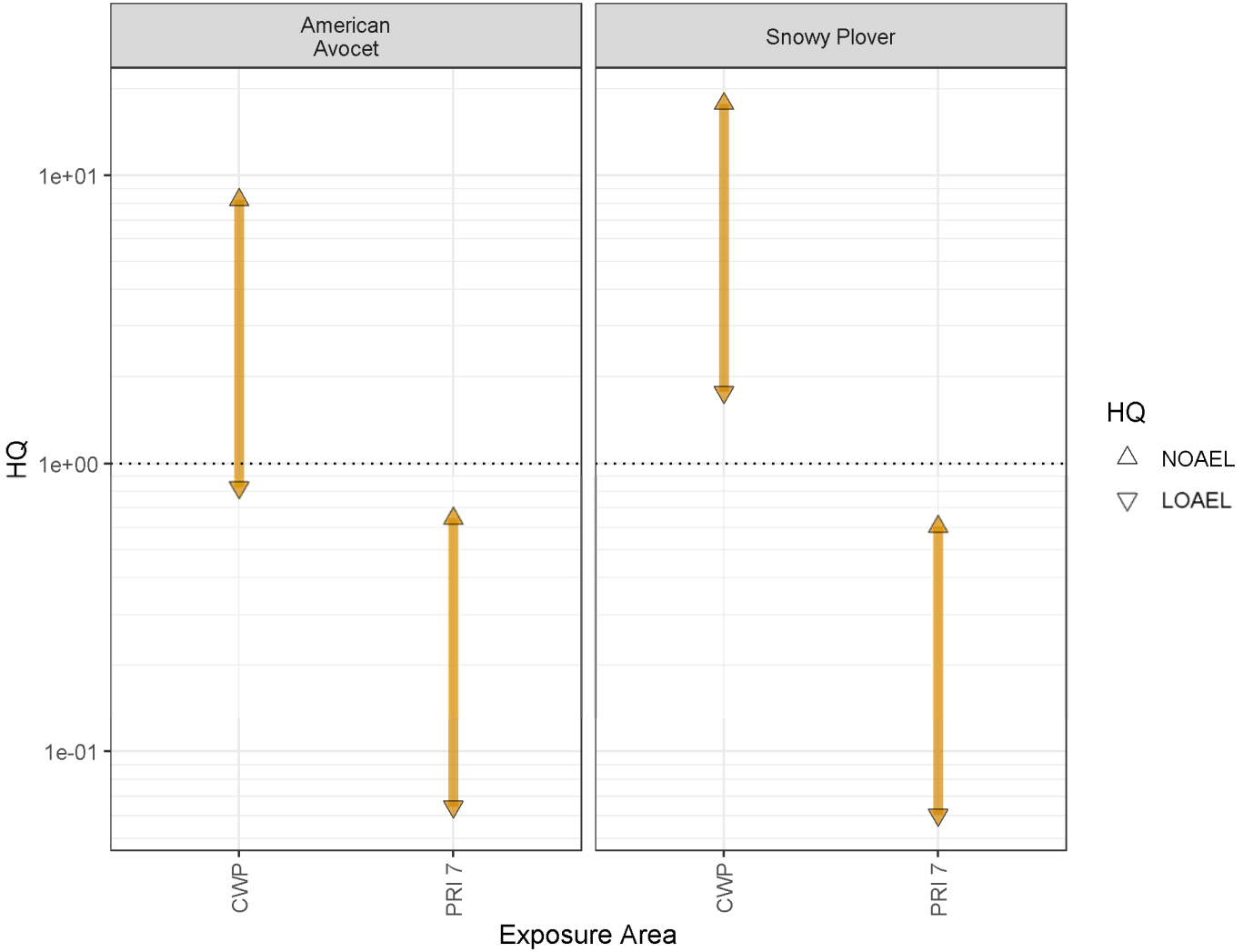

Figure 3-5b
Avian Intermittent Longer-Term HQs in Lakebed Habitat
Avian TEQ Category 2 ND=1/2DL

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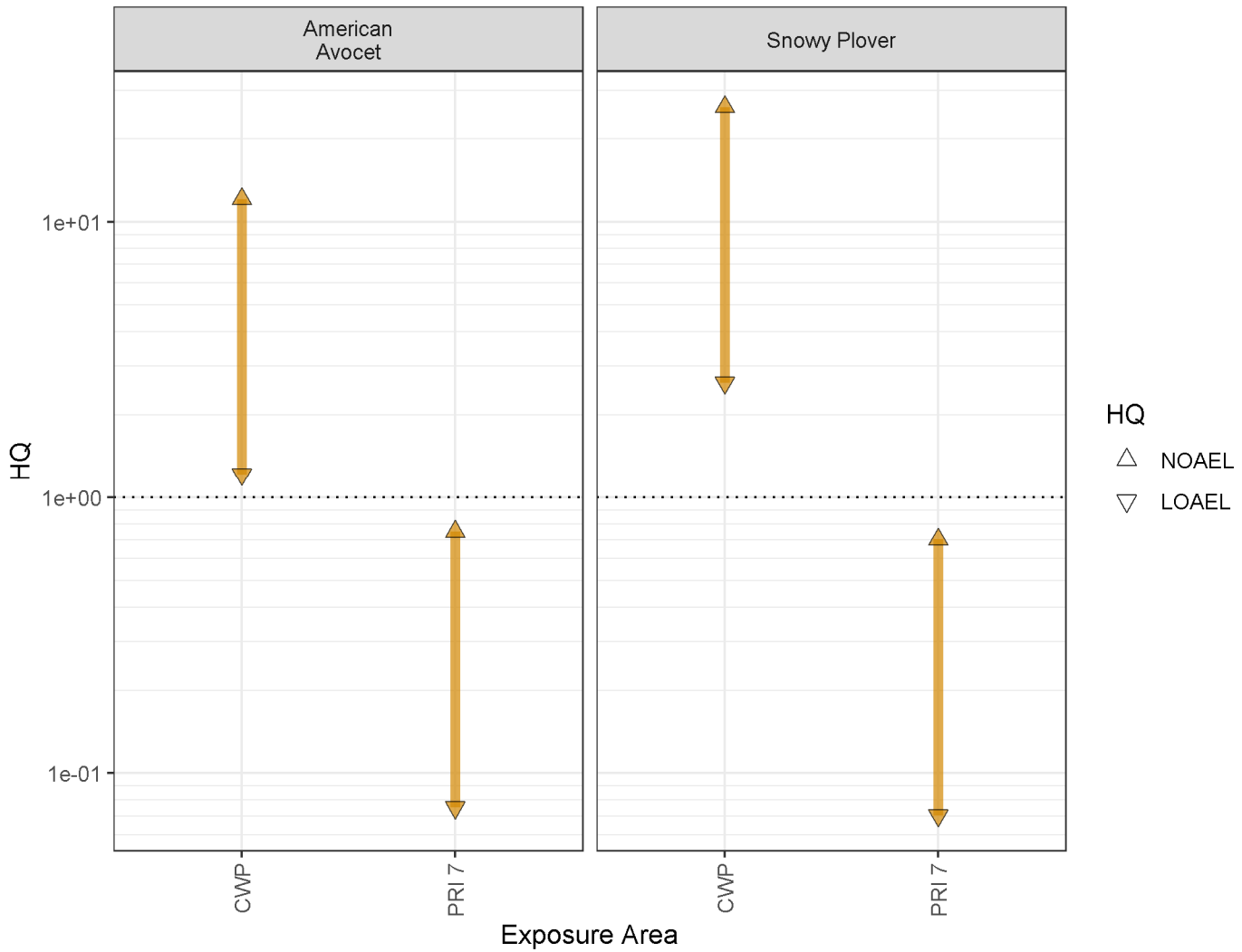

Figure 3-5c
Avian Intermittent Longer-Term HQs in Lakebed Habitat
Avian TEQ Category 3 ND=1/2DL

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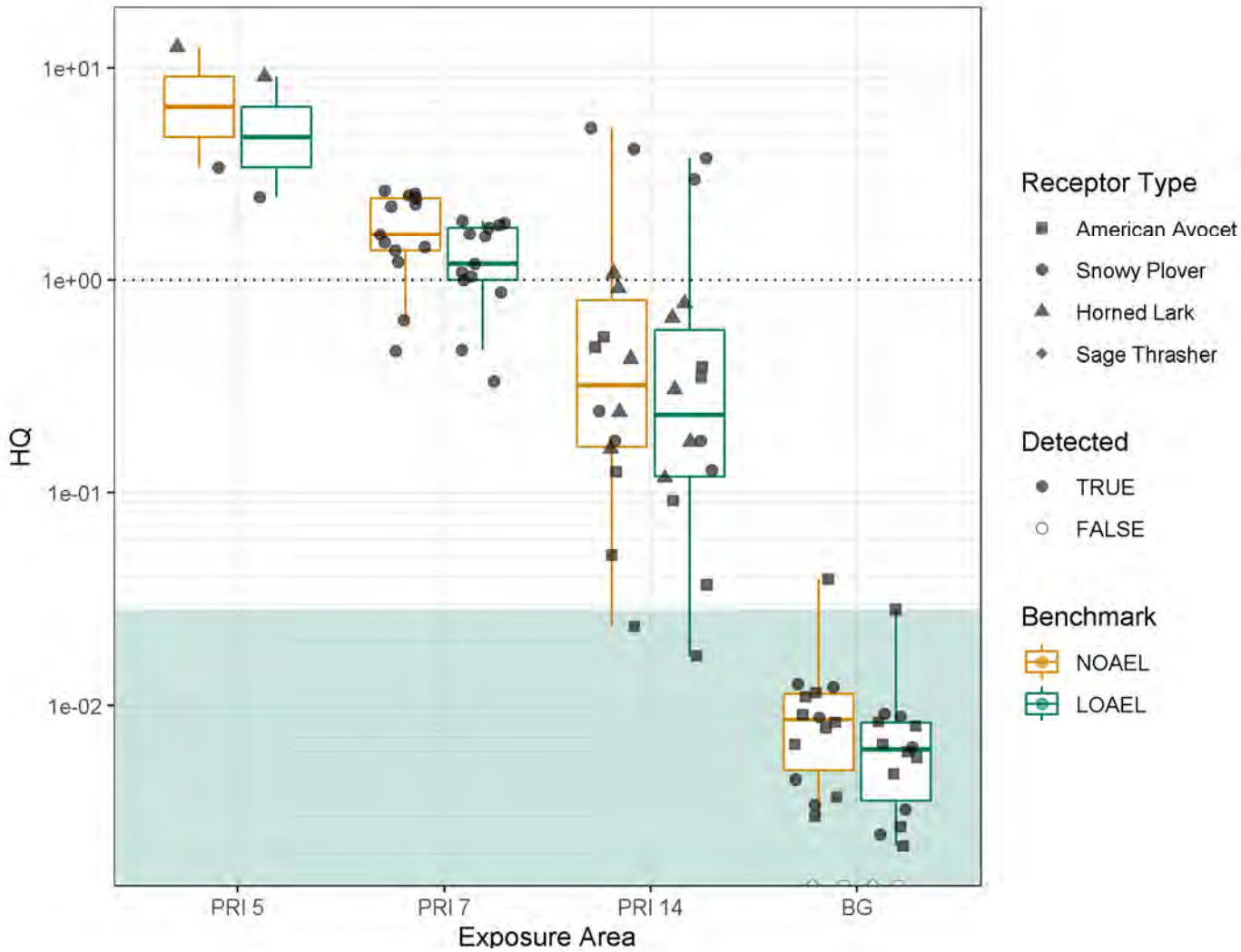

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. Four background samples have an HQ=0 due to all TEQ constituents being nondetects. These samples are partially visible.

Parts of a boxplot

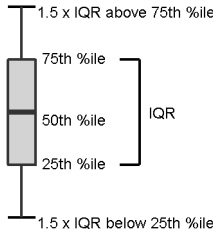

Figure 3-6a
Tissue HQs for Avian Eggs
Avian TEQ Category 1, ND=0

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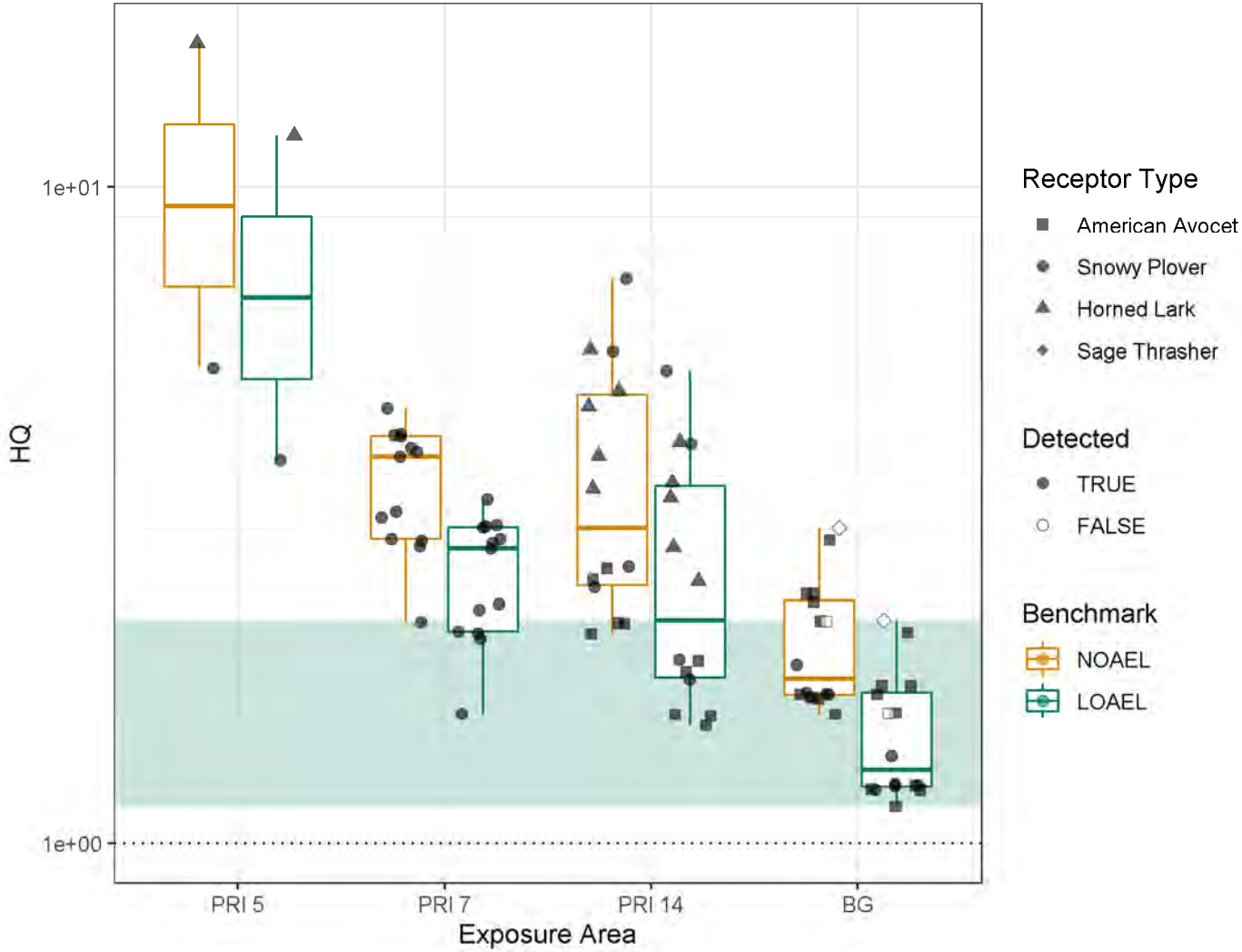

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

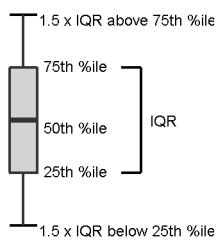

Figure 3-6b
Tissue HQs for Avian Eggs
Avian TEQ Category 1, ND=1/2DL

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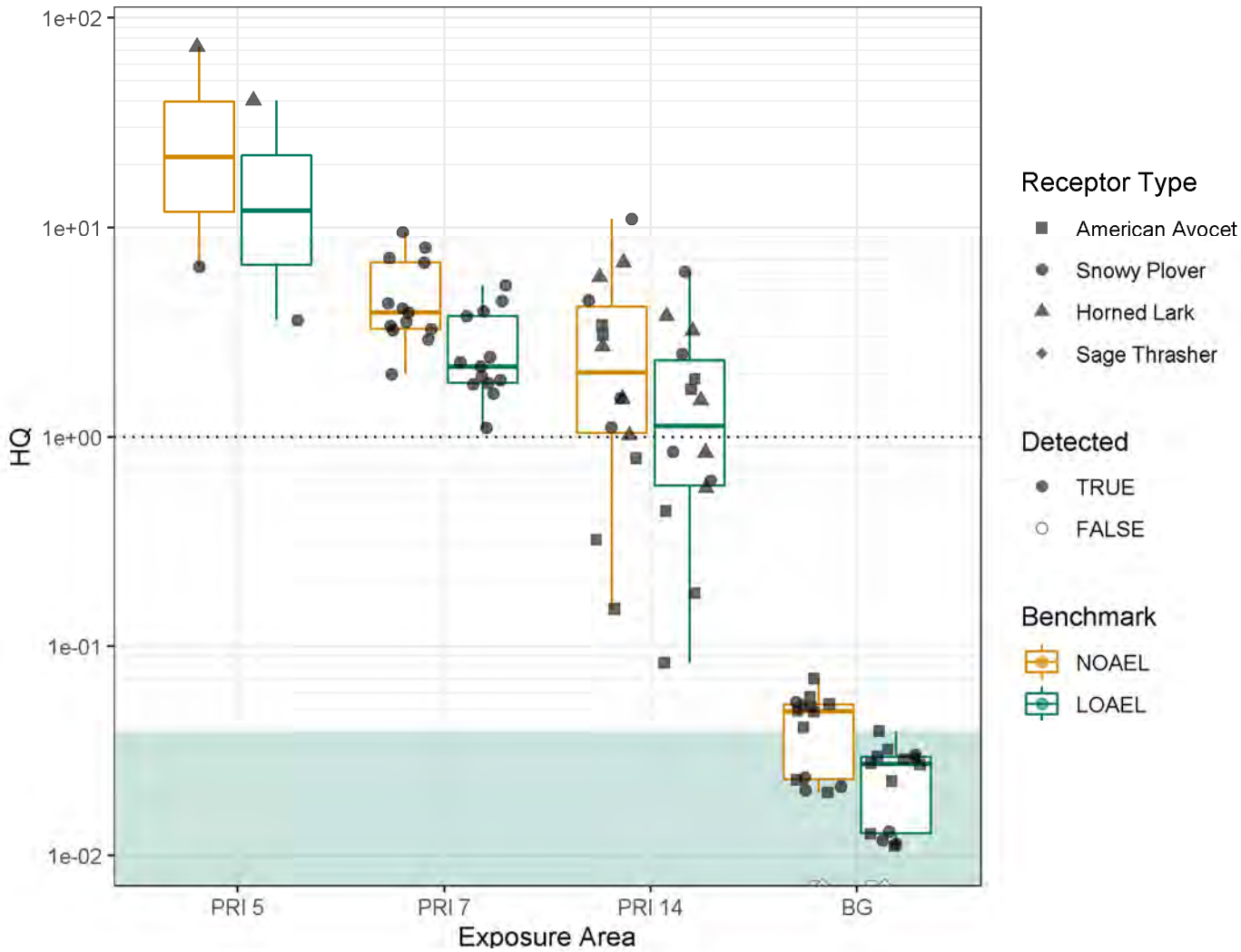

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. Four background samples have an HQ=0 due to all TEQ constituents being nondetects. These samples are partially visible.

Parts of a boxplot

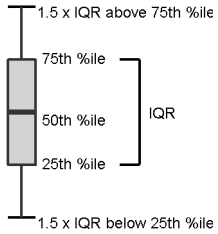

Figure 3-6c
Tissue HQs for Avian Eggs
Avian TEQ Category 2, ND=0

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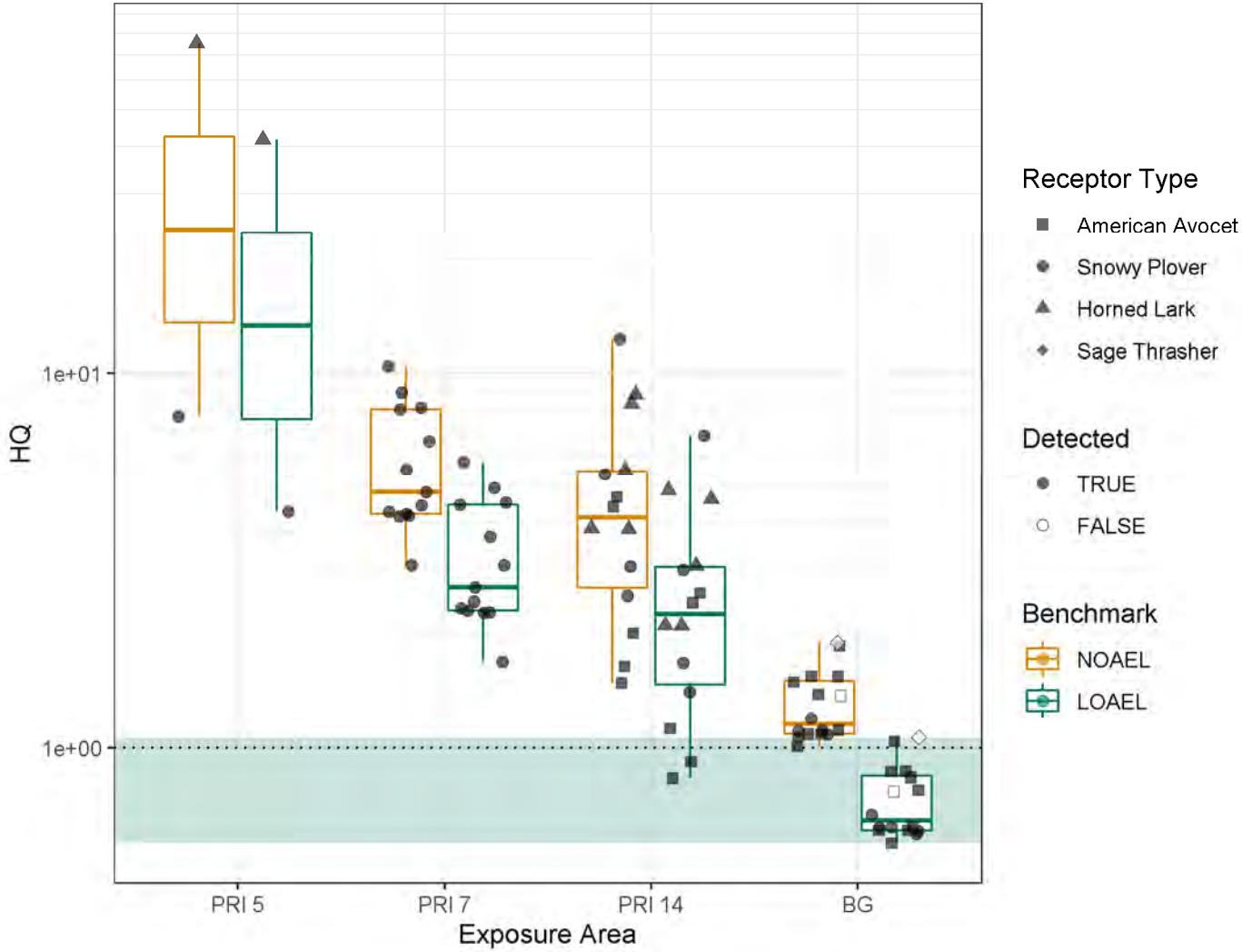

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

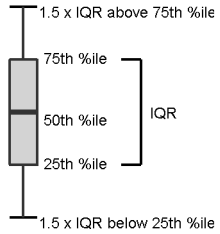

Figure 3-6d
Tissue HQs for Avian Eggs
Avian TEQ Category 2, ND=1/2DL

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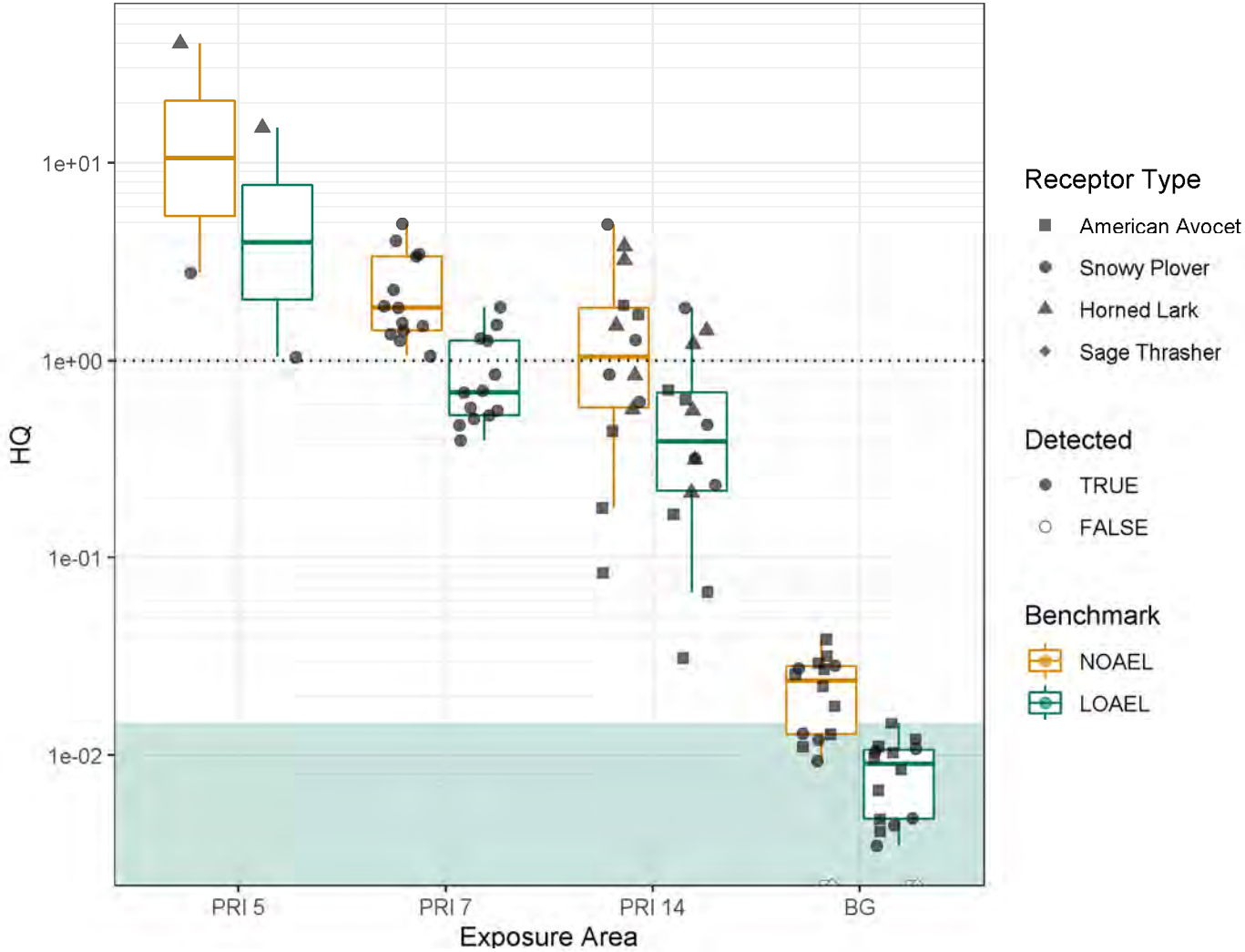

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. Four background samples have an HQ=0 due to all TEQ constituents being nondetects. These samples are partially visible.

Parts of a boxplot

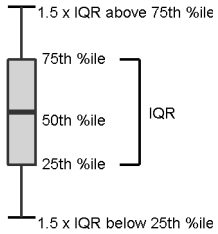

Figure 3-6e
Tissue HQs for Avian Eggs
Avian TEQ Category 3, ND=0

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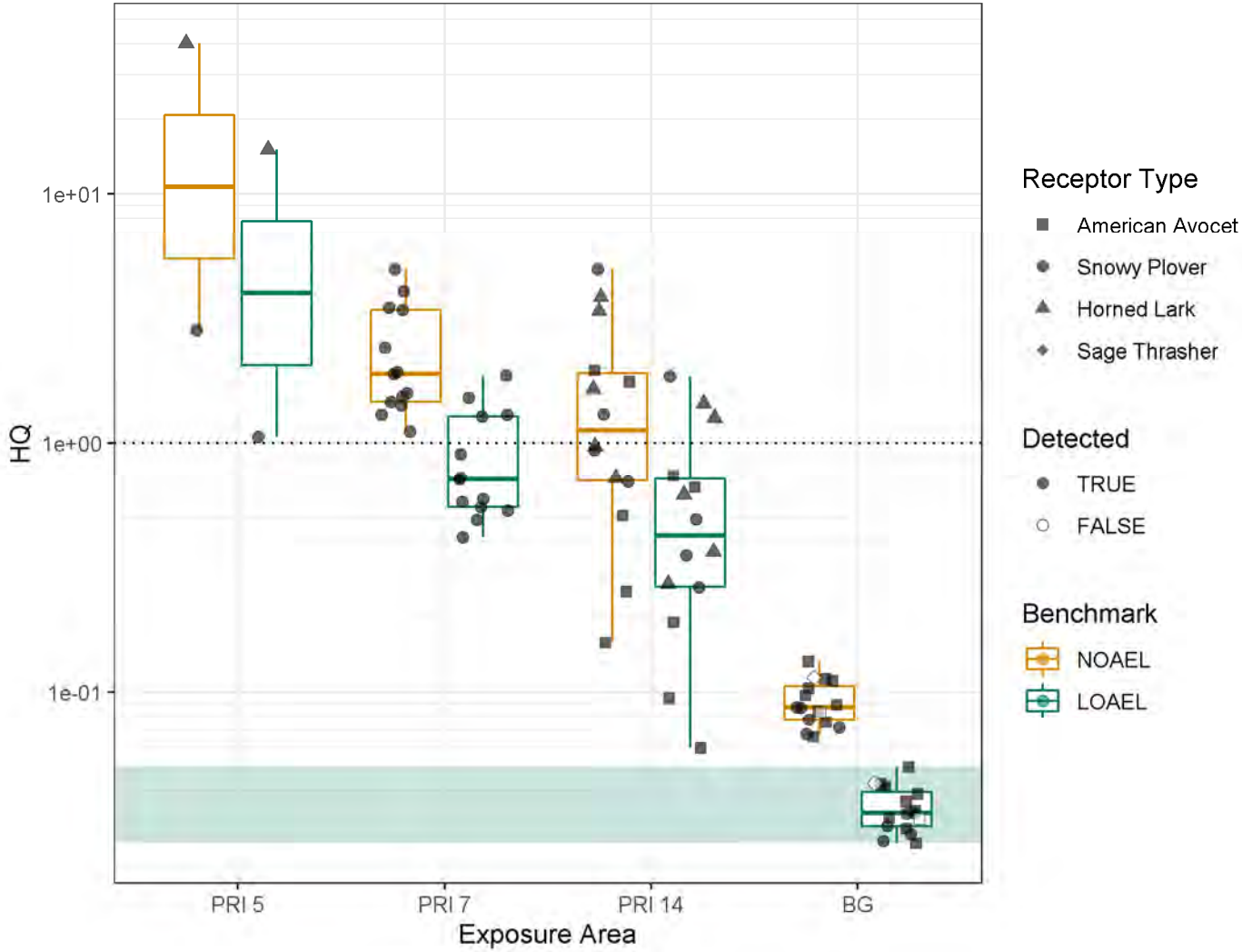

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

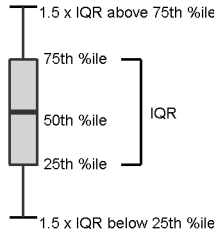

Figure 3-6f
Tissue HQs for Avian Eggs
Avian TEQ Category 3, ND=1/2DL

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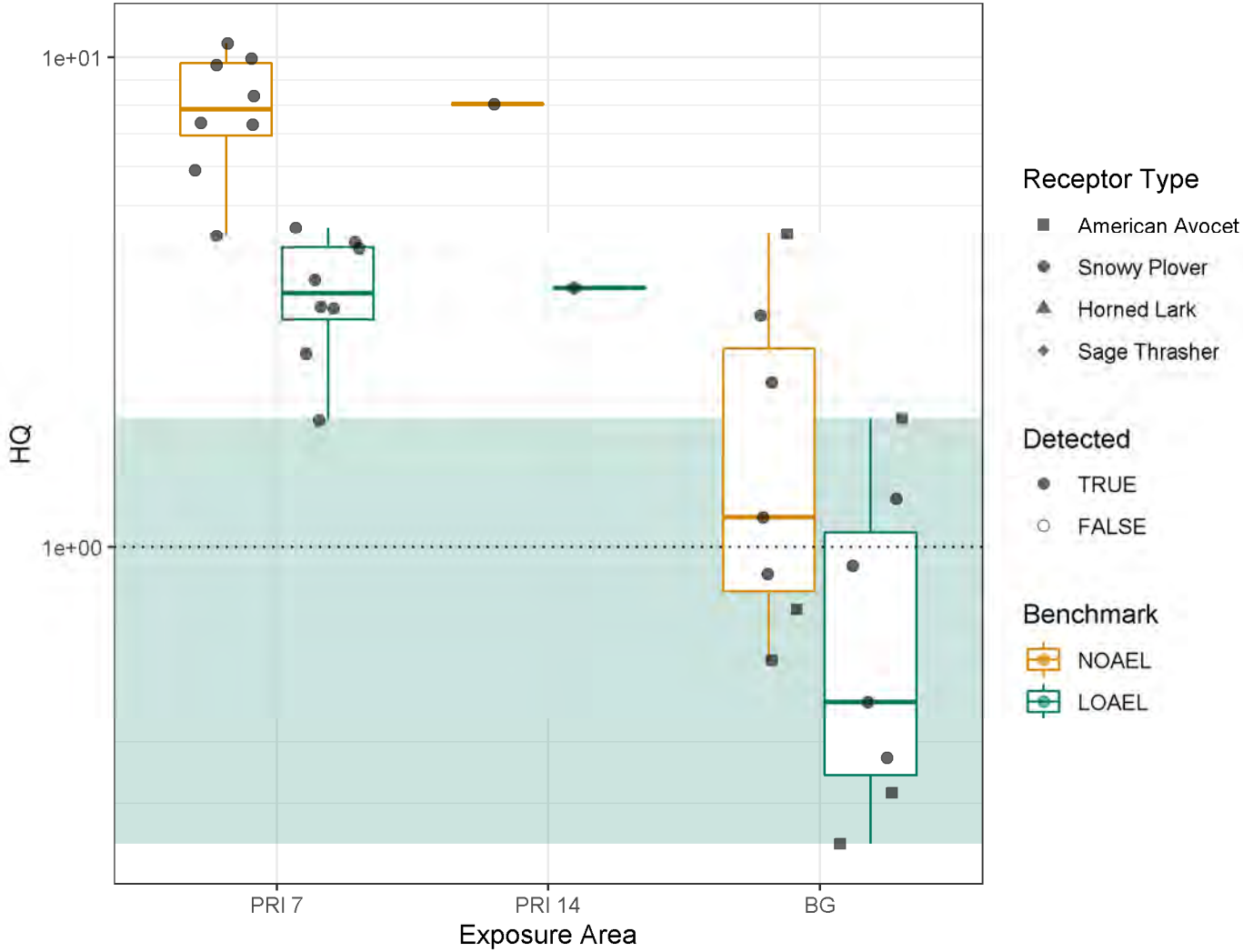

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

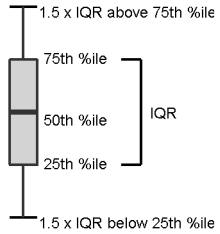

Figure 3-6g
Tissue HQs for Avian Eggs
Total PCBs

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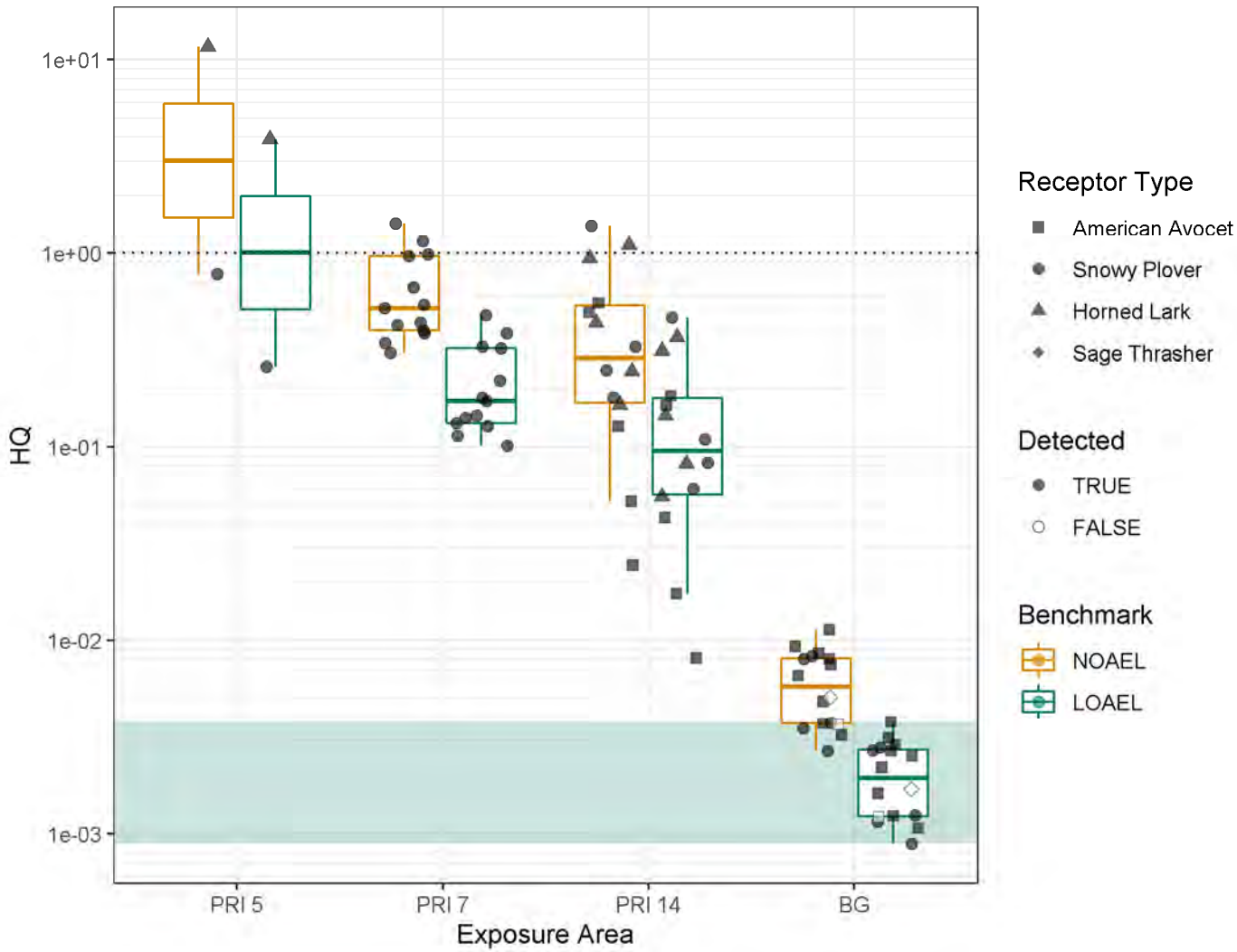

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

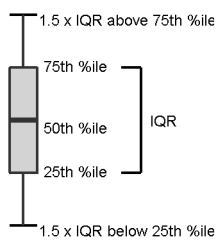

Figure 3-6h
Tissue HQs for Avian Eggs
Hexachlorobenzene

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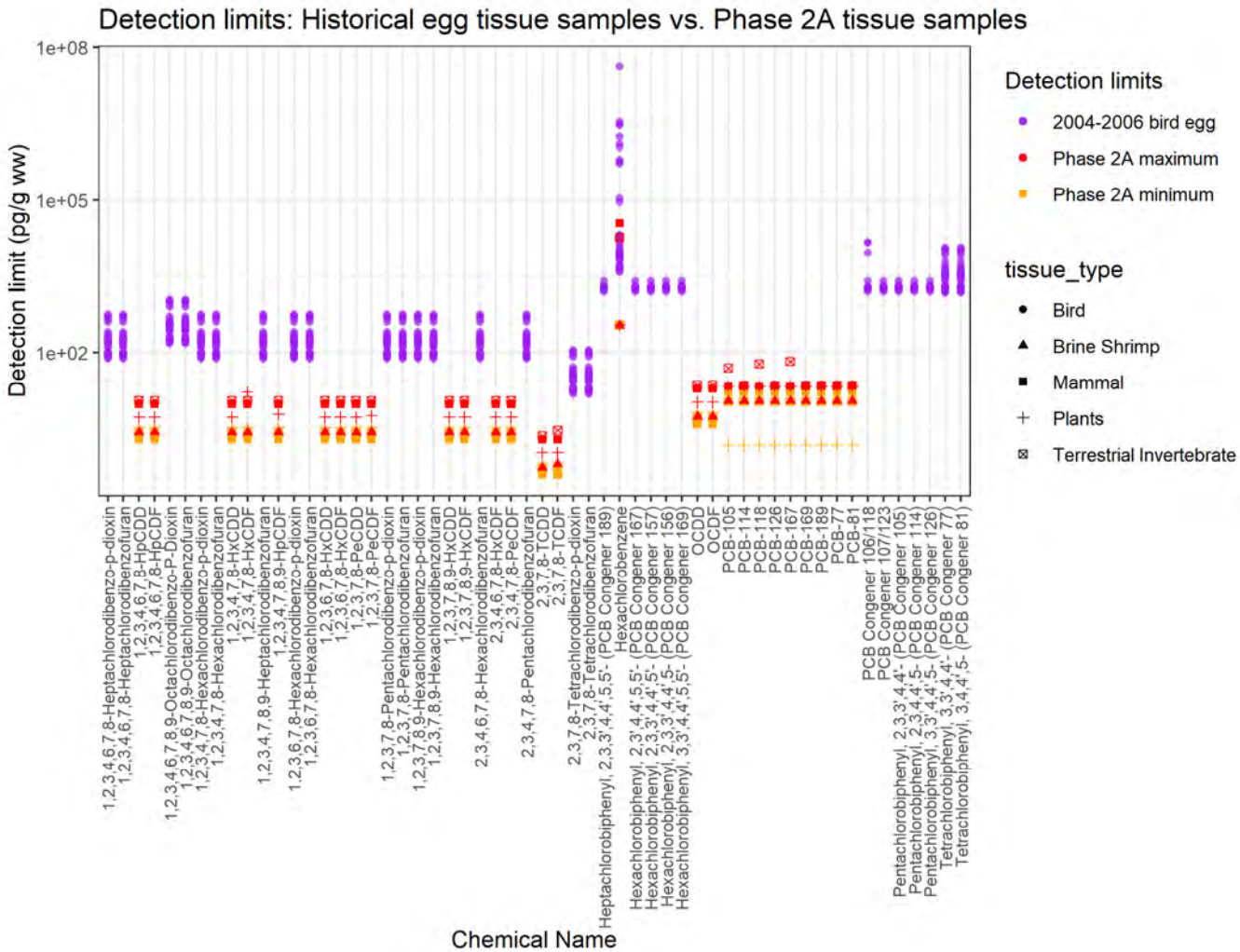

Figure 3-7
Detection Limits:
Historical Egg Tissue Samples vs. Phase 2A Tissue Samples

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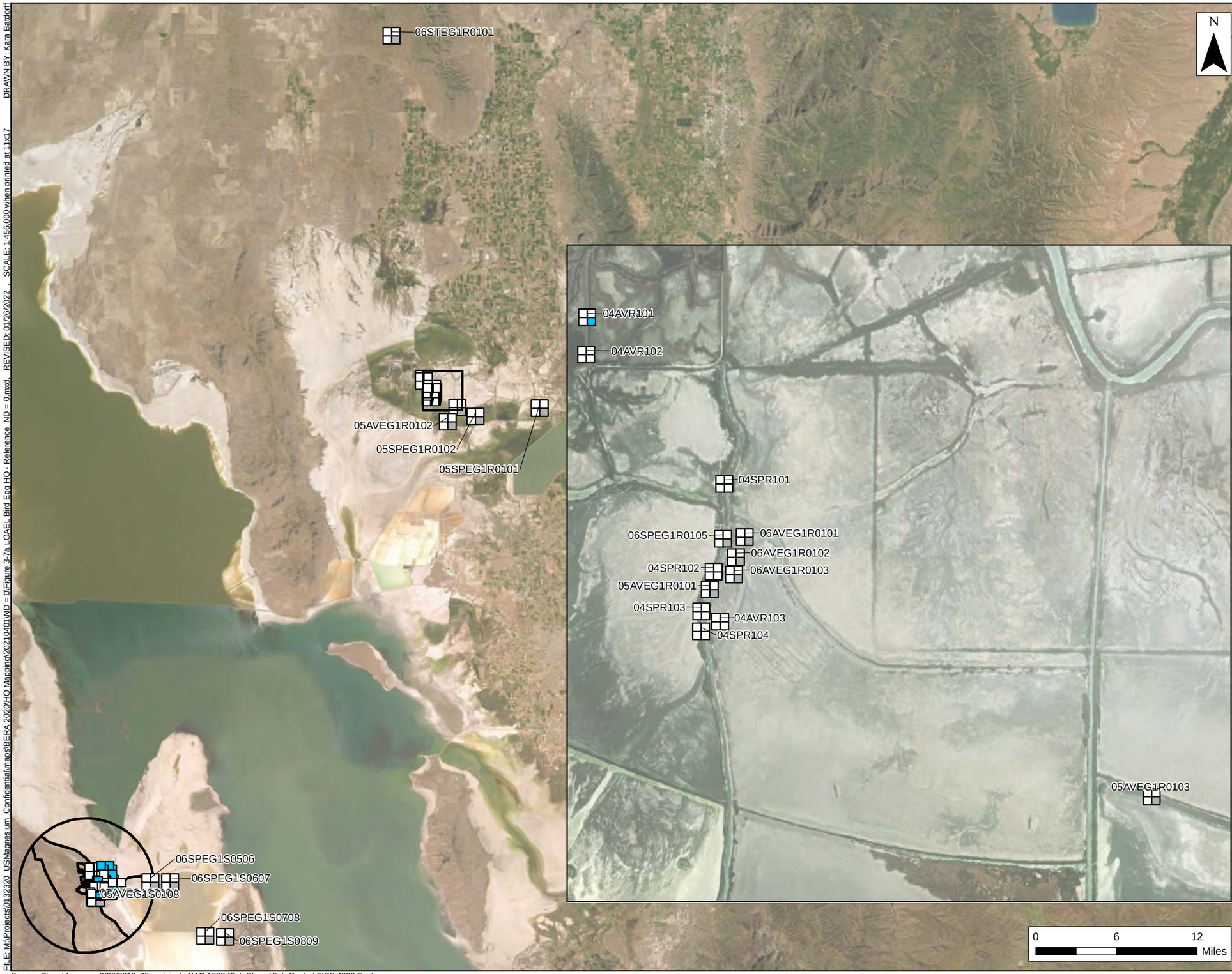

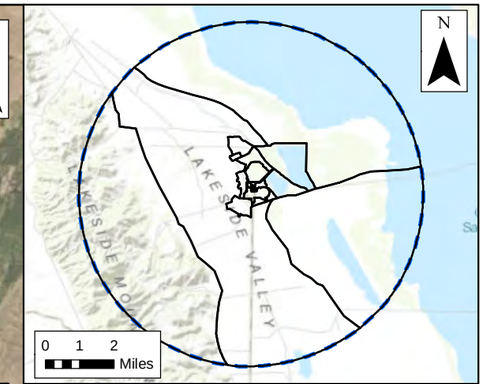

Legend

LOAEL Hazard Quotient (HQ)

- HQ <= 1
- HQ > 1 and <= 10
- HQ > 10 and <= 100
- Not Analyzed
- RI/FS Study Area Boundary
- Preliminary Remedial Investigation Areas

Avian TEQ Cat 1 **Avian TEQ Cat 2**
Avian TEQ Cat 3 **PCBs**

Notes:
LOAEL = Lowest Observed Adverse Effect Level
ND = non-detect
TEQ = Dioxin/furan toxicity equivalence factor, ND = 0
PCBs = Polychlorinated biphenyls
TEQ calculated using half the detection limit for non-detects.
Some sample location shifted slightly to allow for visibility of adjacent locations.

Figure 3-8a
Bird Egg LOAEL
Hazard Quotients ND=0
Background Area
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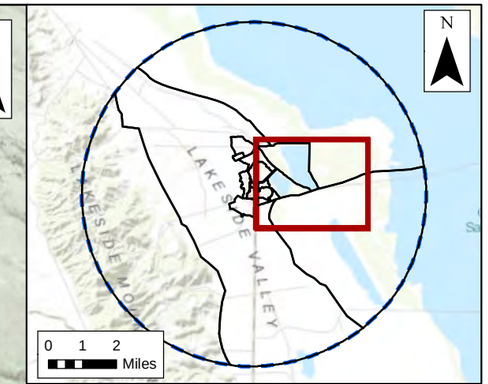
FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\HQ Mapping\20210401\ND = 0\Figure 3-7a LOAEL Bird Egg HQ - Reference_ND = 0.mxd, REVISED: 01/26/2022 , SCALE: 1:456,000 when printed at 11x17 DRAWN BY: Kara Batdorff

Source: Planet Imagery, 9/26/2019, 70 cm/pixel; NAD 1983 StatePlane Utah Central FIPS 4302 Feet



Legend

LOAEL Hazard Quotient (HQ)

- HQ <= 1
- HQ > 1 and <= 10
- HQ > 10 and <= 100
- Not Analyzed
- RI/FS Study Area Boundary
- Preliminary Remedial Investigation Areas

Avian TEQ Cat 1 **Avian TEQ Cat 2**
Avian TEQ Cat 3 **PCBs**

Notes:
LOAEL = Lowest Observed Adverse Effect Level
ND = non-detect
TEQ = Dioxin/furan toxicity equivalence factor, ND = 0
PCBs = Polychlorinated biphenyls
TEQ calculated using half the detection limit for non-detects.
Some sample location shifted slightly to allow for visibility of adjacent locations.
Coordinates for 05SPEG1S0104 and 05SPEG1S0406 are assumed due to discrepancies in source report.

Figure 3-8b
Bird Egg LOAEL
Hazard Quotients ND=0
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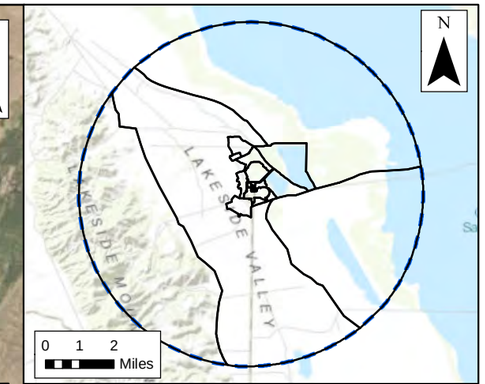
Source: Planet Imagery, 9/26/2019, 70 cm/pixel; NAD 1983 StatePlane Utah Central FIPS 4302 Feet

FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\HQ Mapping\20210401\ND = 0\Figure 3-7b LOAEL Bird Egg Samples HQ_ND = 0.mxd REVISED: 01/27/2022 SCALE: 1:16,200 when printed at 11x17 DRAWN BY: Kara Batdorff



Legend

LOAEL Hazard Quotient (HQ)

- HQ <= 1
- HQ > 1 and <= 10
- HQ > 10 and <= 100
- Not Analyzed
- RI/FS Study Area
- Preliminary Remedial Investigation

Avian TEQ Cat 1 **Avian TEQ Cat 2**
Avian TEQ Cat 3 **PCBs**

Notes:
LOAEL = Lowest Observed Adverse Effect Level
ND=0.5 DL
ND = non-detect
DL = detection limit
TEQ = Dioxin/furan toxicity equivalence factor,
ND = 1/2
PCBs = Polychlorinated biphenyls
TEQ calculated using half the detection limit for non-detects.
Some sample location shifted slightly to allow for visibility of adjacent locations.

Figure 3-8c
Bird Egg LOAEL
Hazard Quotients ND = 1/2DL
Background Area
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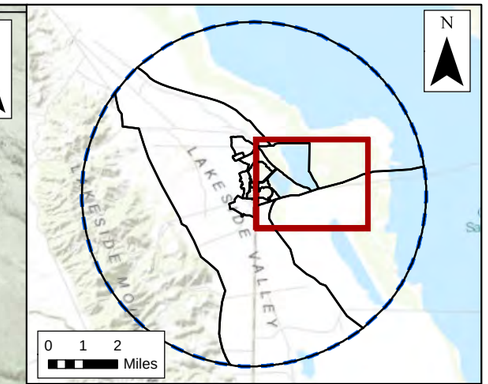
Source: Planet Imagery, 9/26/2019, 70 cm/pixel; NAD 1983 StatePlane Utah Central FIPS 4302 Feet

FILE: M:\Projects\0132320_USMagnesium_Confidential\maps\BERA 2020\HQ Mapping\20210401\ND = 0.5\Figure 3-7c LOAEL Bird Egg HQ - Reference.mxd REVISED: 01/26/2022 , SCALE: 1:456,000 when printed at 11x17 DRAWN BY: Kara Batdorff



Legend

LOAEL Hazard Quotient (HQ)

- HQ <= 1
- HQ > 1 and <= 10
- HQ > 10 and <= 100
- Not Analyzed
- RI/FS Study Area Boundary
- Preliminary Remedial Investigation Areas

Avian TEQ Cat 1 **Avian TEQ Cat 2**
Avian TEQ Cat 3 **PCBs**

Notes:
LOAEL = Lowest Observed Adverse Effect Level
ND=0.5 DL
ND = non-detect
DL = detection limit
TEQ = Dioxin/furan toxicity equivalence factor, ND=0.5DL
PCBs = Polychlorinated biphenyls
TEQ calculated using half the detection limit for non-detects.
Some sample location shifted slightly to allow for visibility of adjacent locations.
Coordinates for 05SPEG1S0104 and 05SPEG1S0406 are assumed due to discrepancies in source report.

Figure 3-8d
Bird Egg LOAEL
Hazard Quotients ND = 1/2DL
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Source: Planet Imagery, 9/26/2019, 70 cm/pixel; NAD 1983 StatePlane Utah Central FIPS 4302 Feet

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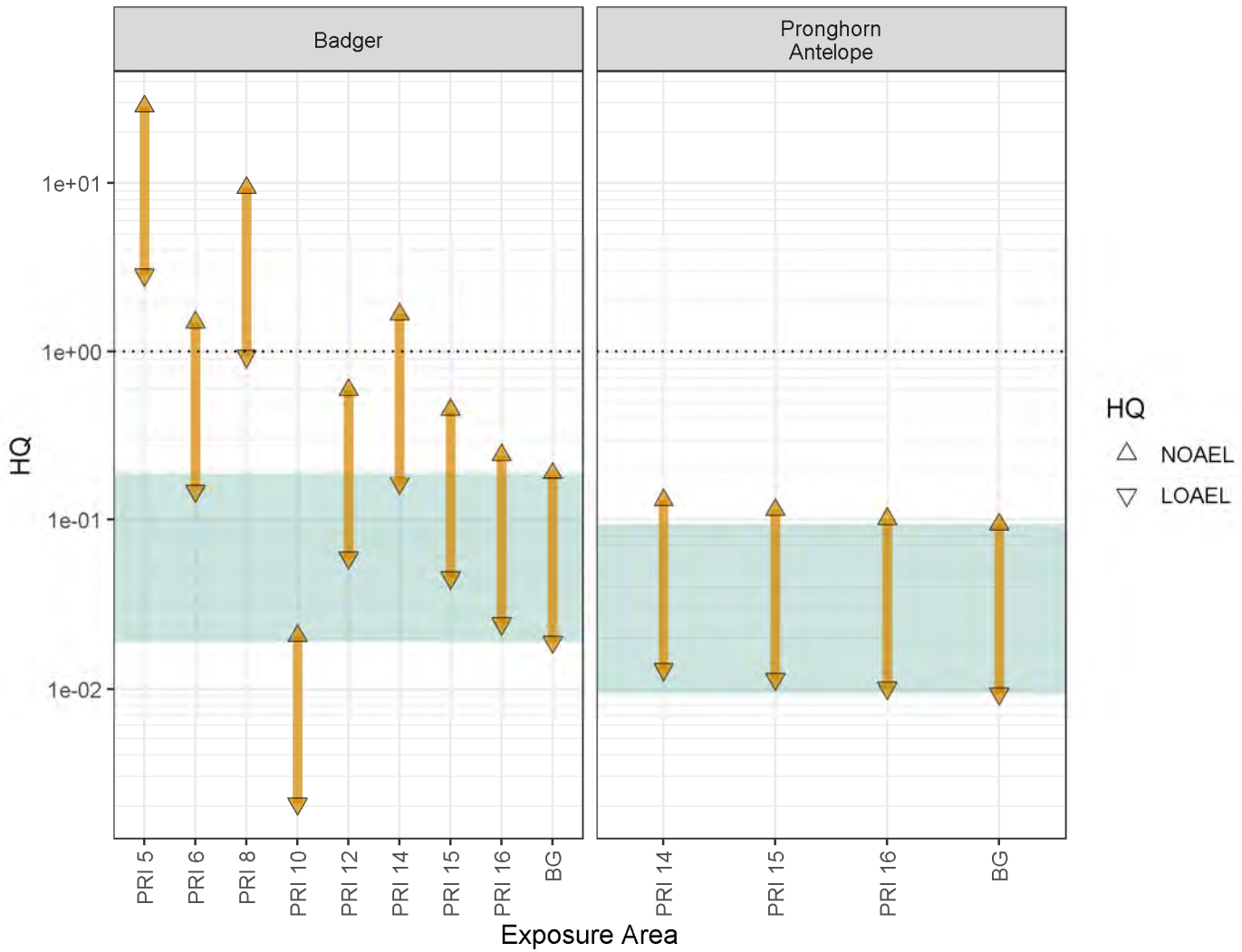

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 4-1a
Large Mammal Chronic Dietary Dose HQs in Upland Habitat
Mammalian TEQ, ND=1/2DL

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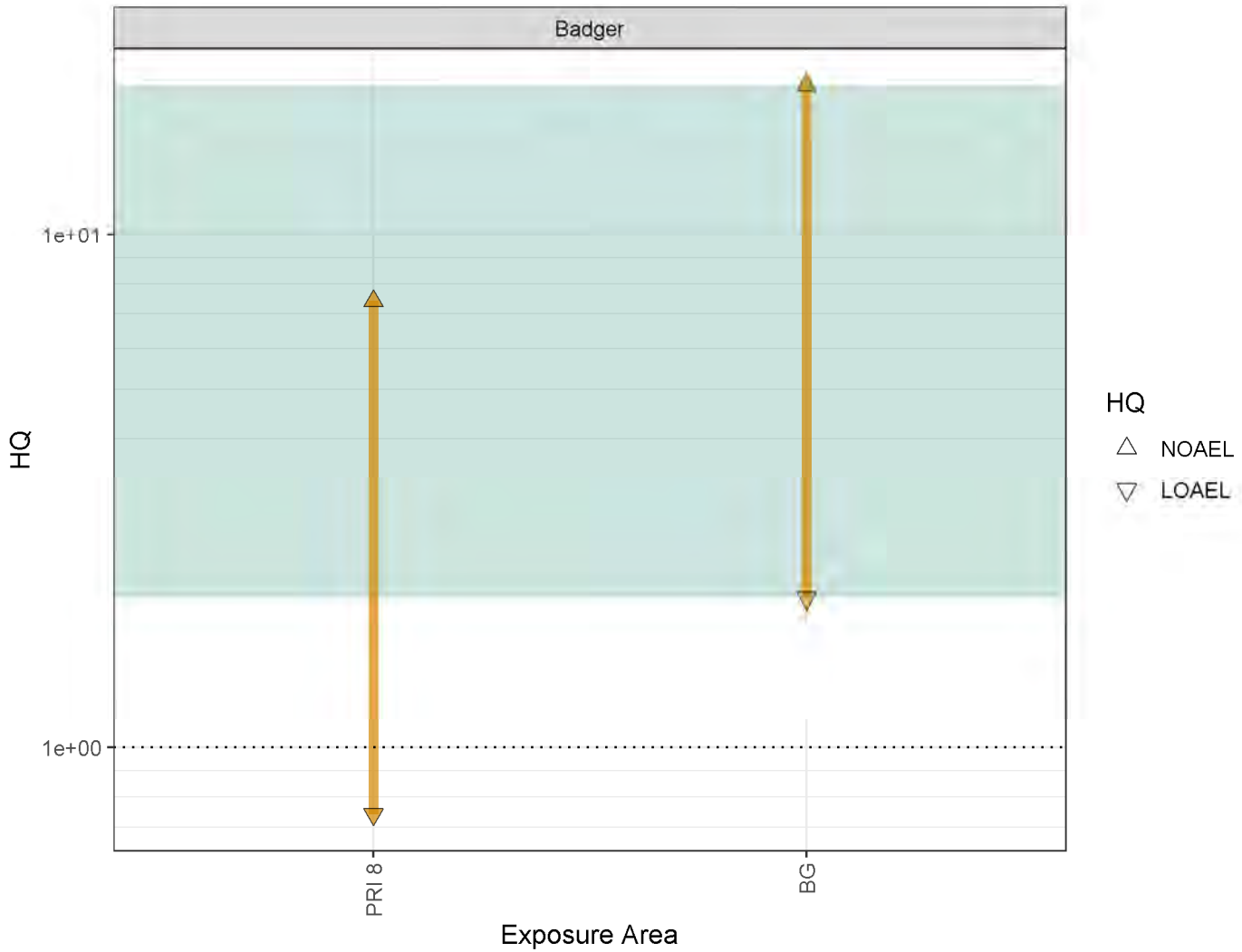

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 4-1b
Large Mammal Chronic Dietary Dose HQs in Upland Habitat
Aluminum

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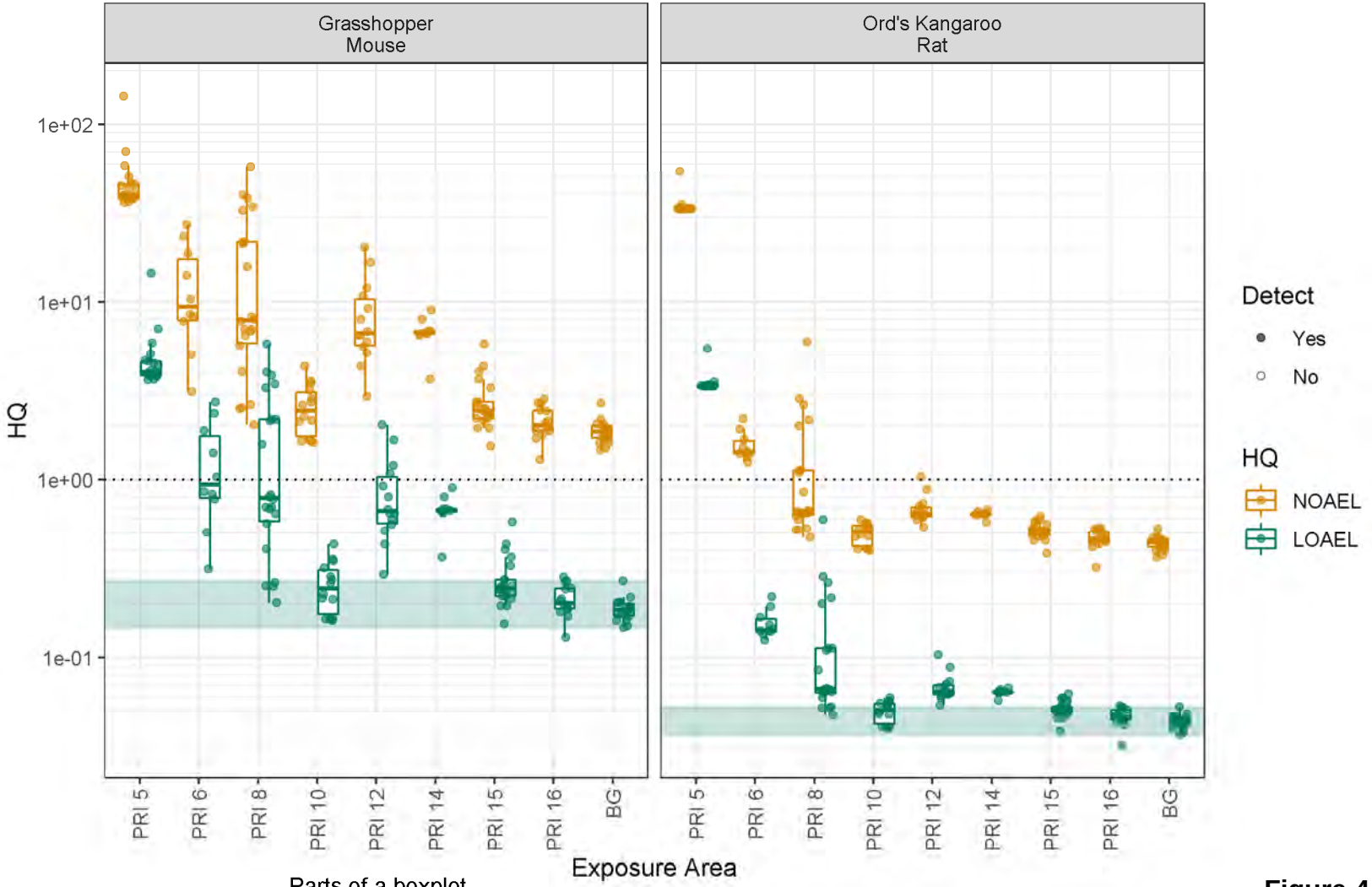
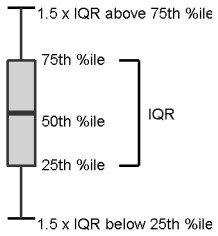


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-2a
Small Mammal Chronic Dietary Dose HQs in Upland Habitat
Mammalian TEQ, ND=1/2DL

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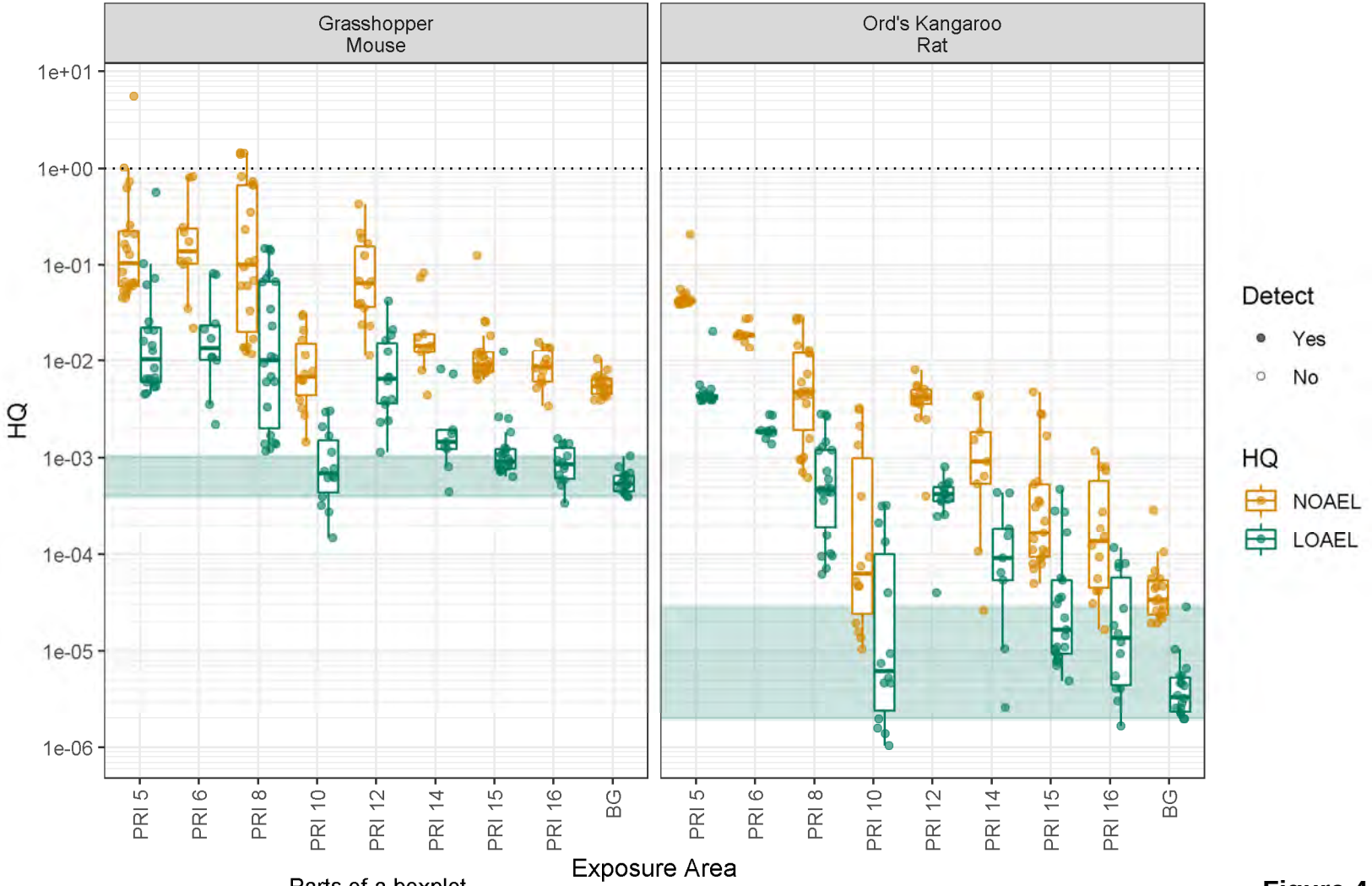
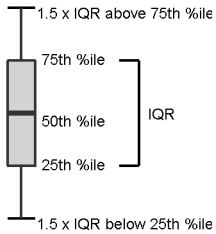


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-2b
Small Mammal Chronic Dietary Dose HQs in Upland Habitat
Total PCBs

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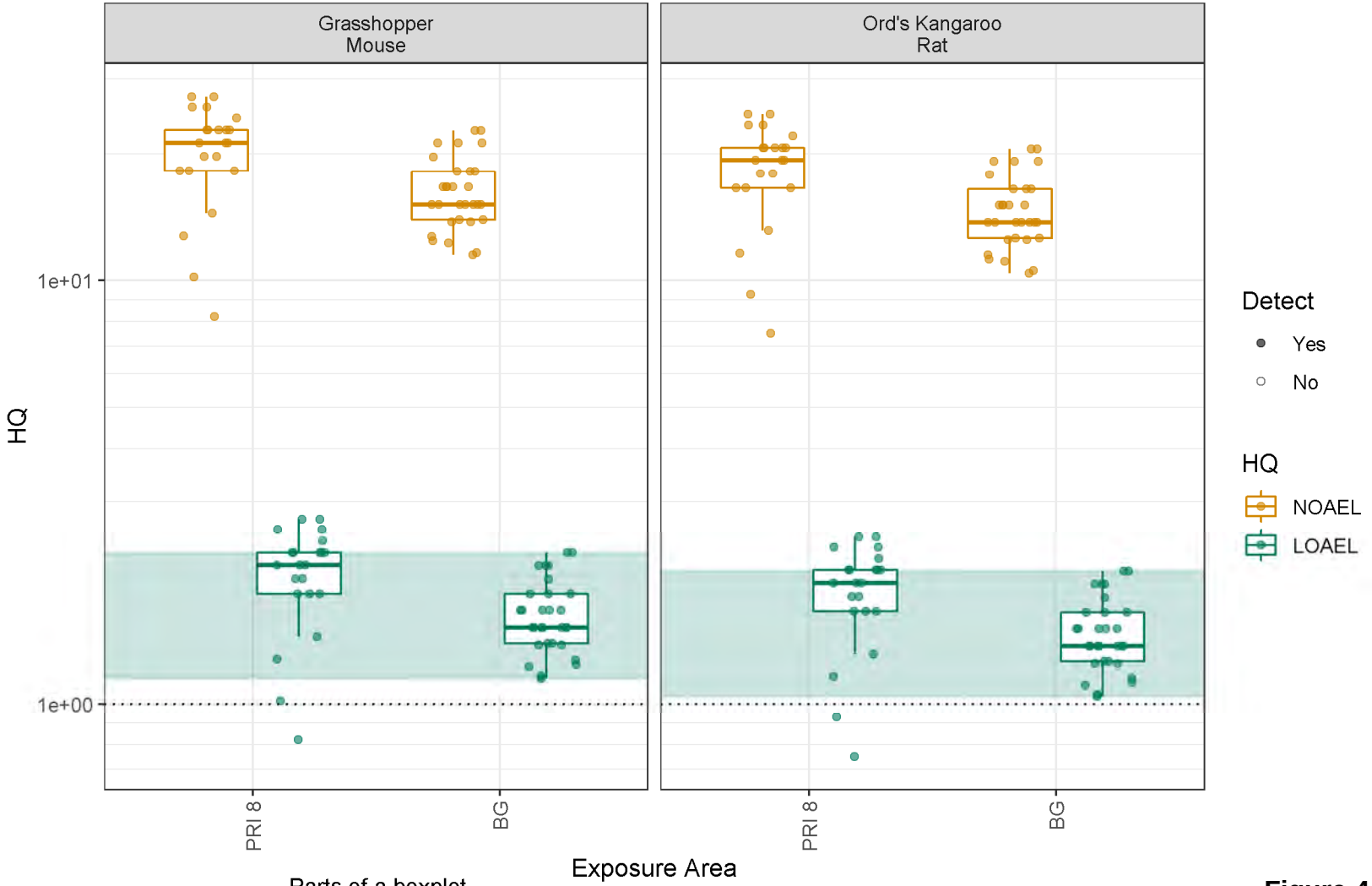
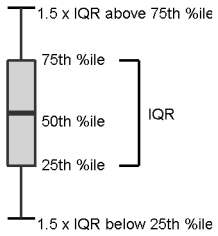


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-2c
Small Mammal Chronic Dietary Dose HQs in Upland Habitat Aluminum

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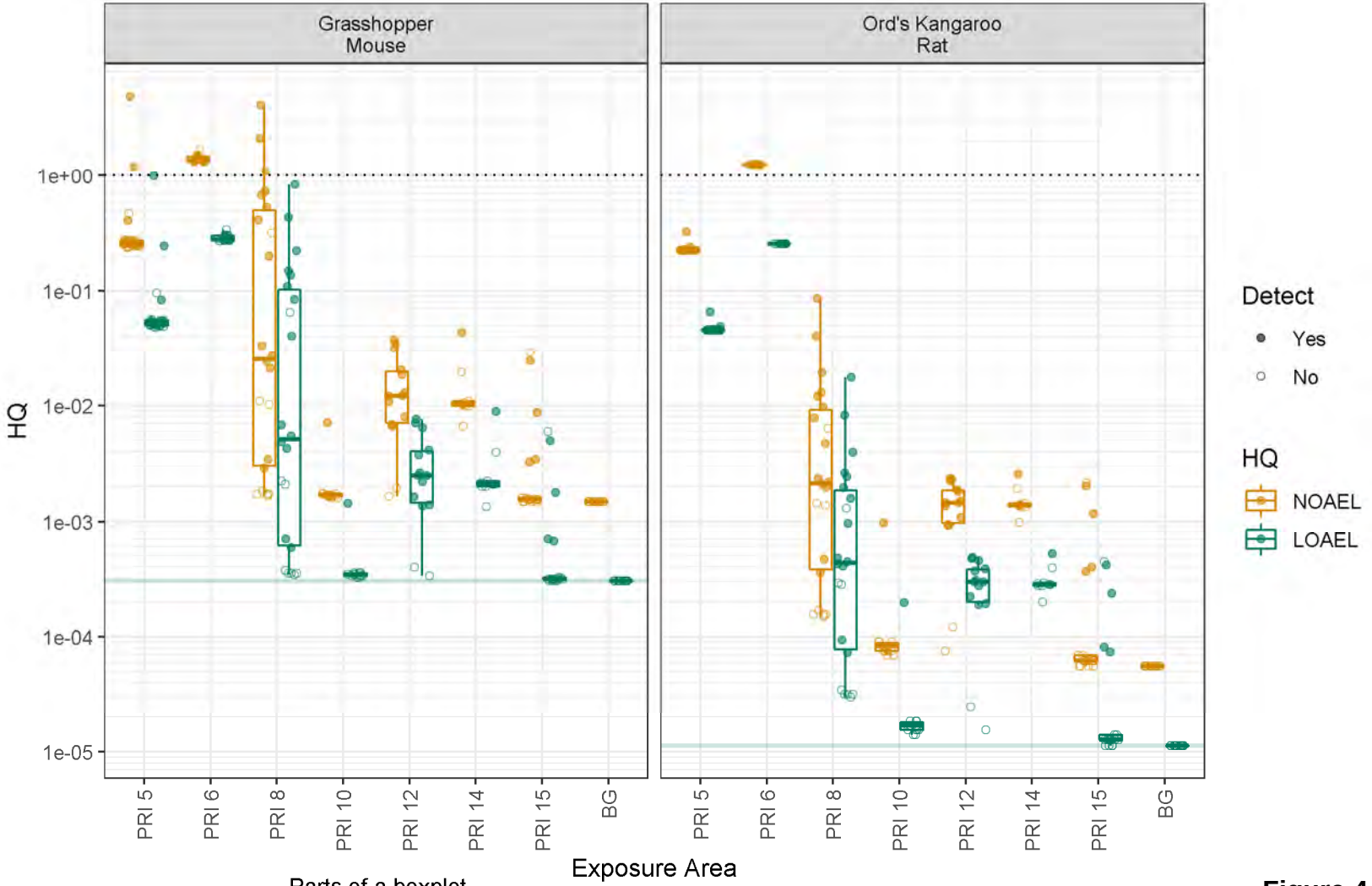

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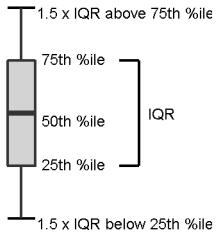

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-2d
Small Mammal Chronic Dietary Dose HQs in Upland Habitat
Hexachlorobenzene

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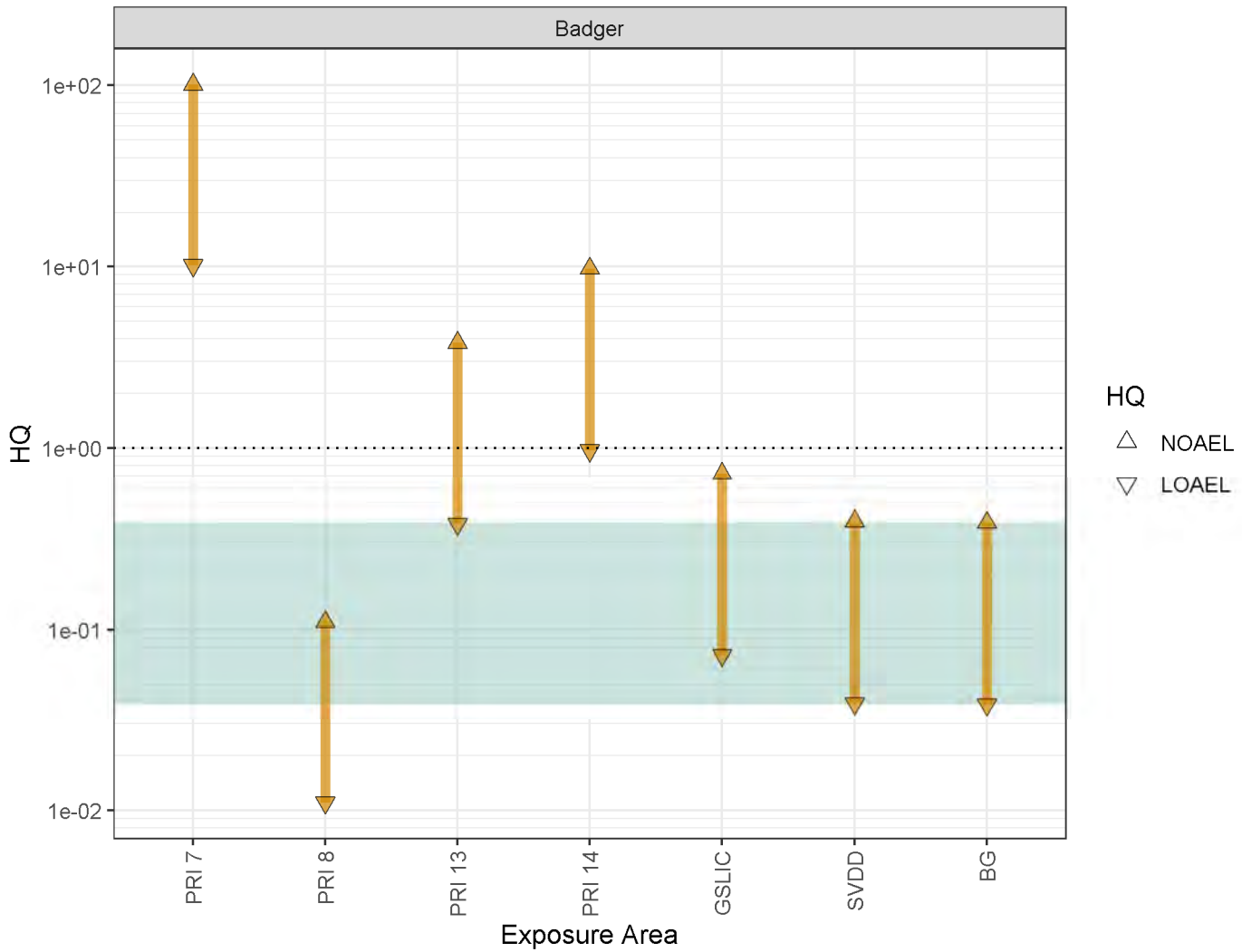

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

Figure 4-3a
Large Mammal Chronic Dietary Dose HQs in Lakebed Habitat
Mammalian TEQ, ND=1/2DL

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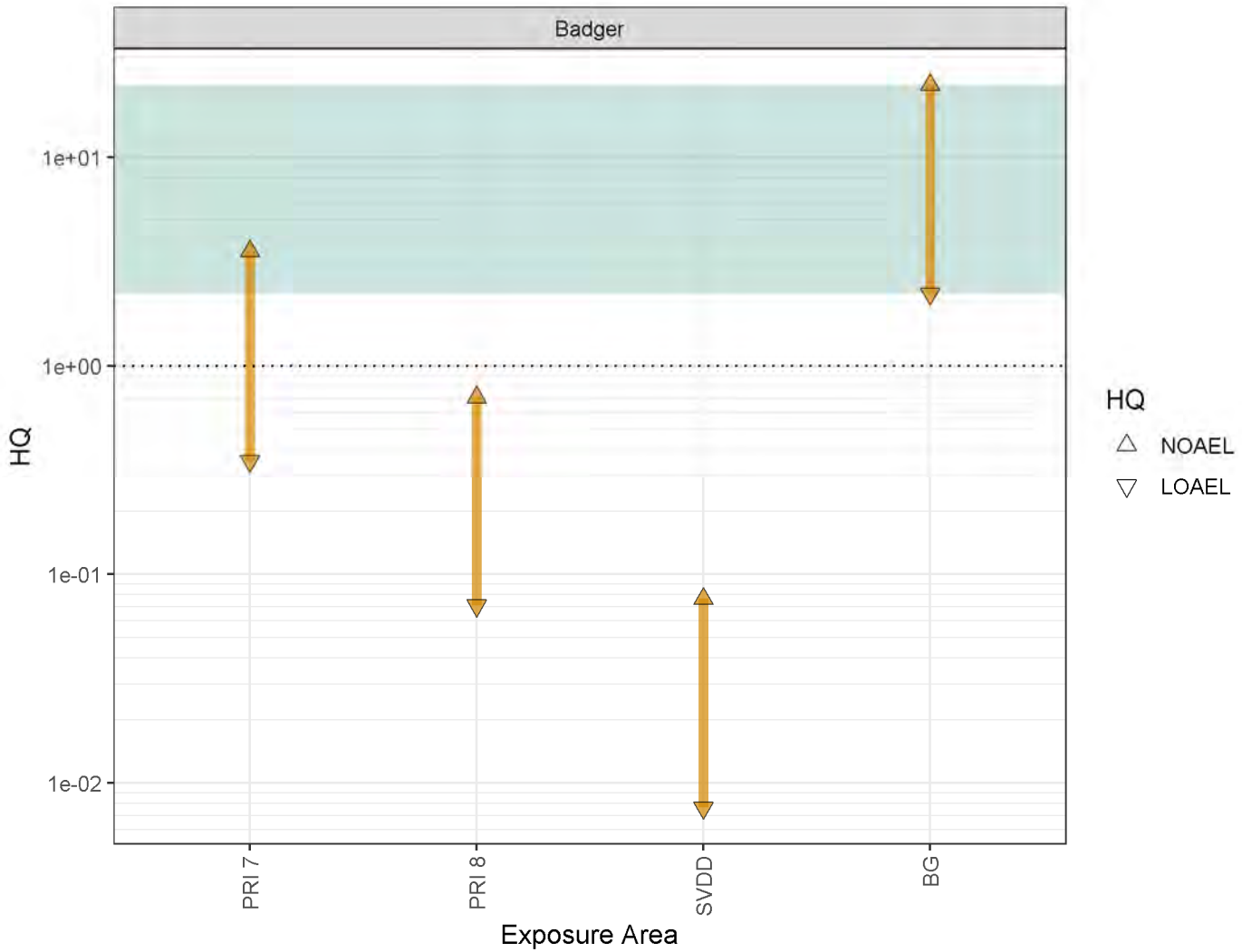

Figure 4-3b
Large Mammal Chronic Dietary Dose HQs in Lakebed Habitat
Aluminum

Notes:
BG = Background
The green shaded area illustrates the range of background HQs.

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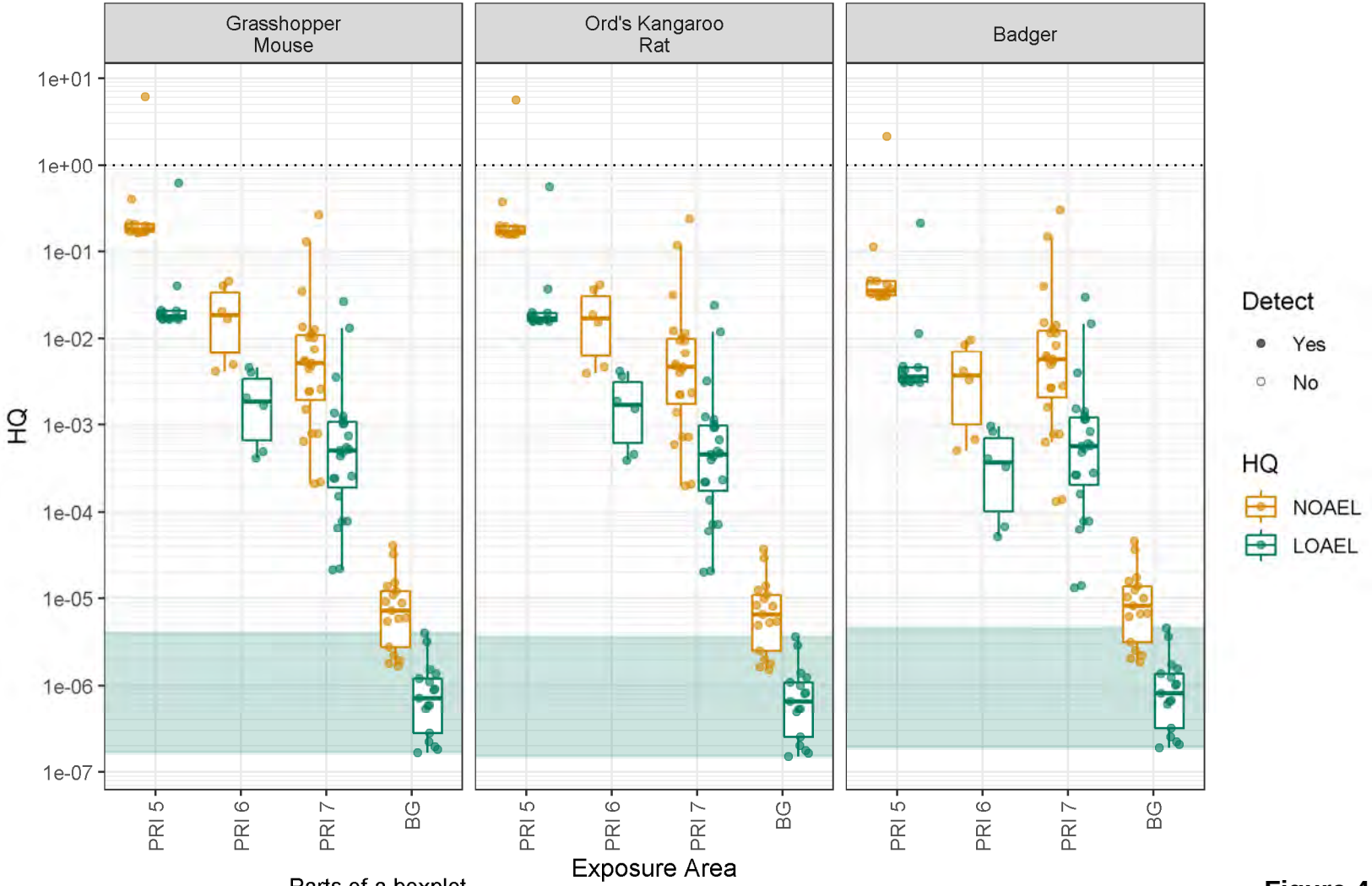

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

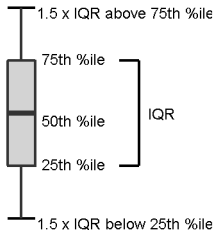

Figure 4-4a
Large and Small Mammal Acute Dietary Dose HQs in Lakebed Habitat
Mammalian TEQ, ND=1/2DL

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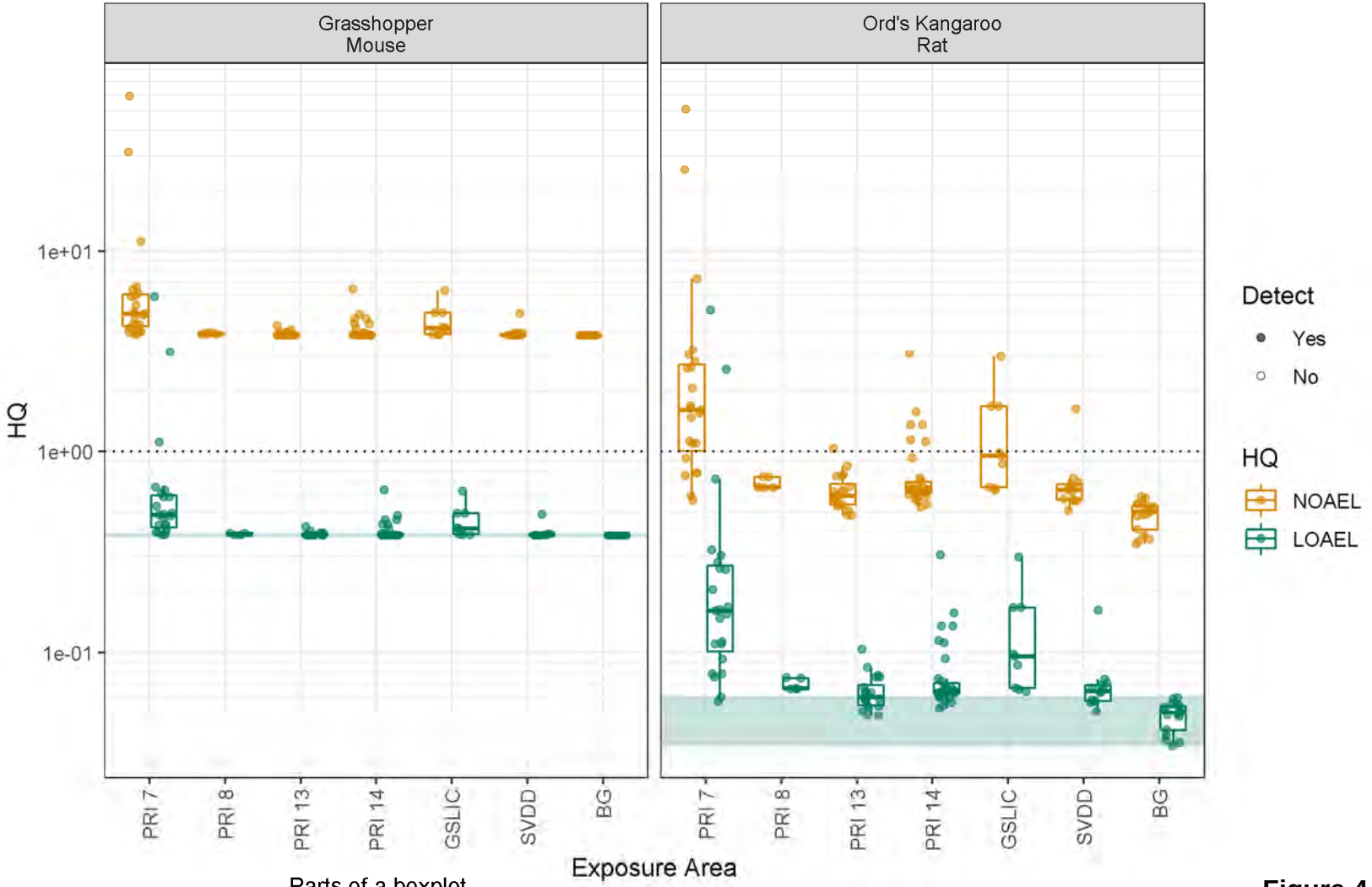
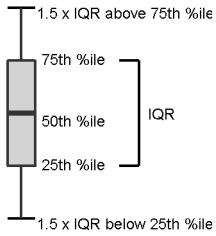


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-4b
Small Mammal Chronic Dietary Dose HQs in Lakebed Habitat
Mammalian TEQ, ND=1/2DL

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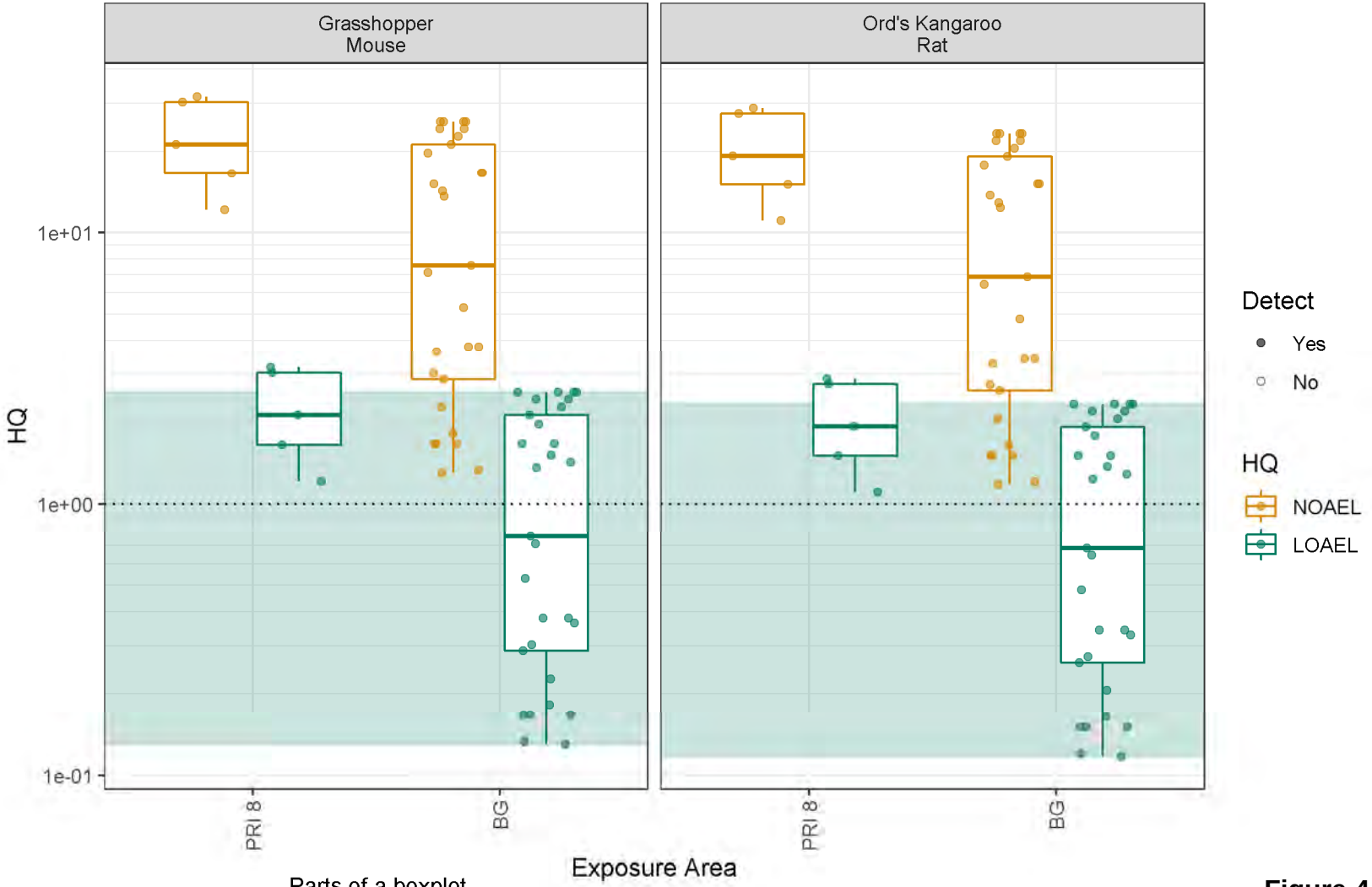

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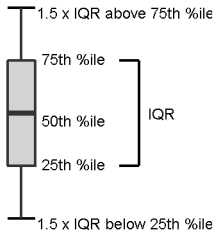

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-4c
Small Mammal Chronic Dietary Dose HQs in Lakebed Habitat Aluminum

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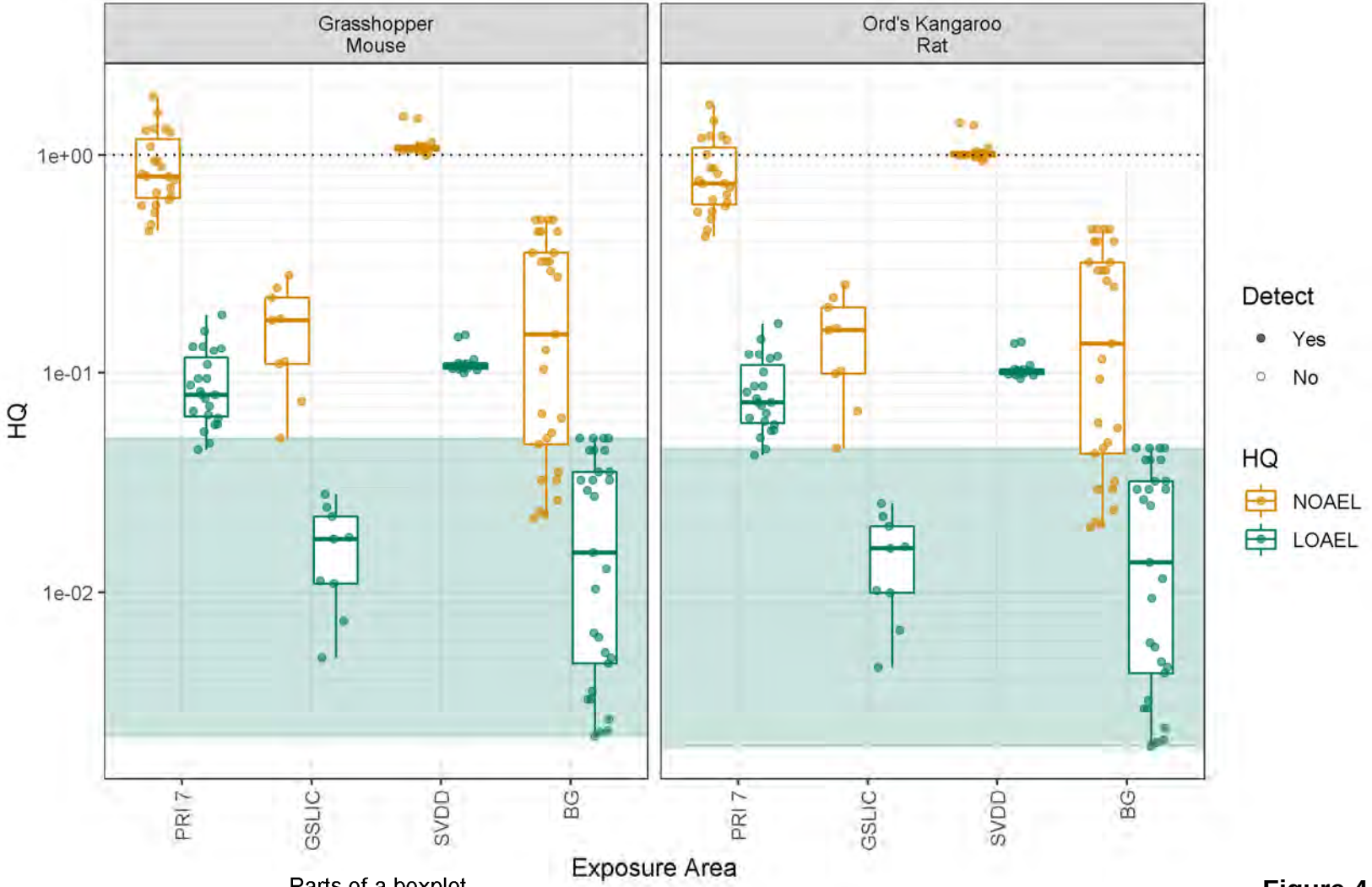

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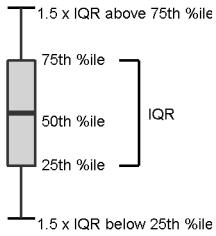

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 4-4d
Small Mammal Chronic Dietary Dose HQs in Lakebed Habitat
Iron

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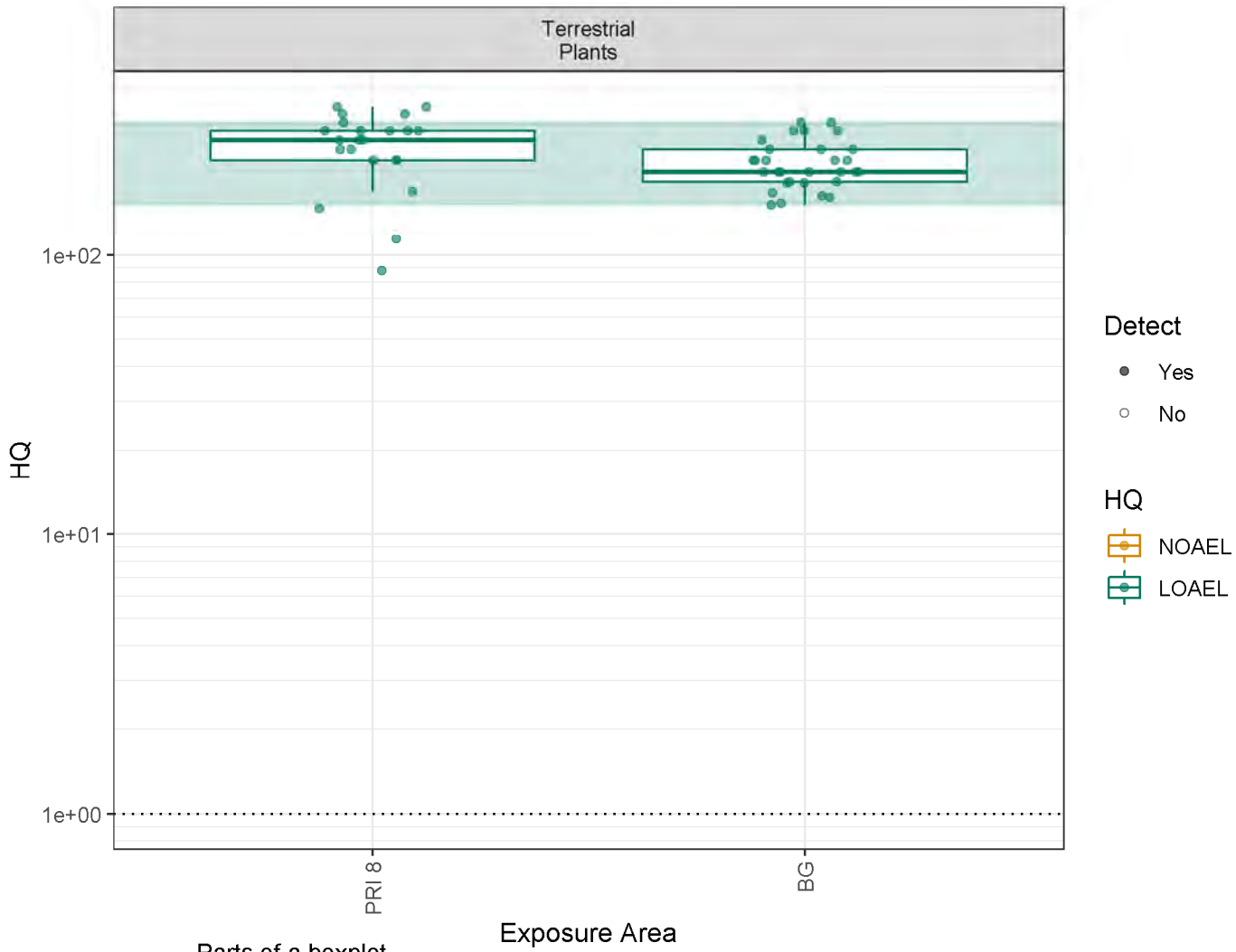

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

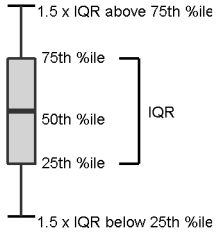

Figure 5-1a
Terrestrial Plant Direct Contact HQs in Upland Habitat
Aluminum

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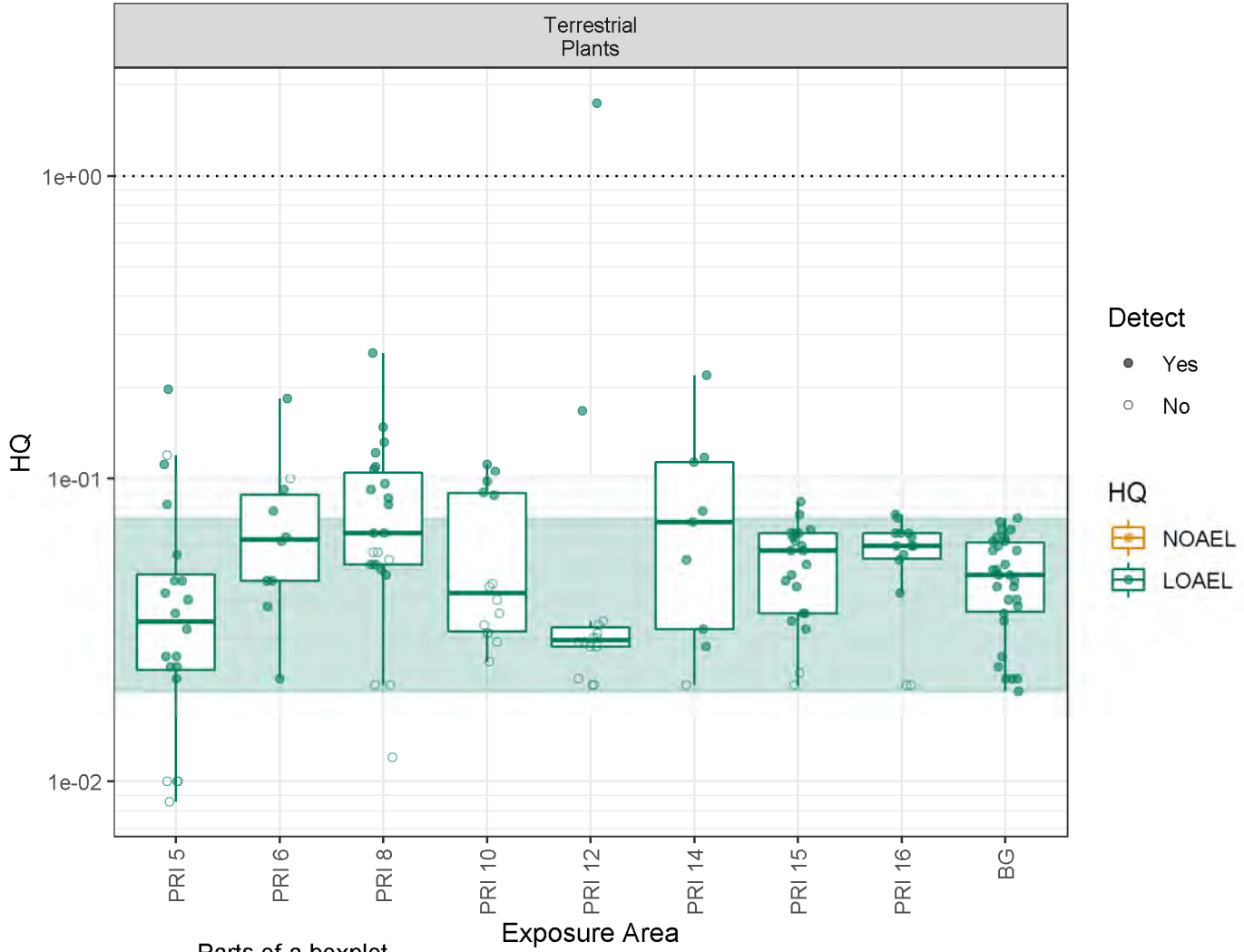

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

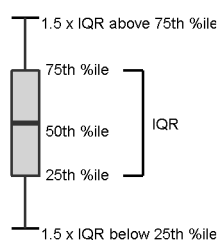

Figure 5-1b
Terrestrial Plant Direct Contact HQs in Upland Habitat
Antimony

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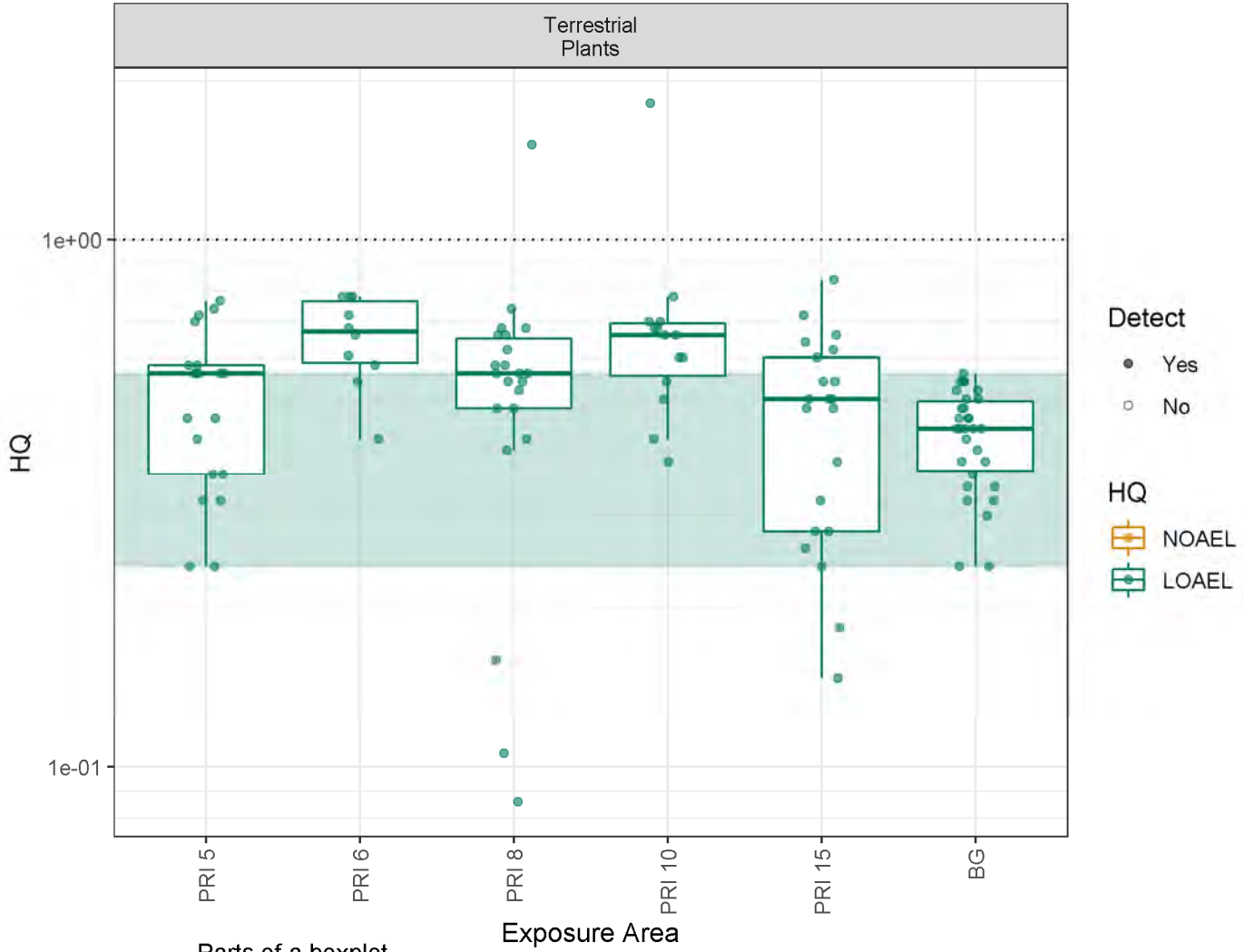

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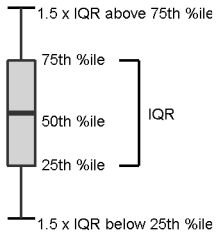

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 5-1c
Terrestrial Plant Direct Contact HQs in Upland Habitat
Barium

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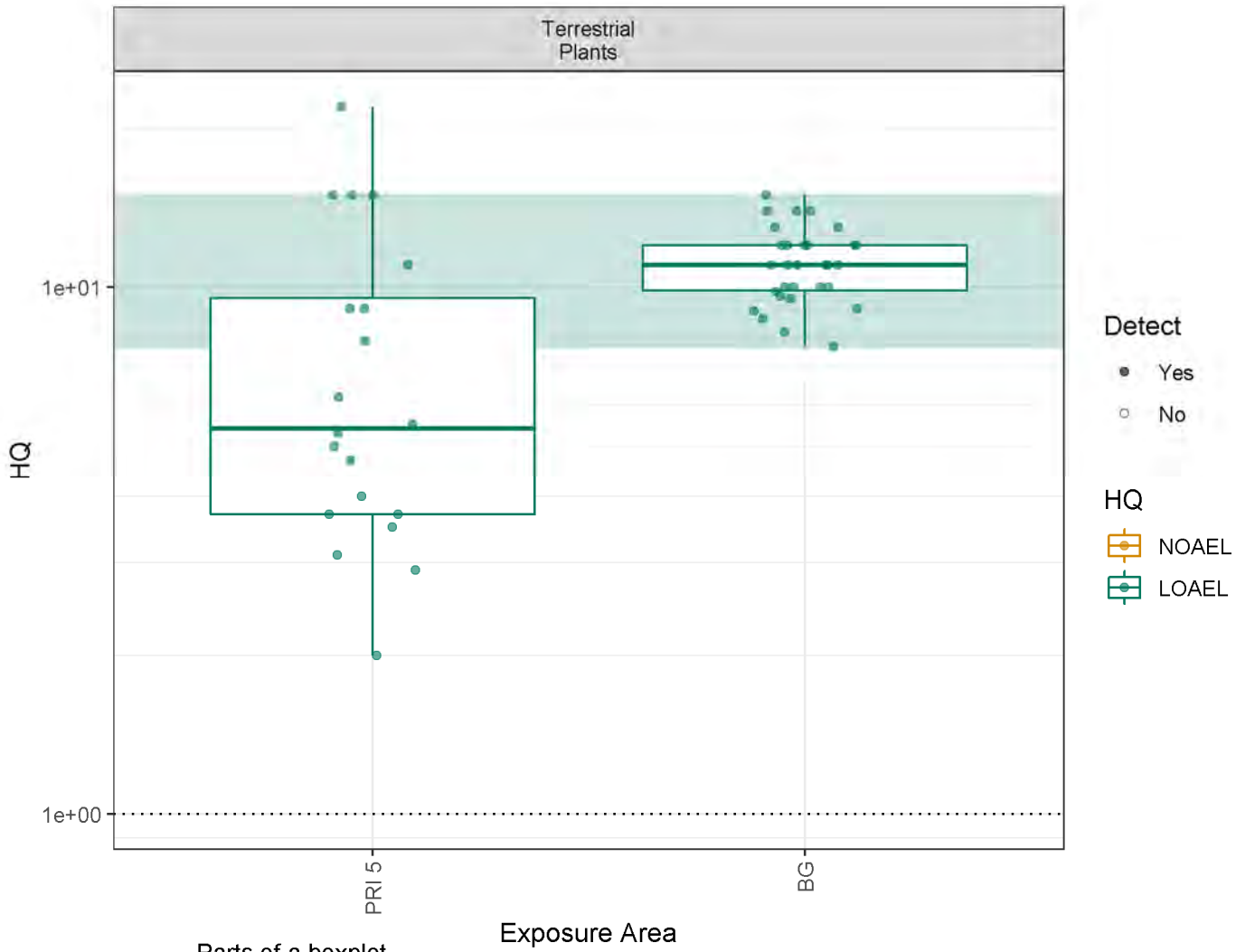

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

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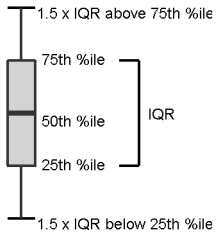

Figure 5-1d
Terrestrial Plant Direct Contact HQs in Upland Habitat
Chromium

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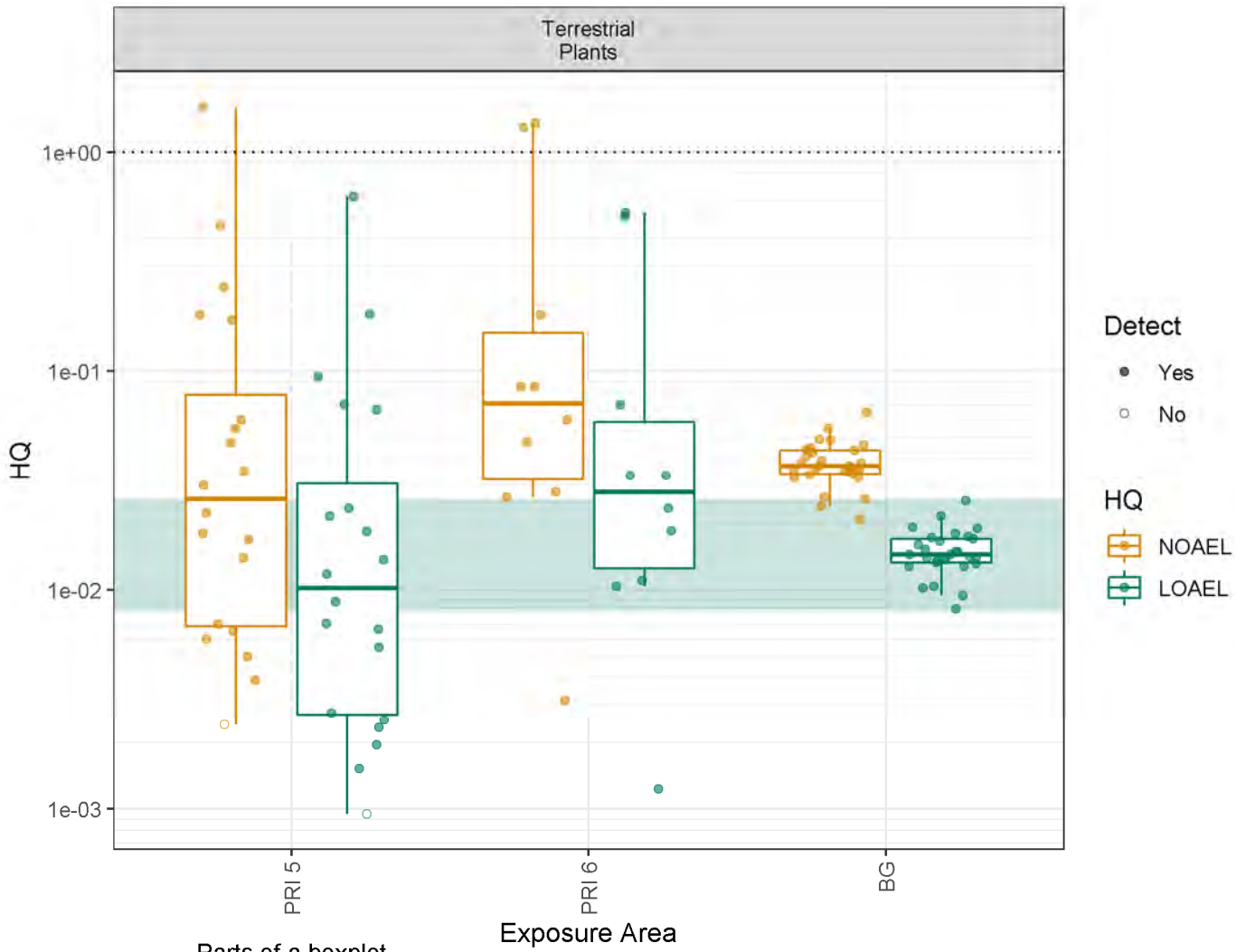

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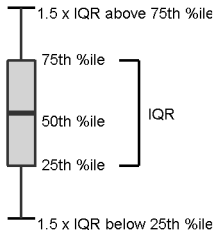

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 5-1e
Terrestrial Plant Direct Contact HQs in Upland Habitat
Molybdenum

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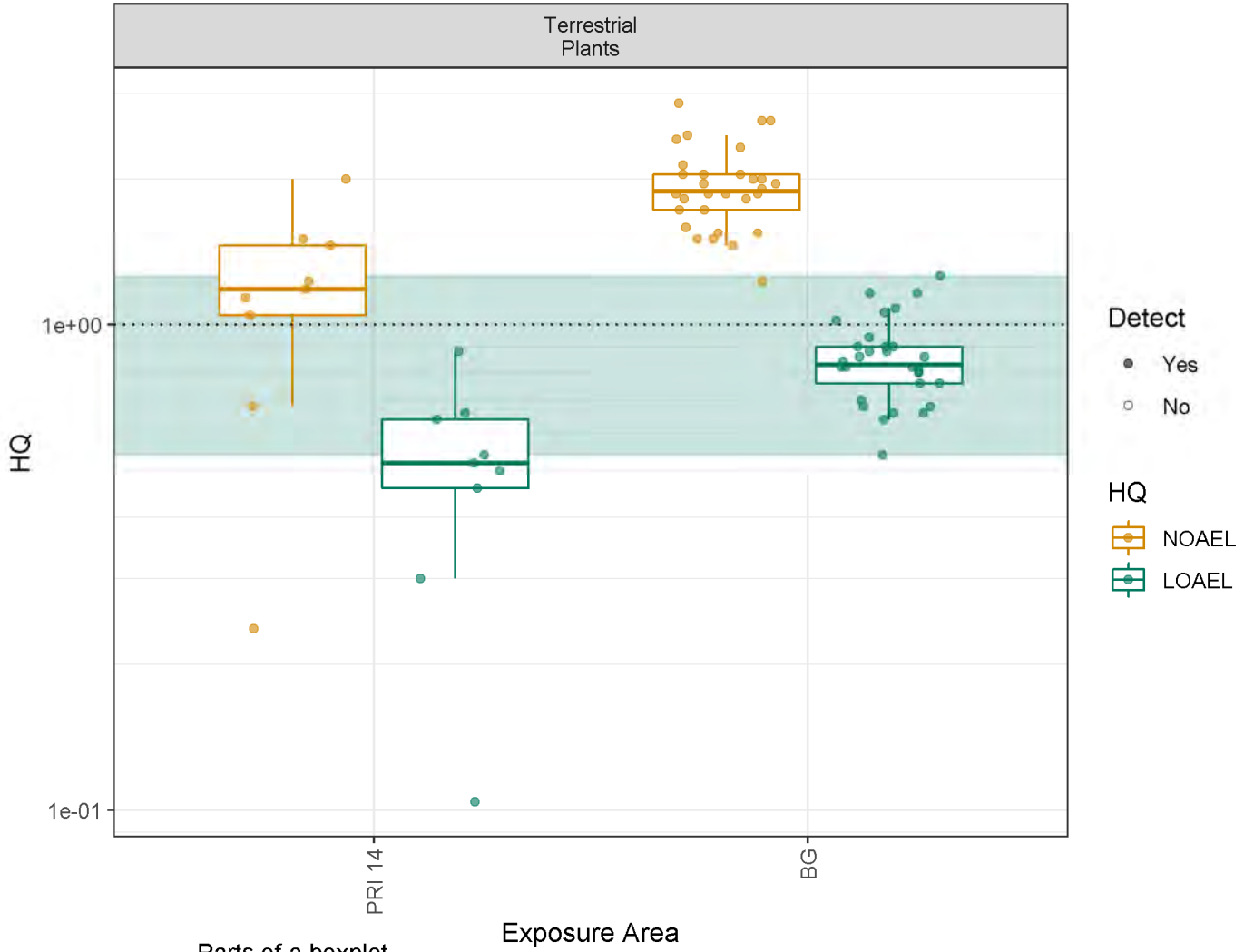

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

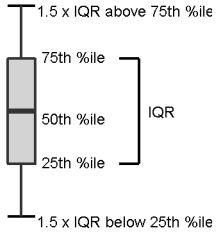

Figure 5-1f
Terrestrial Plant Direct Contact HQs in Upland Habitat
Manganese

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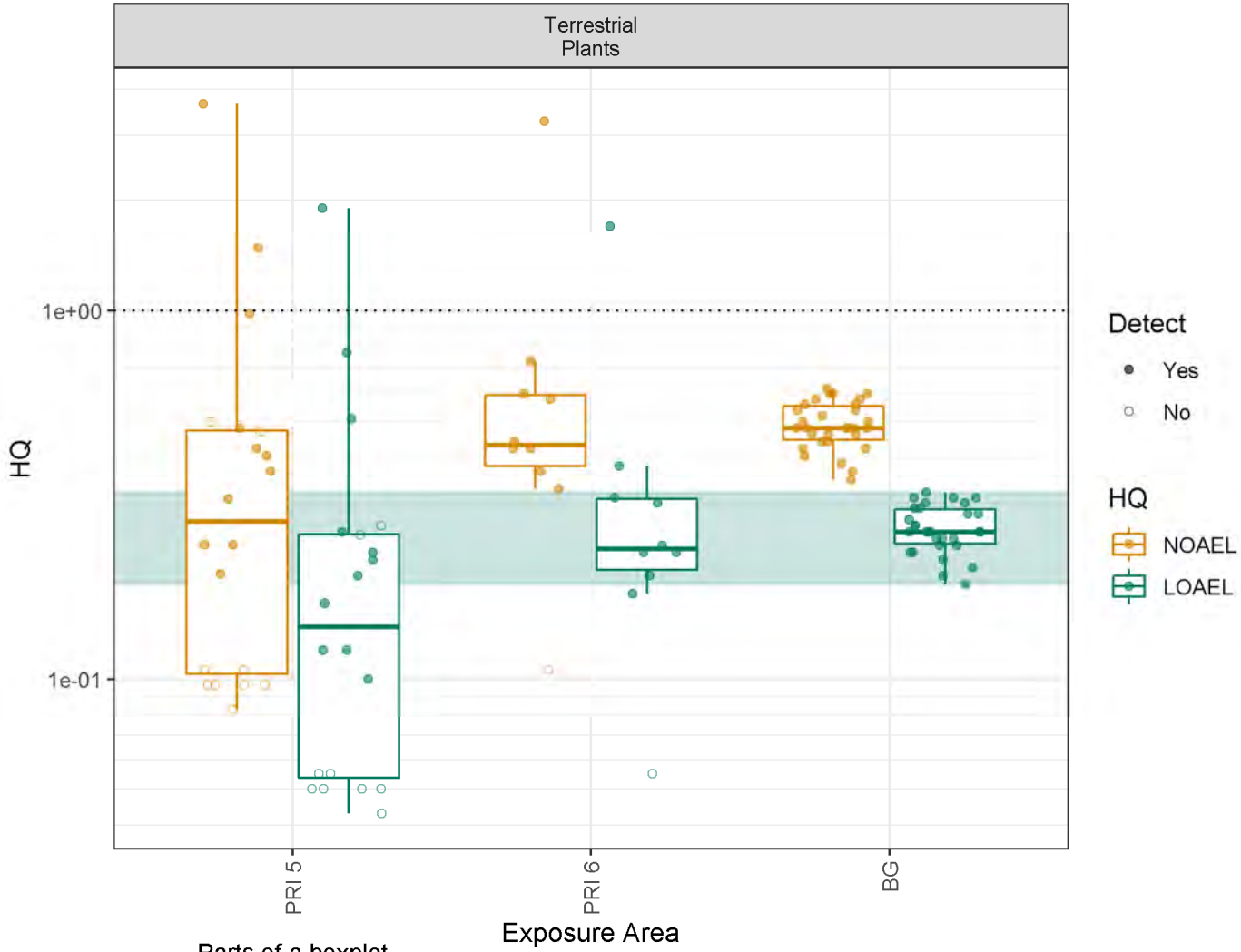
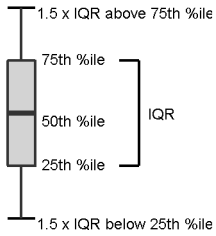


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 5-1g
Terrestrial Plant Direct Contact HQs in Upland Habitat
Selenium

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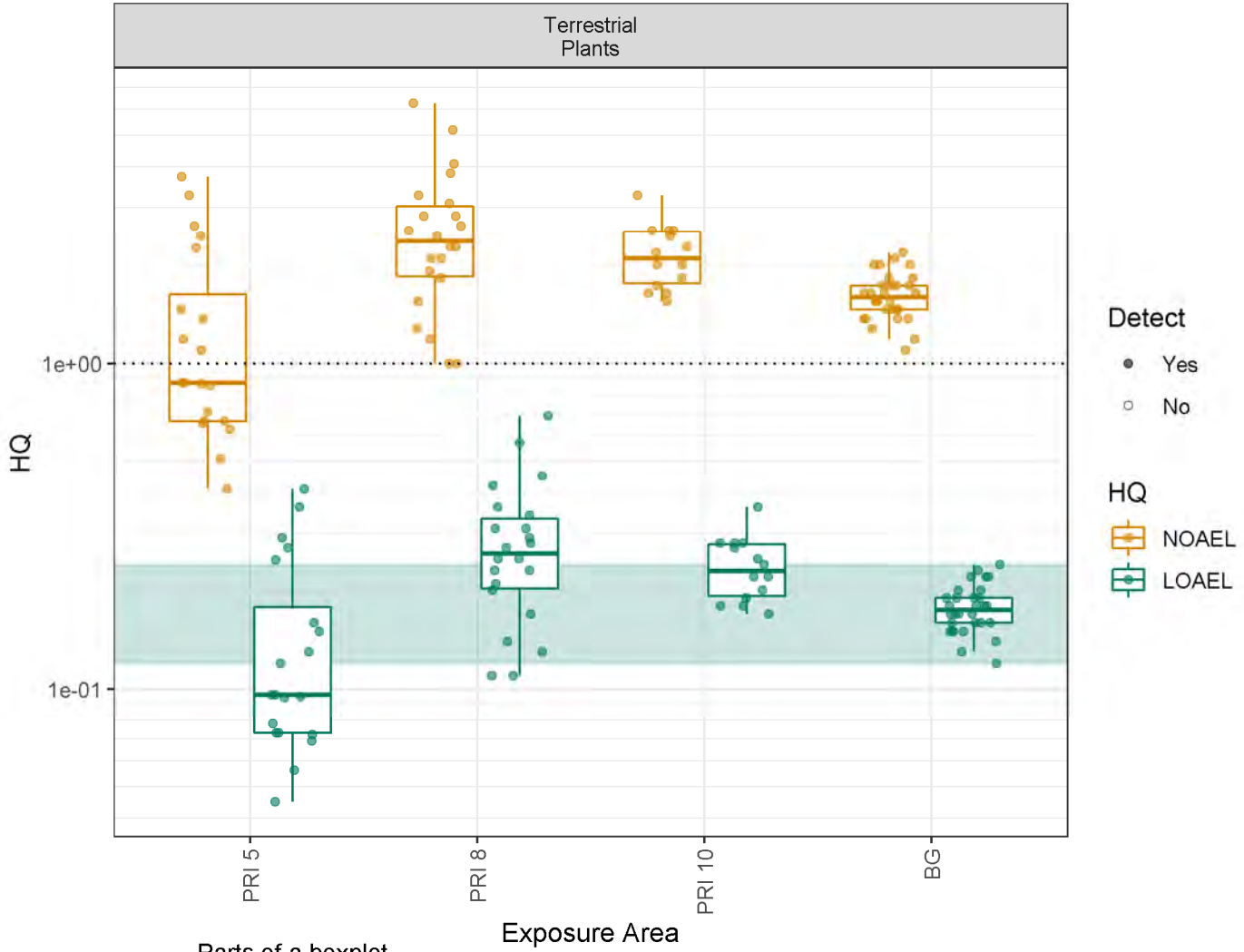
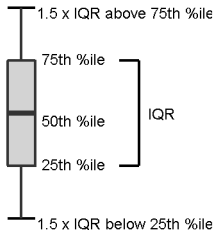


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 5-1h
Terrestrial Plant Direct Contact HQs in Upland Habitat
Vanadium

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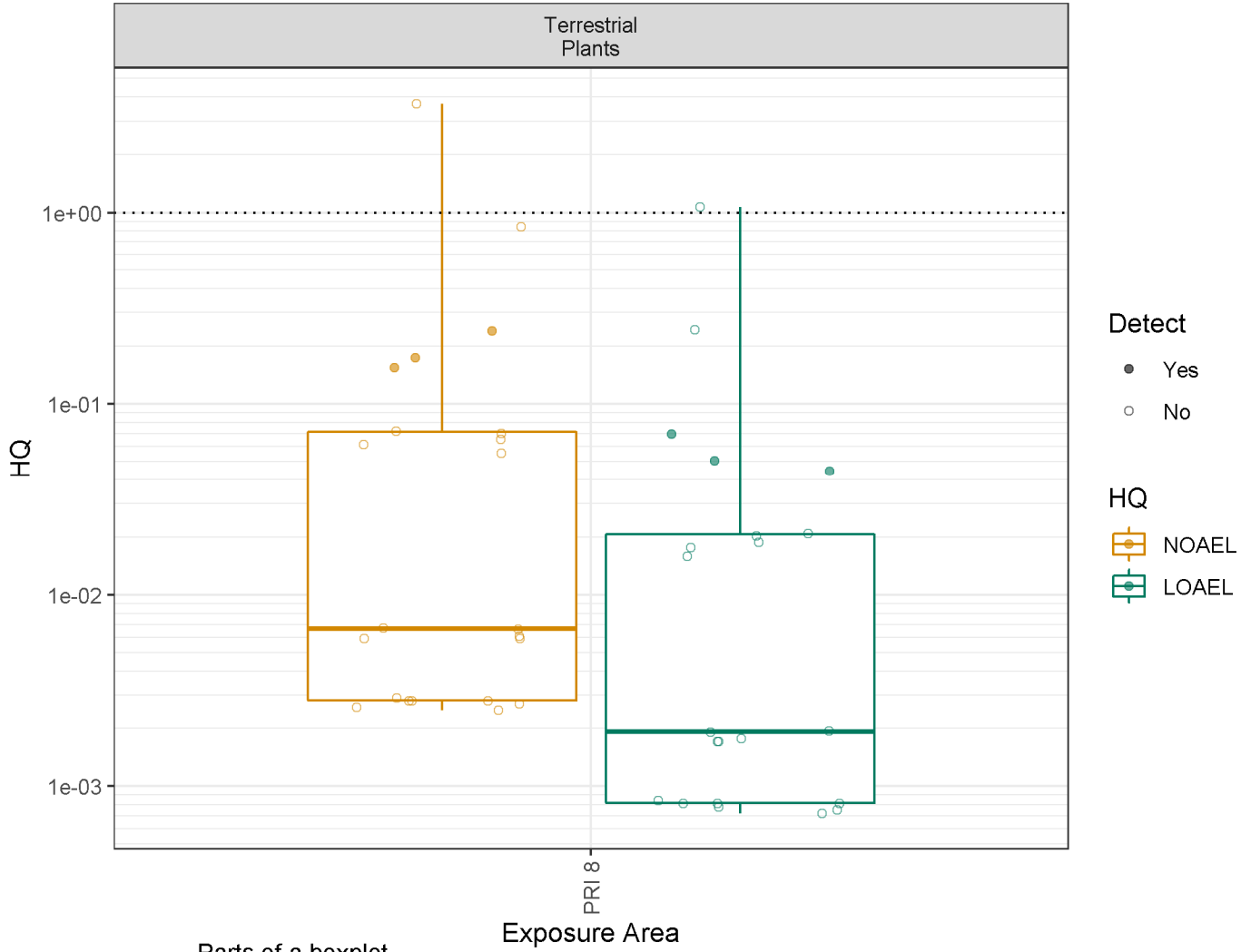

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

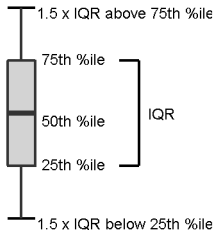

Figure 5-1i
Terrestrial Plant Direct Contact HQs in Upland Habitat
Pentachlorophenol

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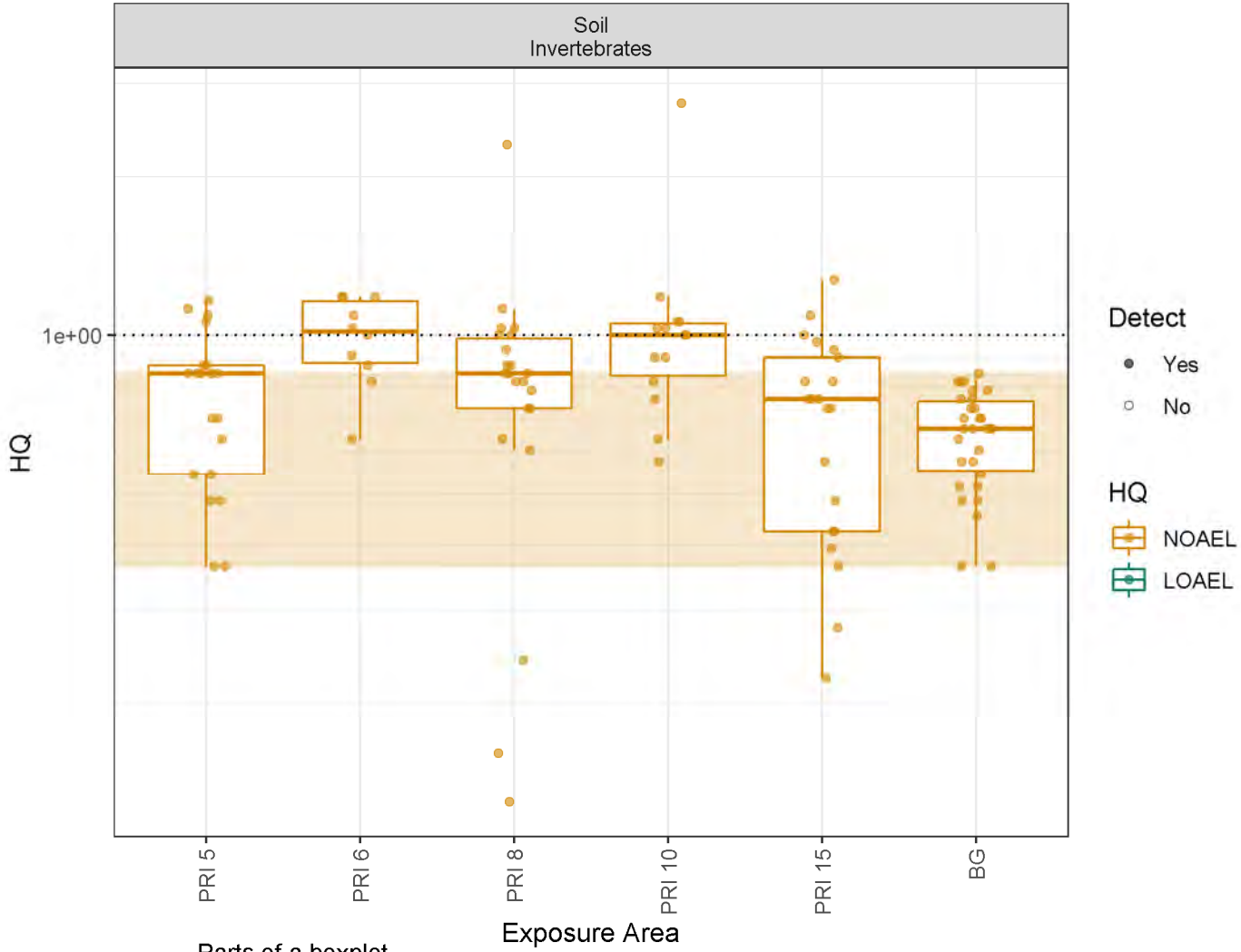
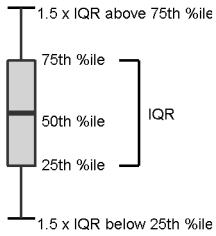


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-1a
Soil Invertebrate Direct Contact HQs in Upland Habitat
Barium

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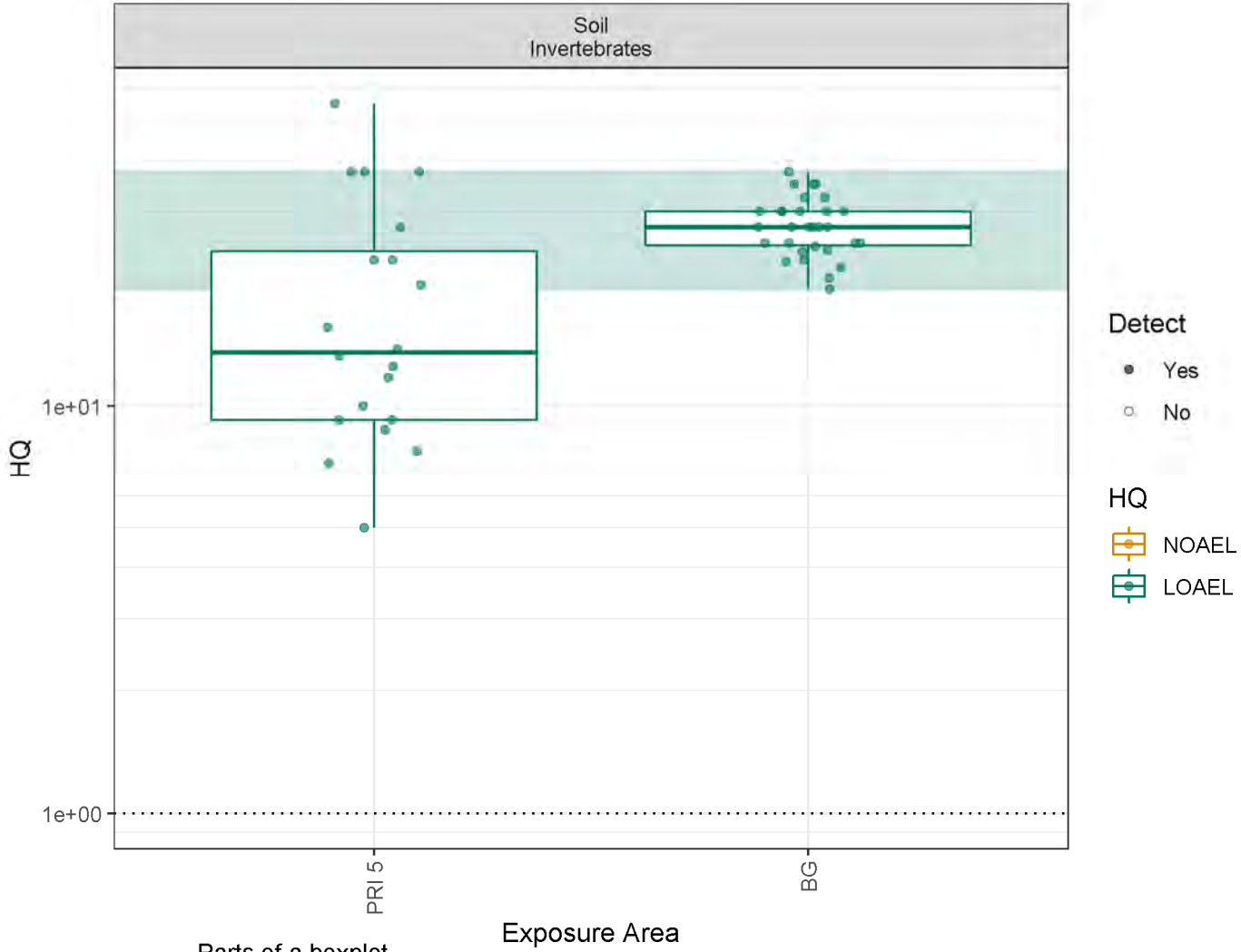

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

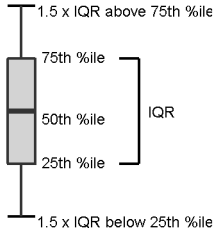

Figure 6-1b
Soil Invertebrate Direct Contact HQs in Upland Habitat
Chromium

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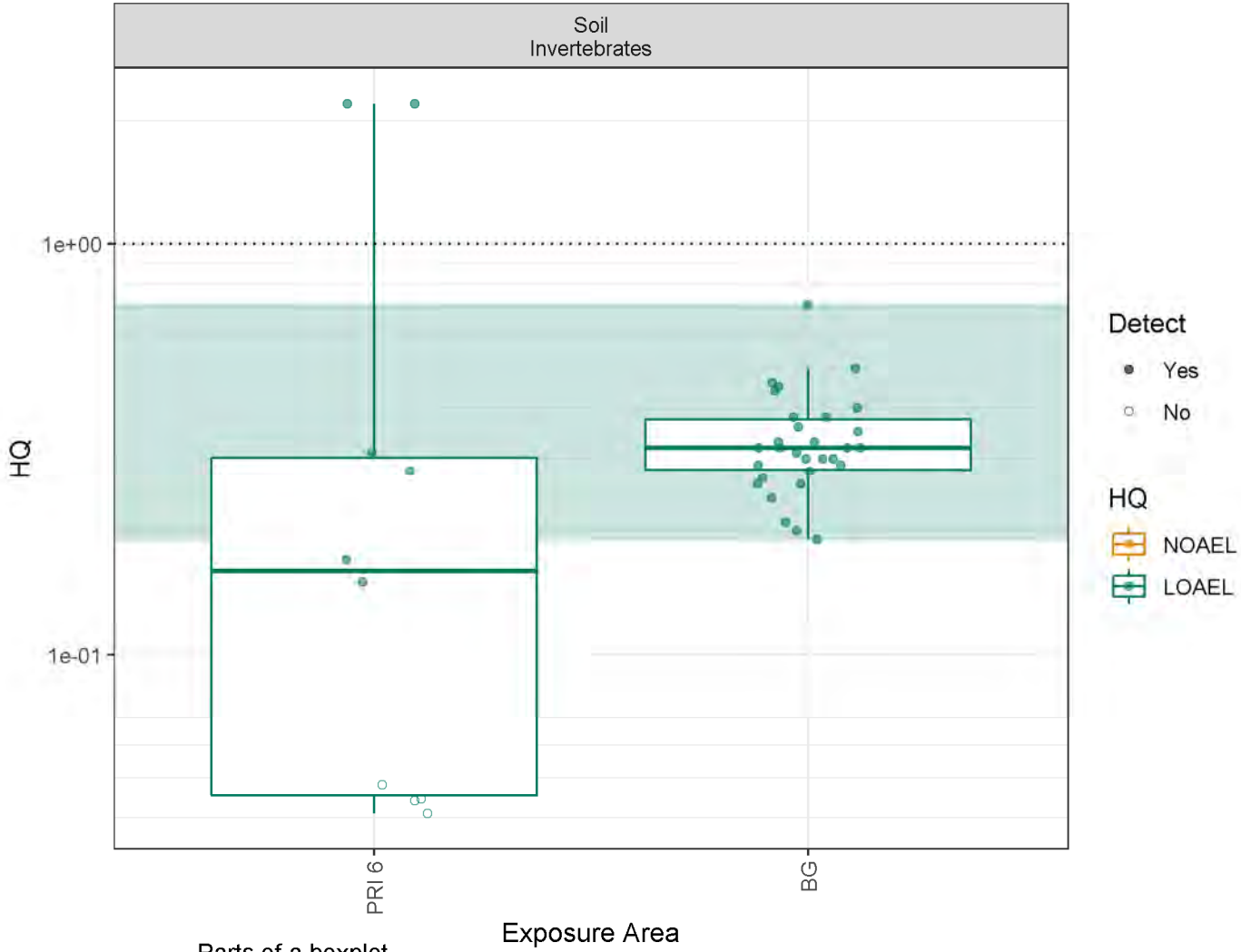

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

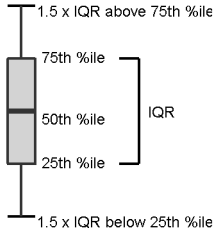

Figure 6-1c
Soil Invertebrate Direct Contact HQs in Upland Habitat
Mercury

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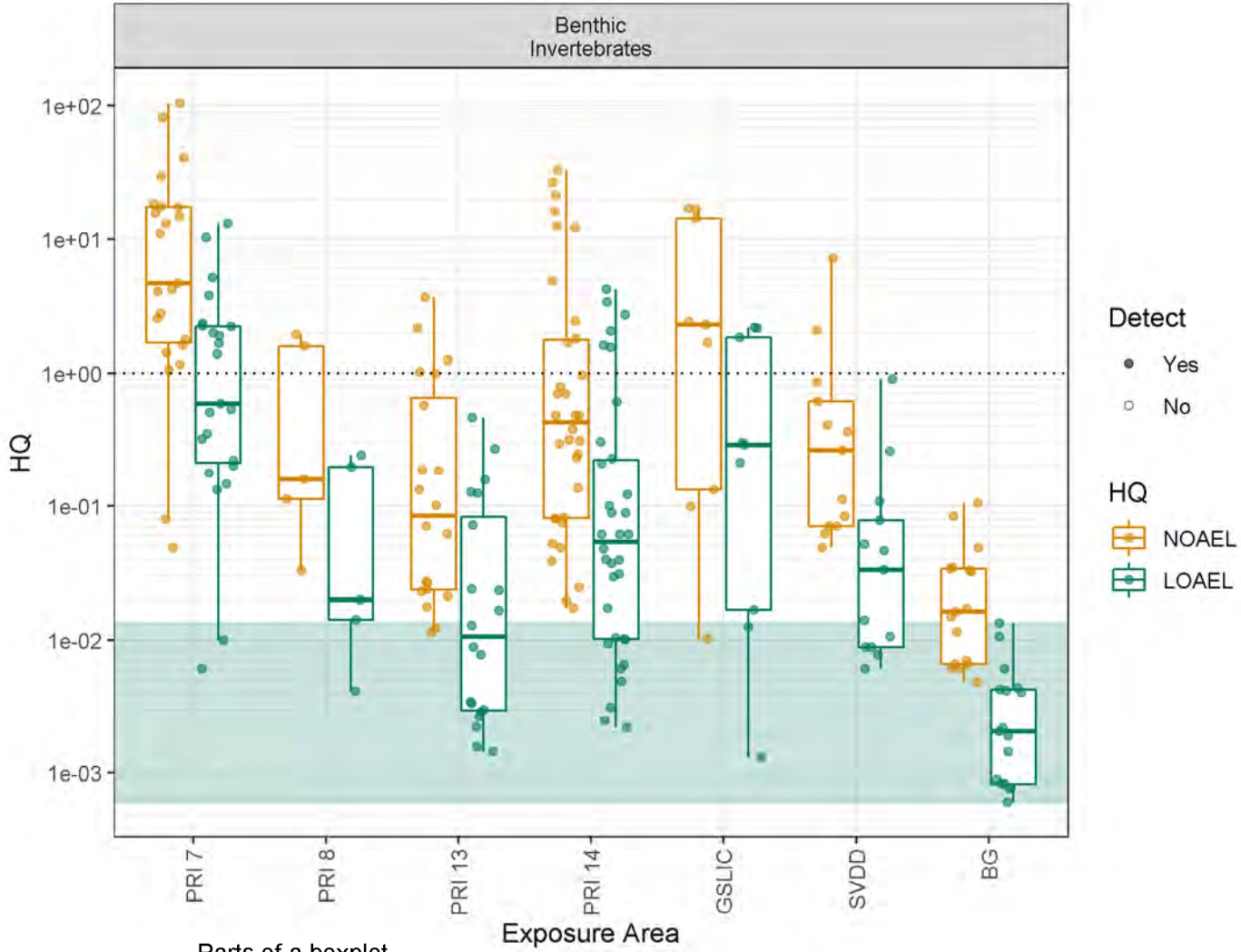

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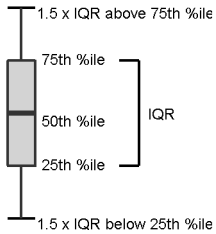

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2a
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Total PCBs

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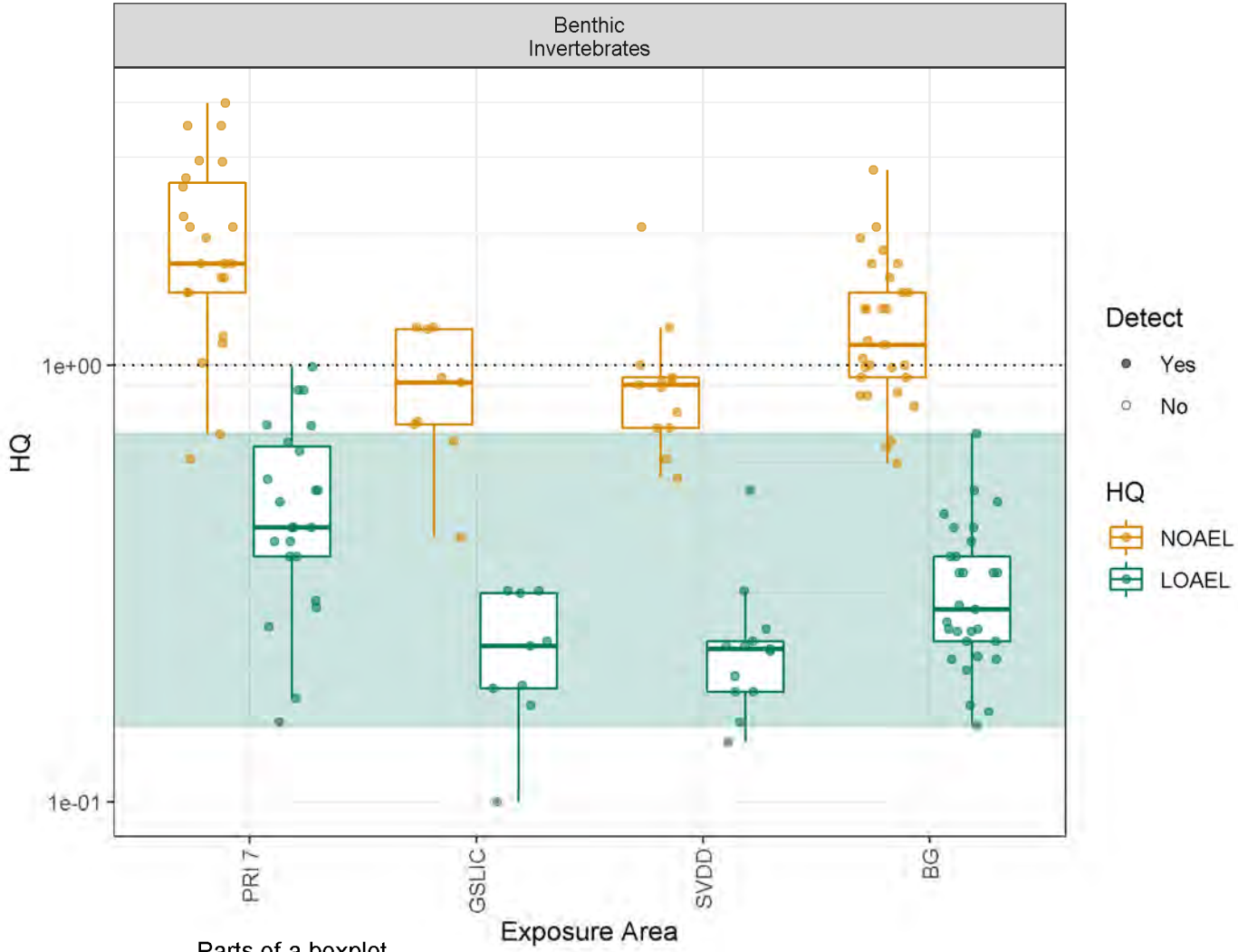

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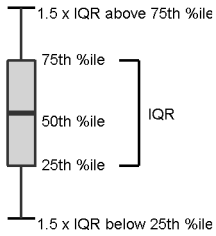

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2b
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Arsenic

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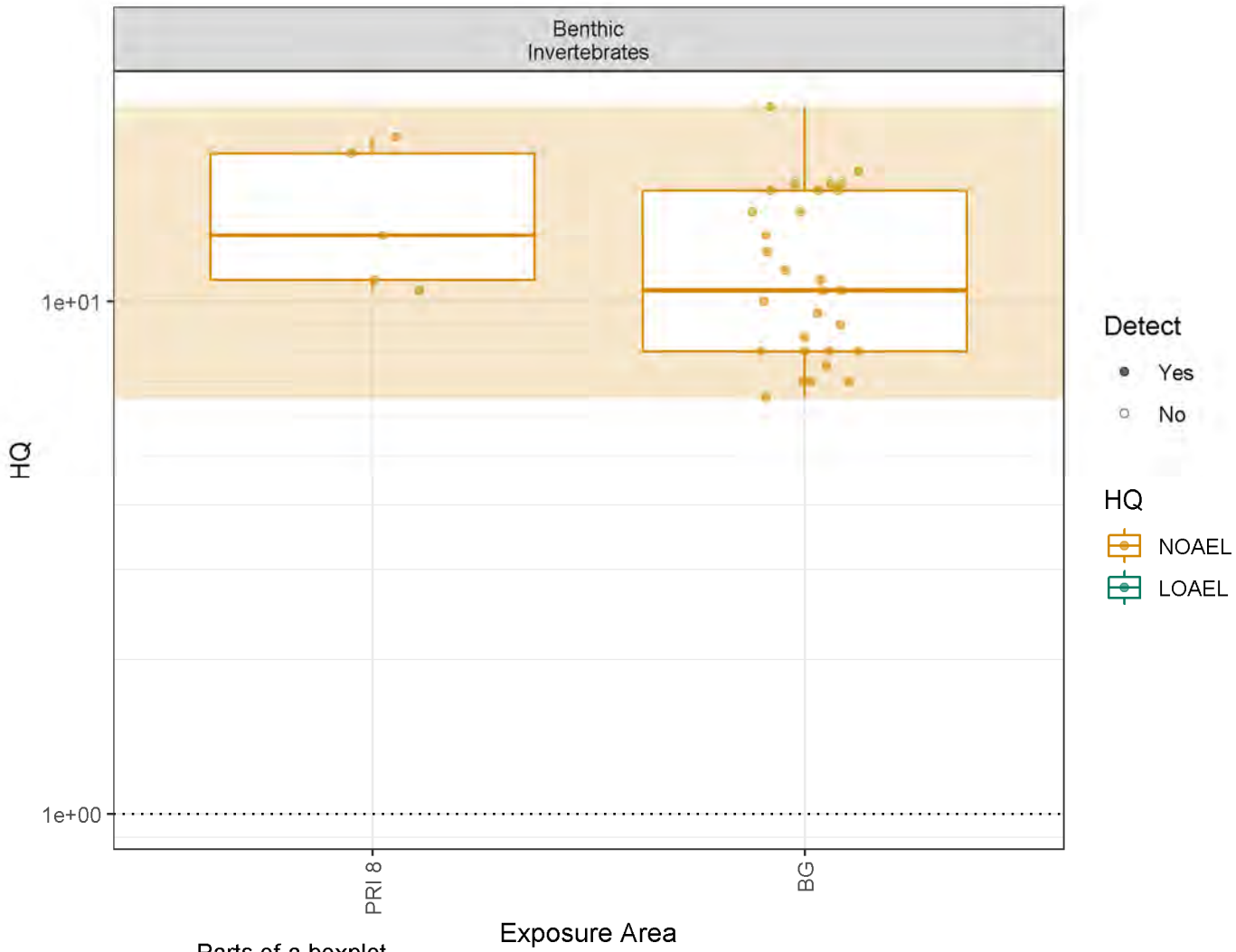

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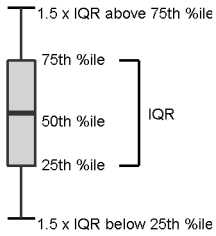

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2c
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Barium

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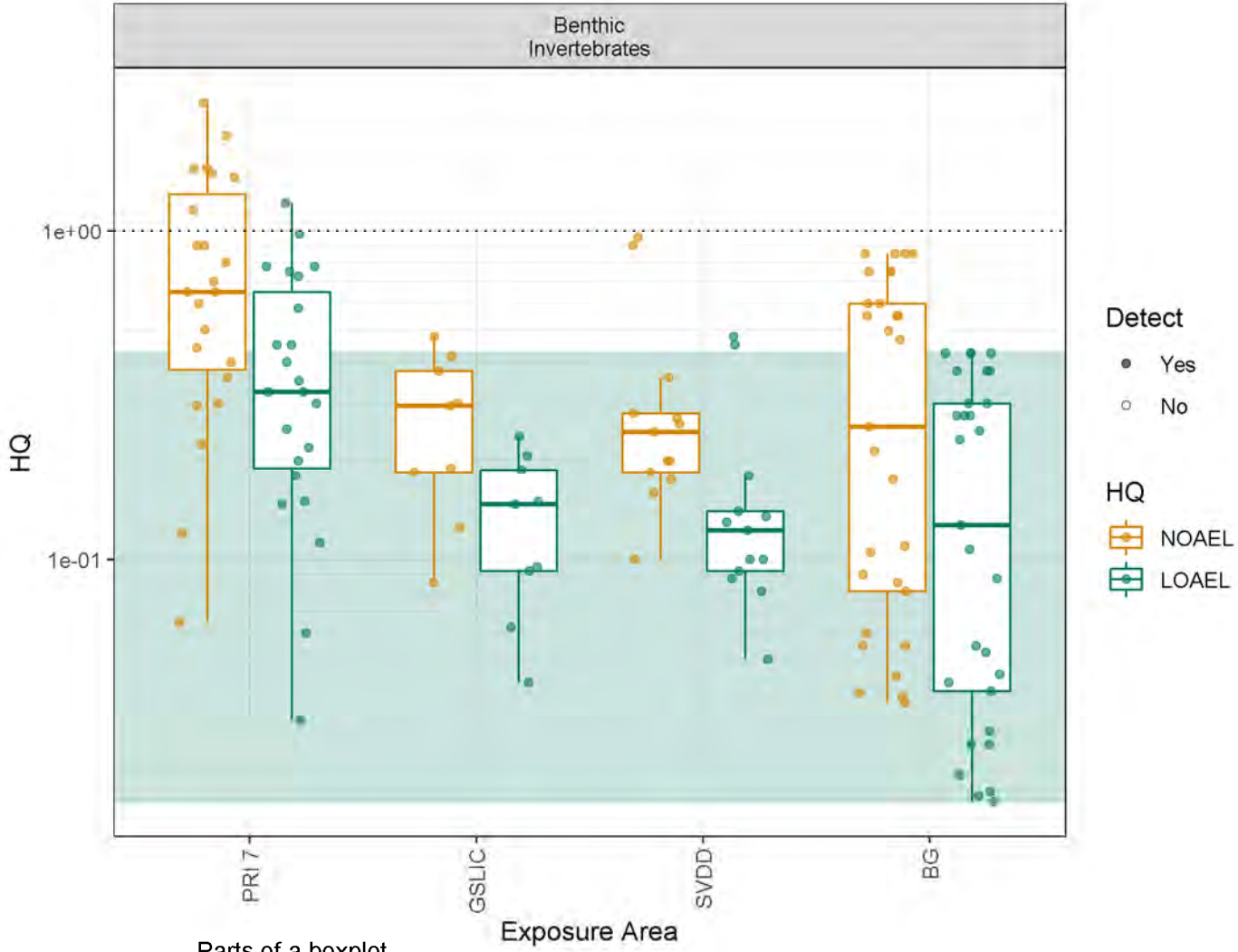

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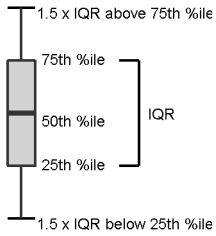

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2d
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Iron

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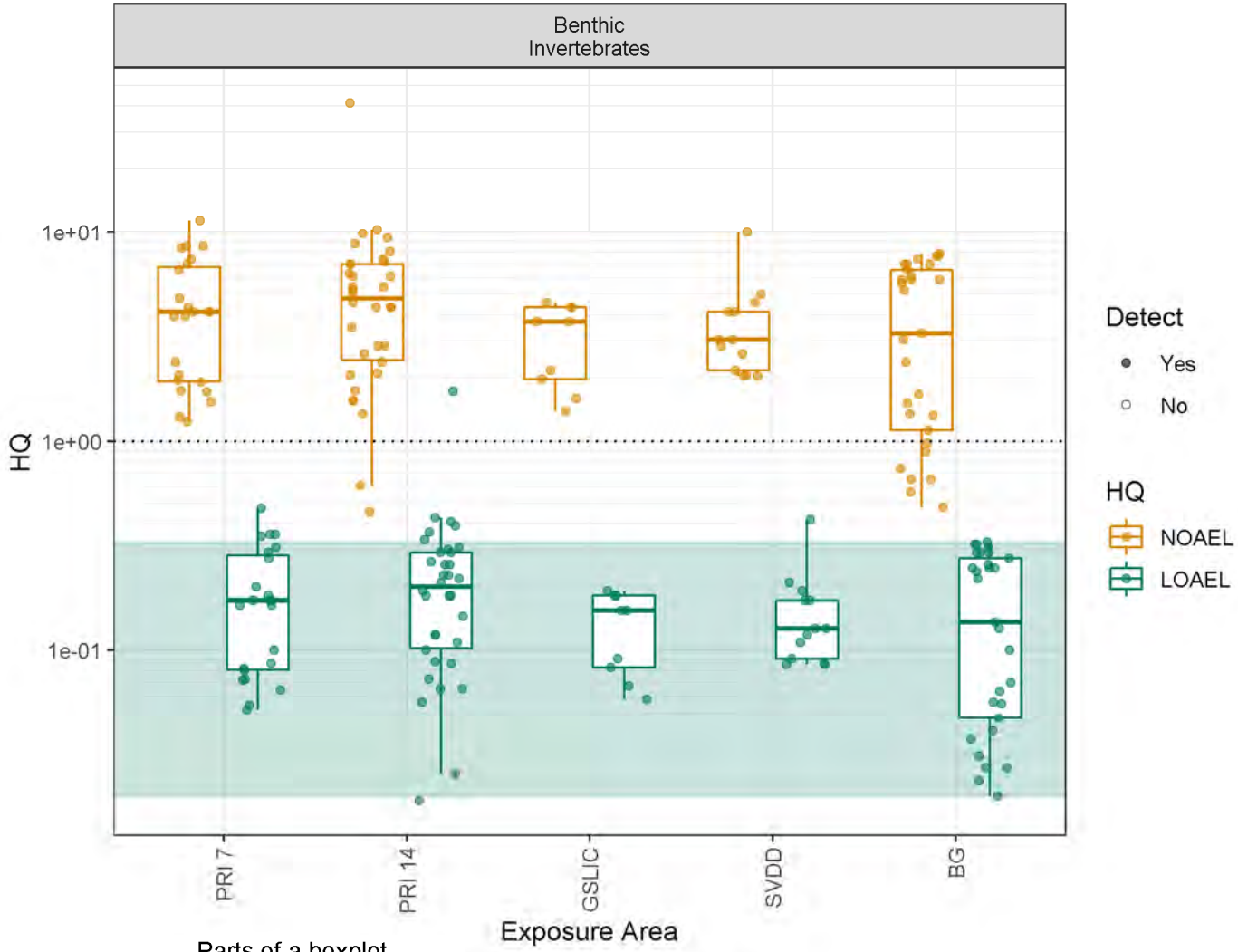

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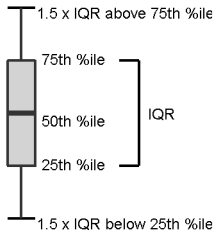

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2e
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Manganese

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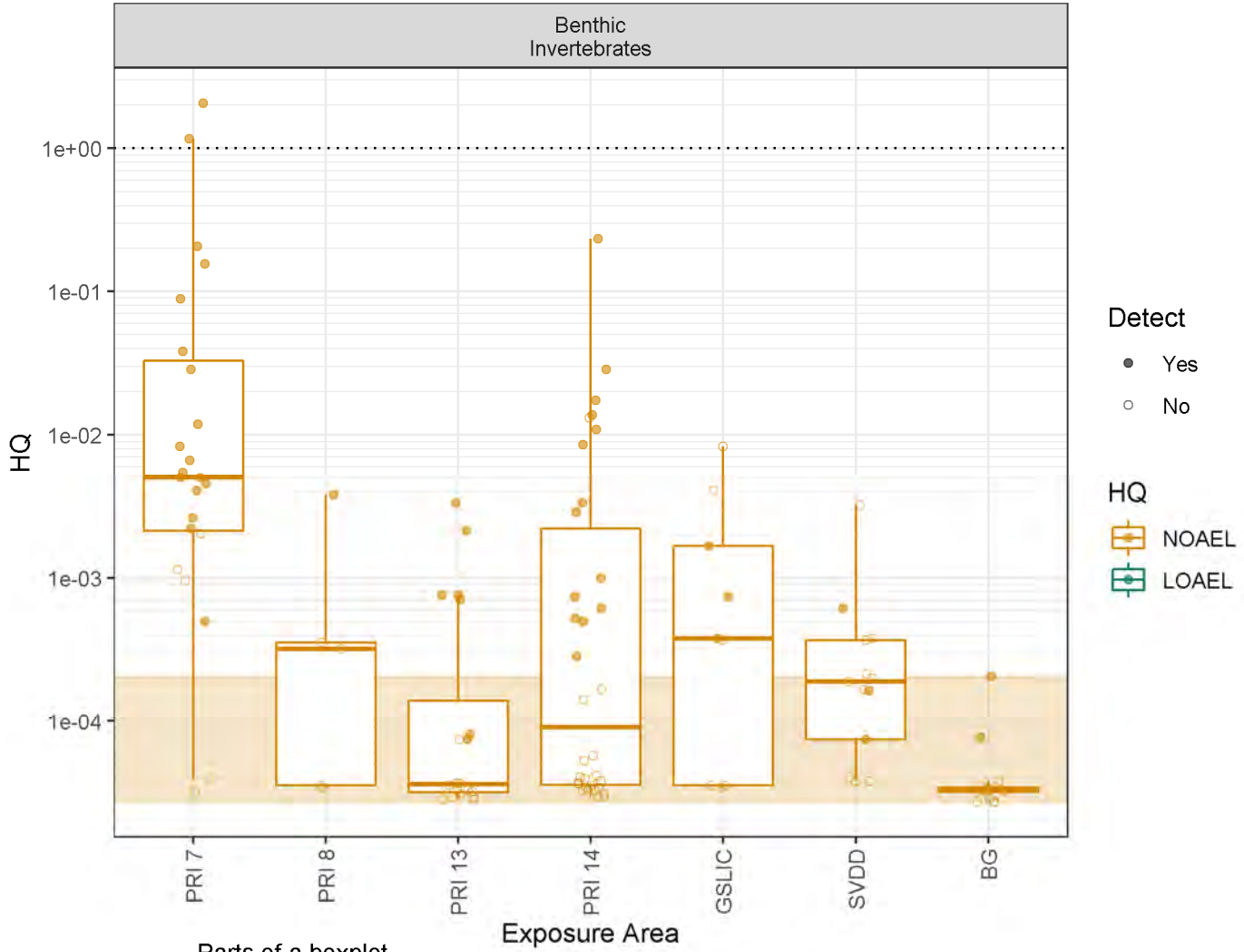

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

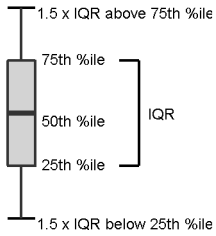

Figure 6-2f
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Hexachlorobenzene

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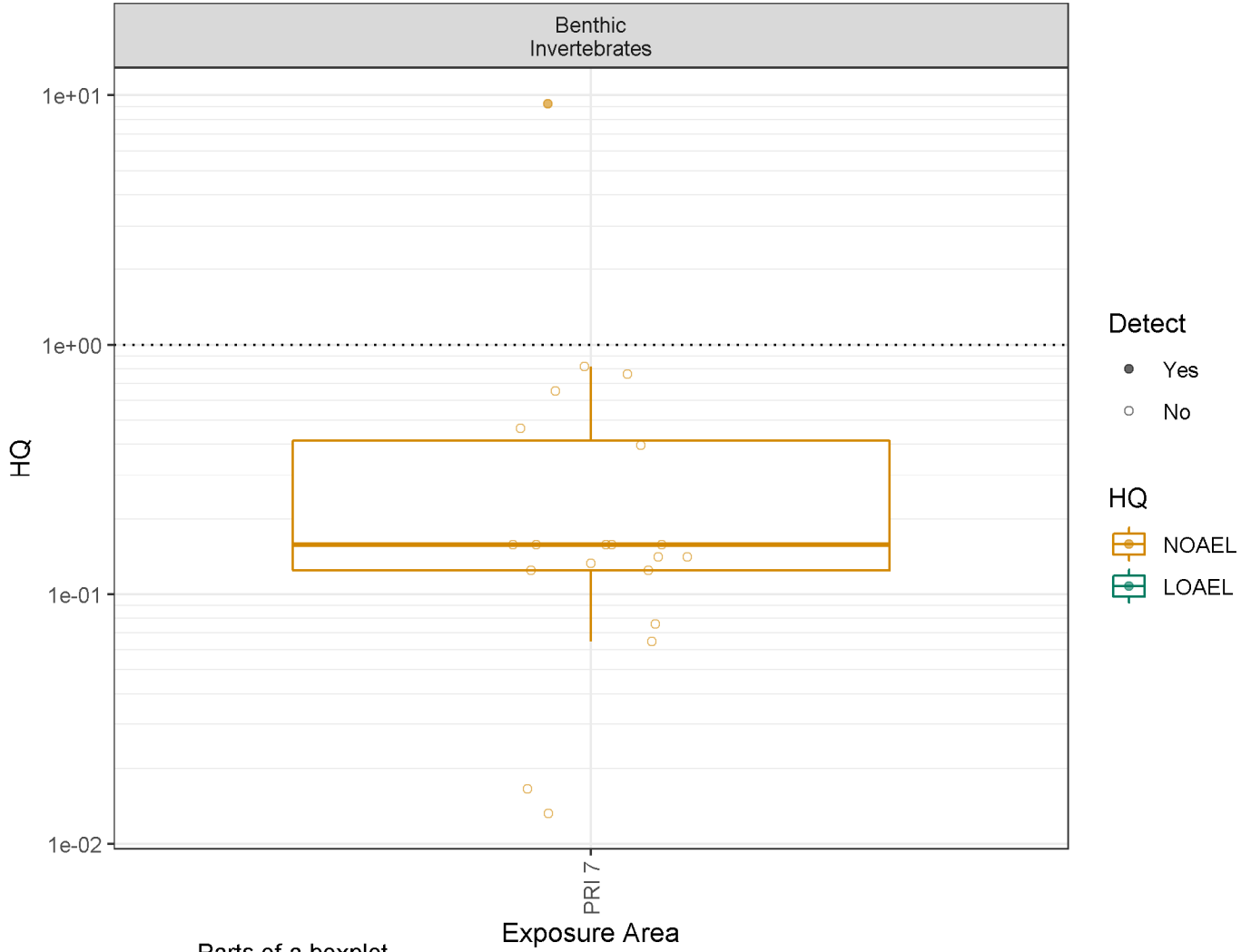

Notes:
BG = Background
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%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

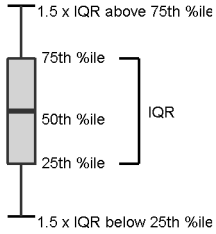

Figure 6-2g
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Pentachlorobenzene

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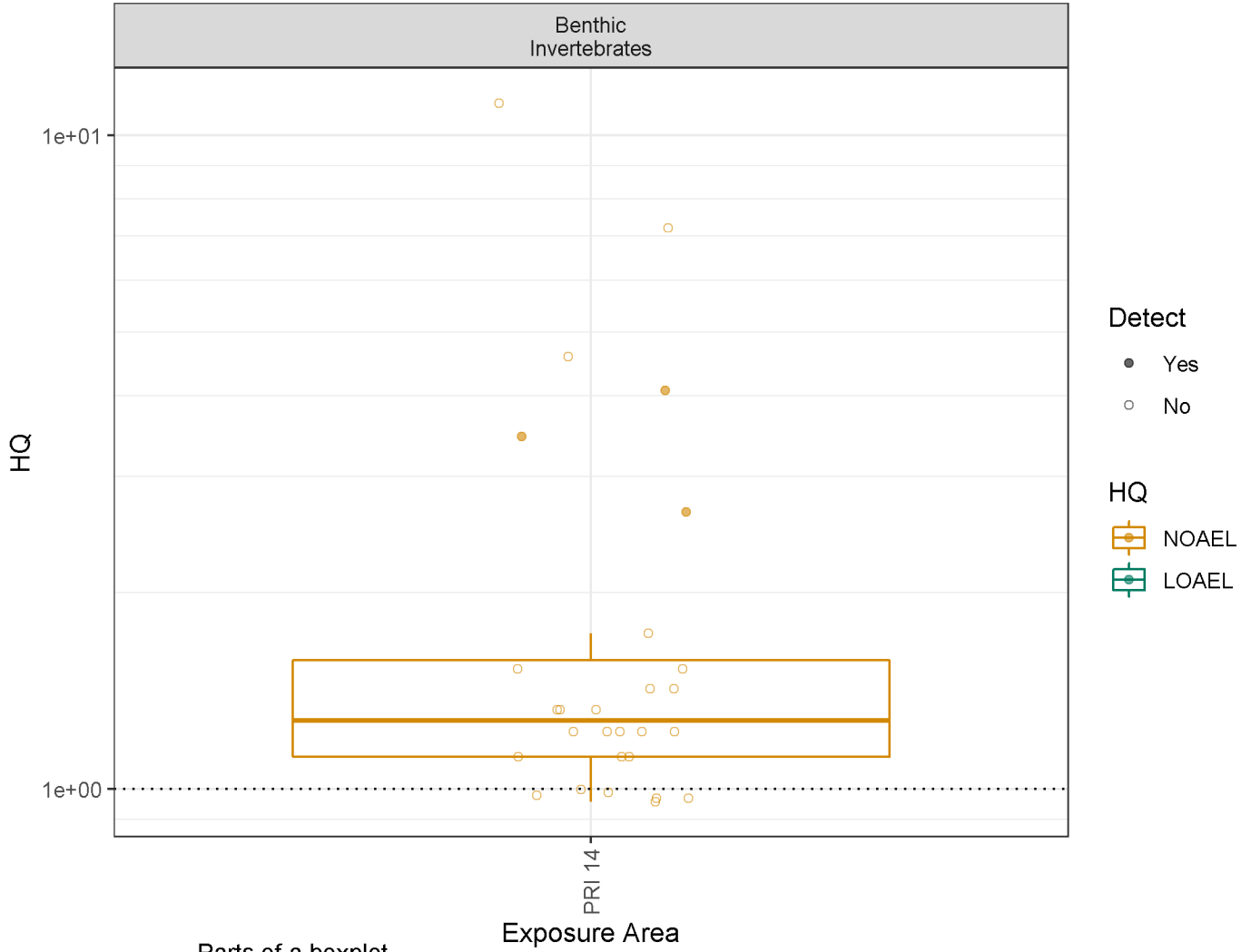

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Parts of a boxplot

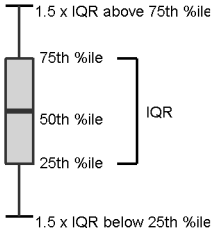

Figure 6-2h
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Phenol

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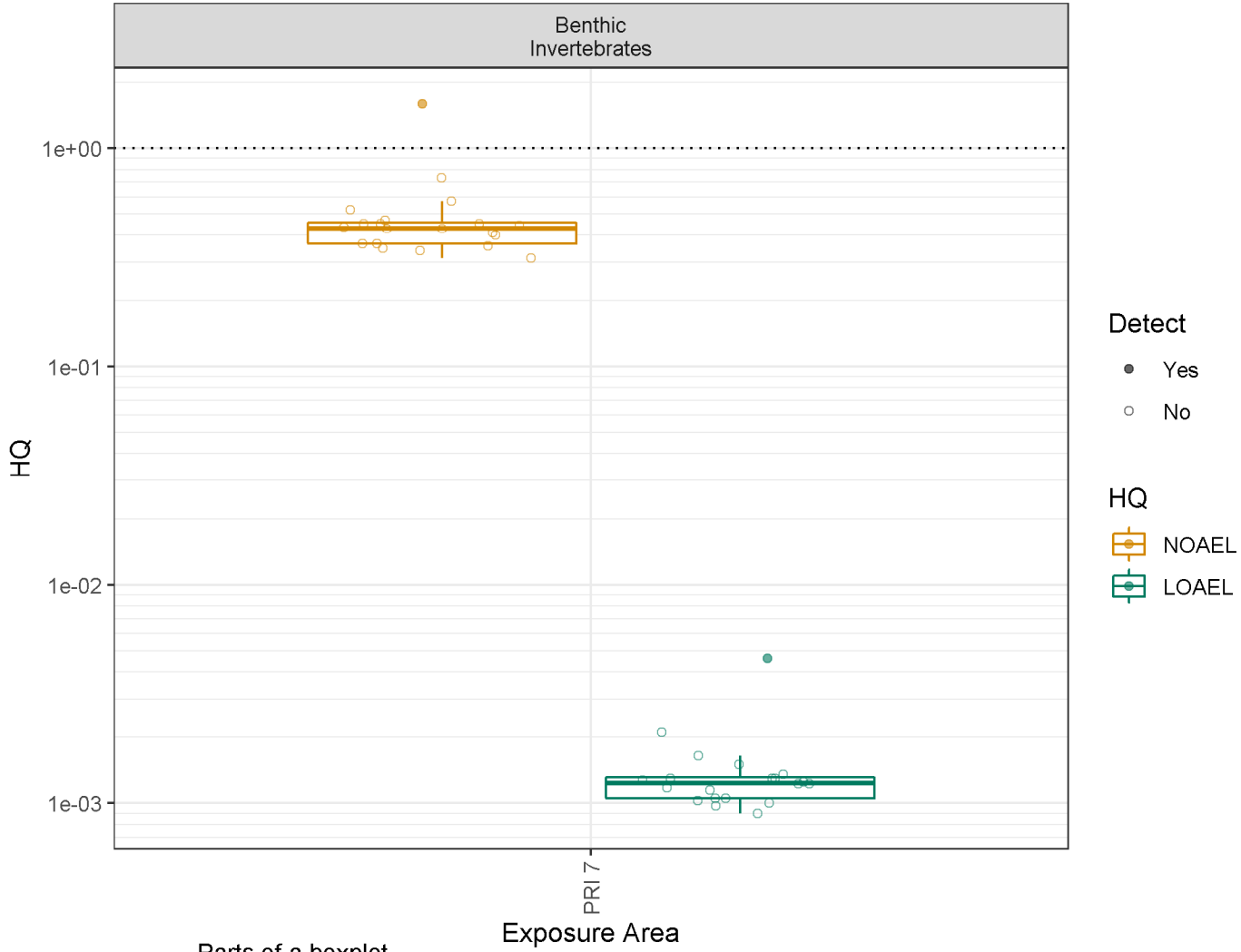

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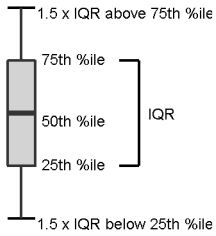

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2i
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
1,1-Dichloroethane

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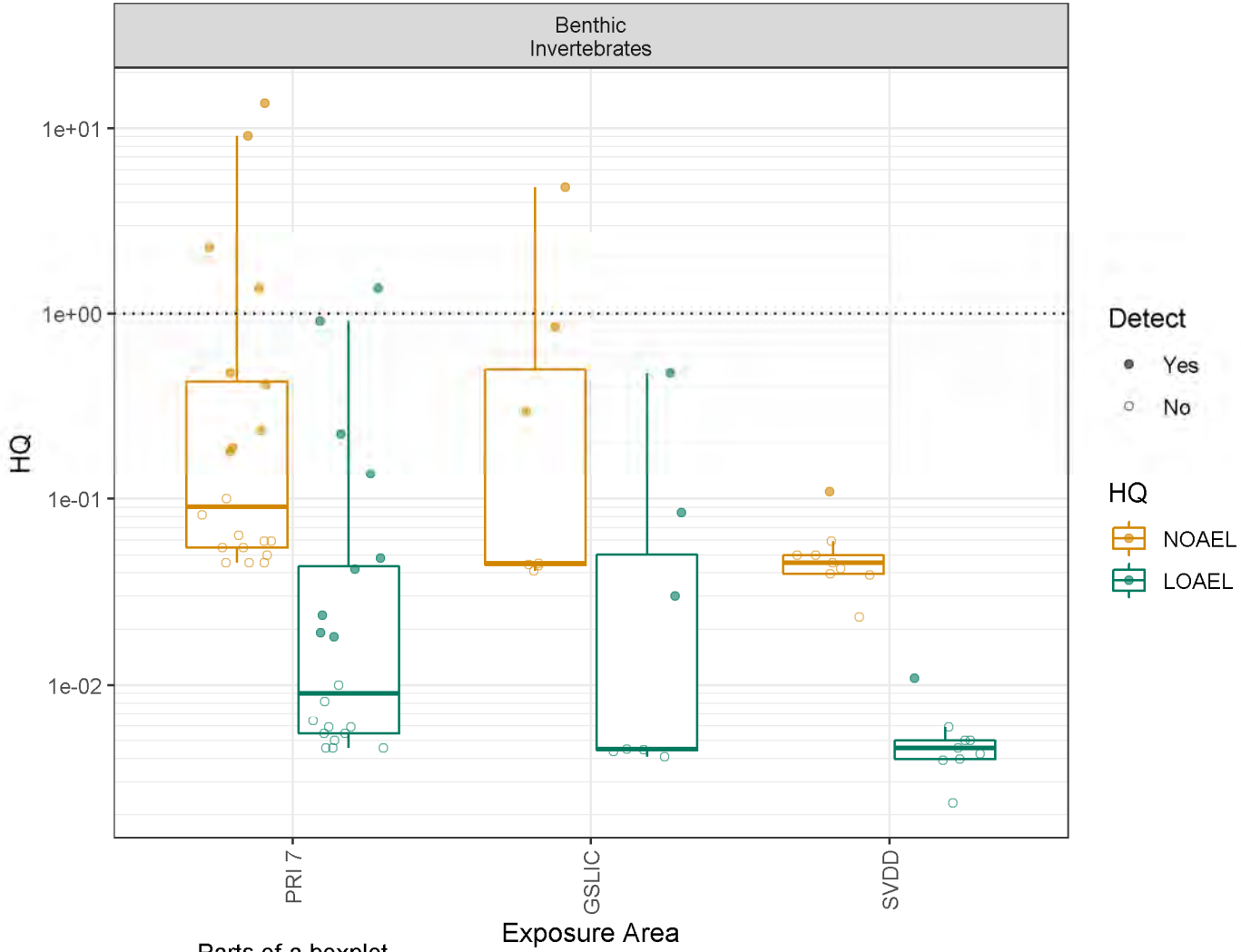

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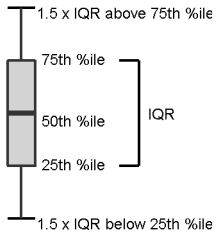

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2j
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
1,2,4-Trichlorobenzene

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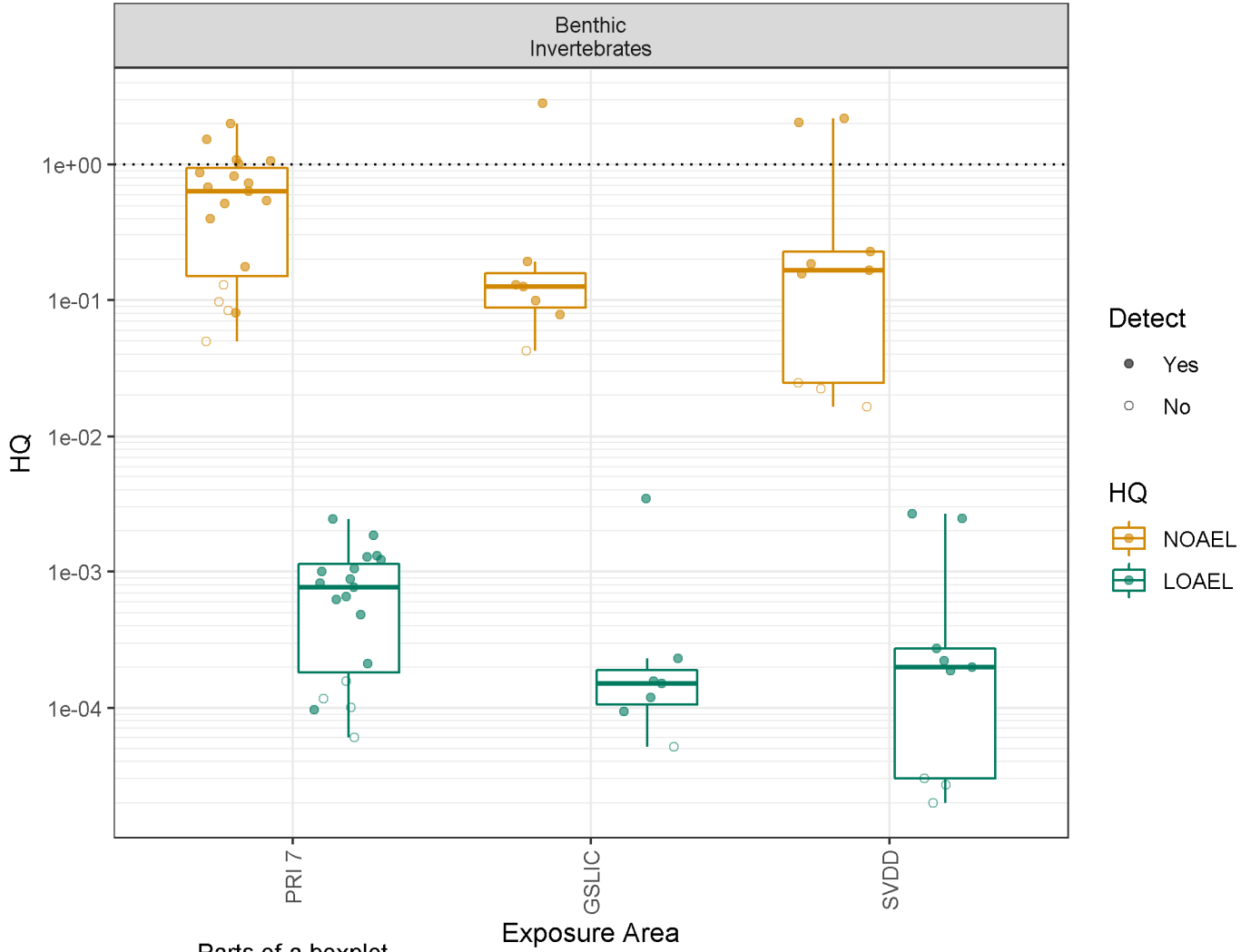
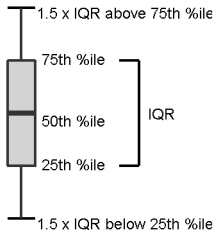


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs. When LOAELs are unavailable, the NOAEL range is shaded.

Figure 6-2k
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
2-Butanone

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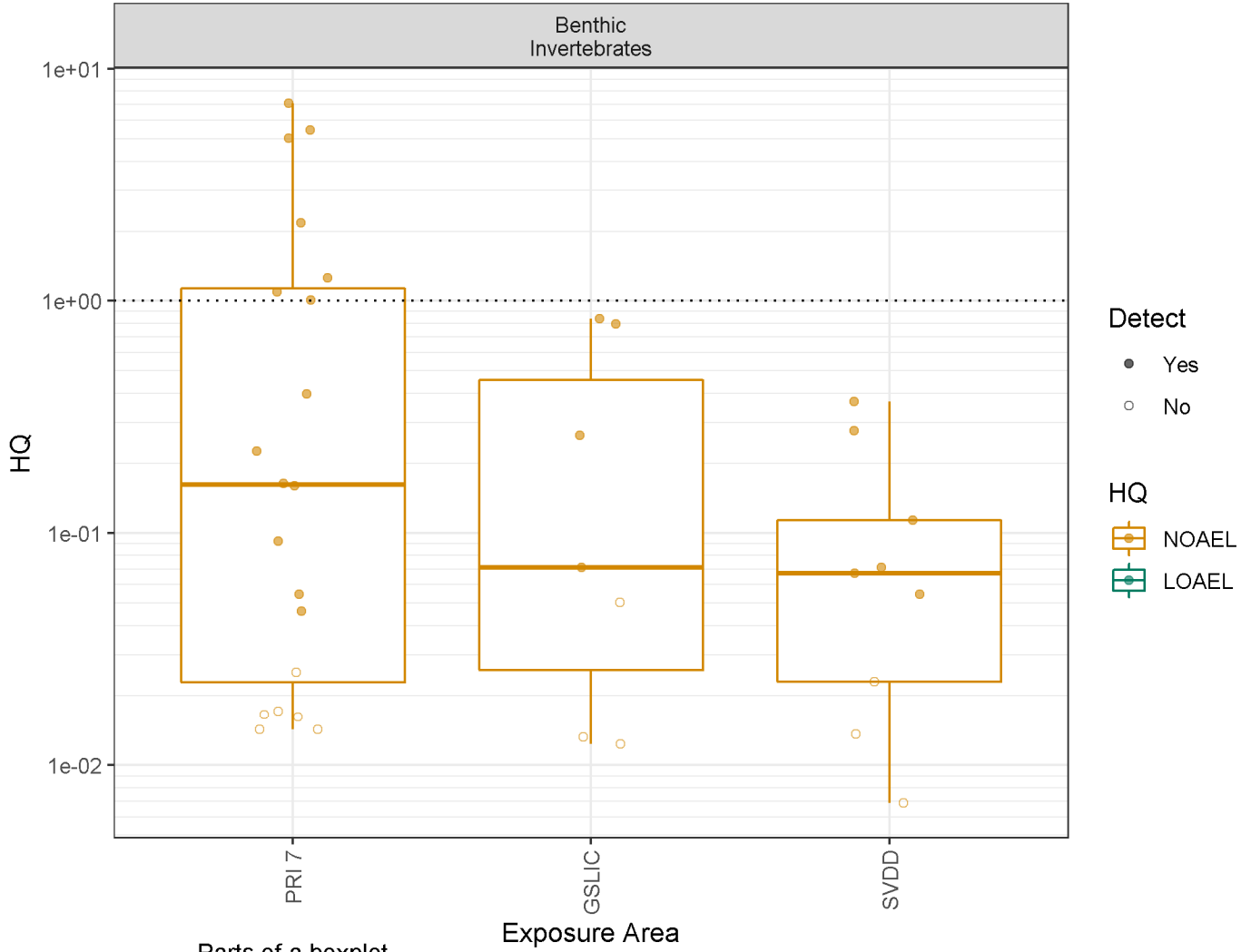
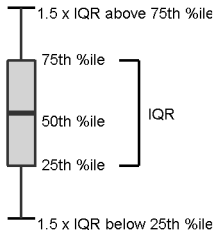


Parts of a boxplot



Notes:
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IQR = Interquartile Range
%ile = percentile

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Figure 6-2l
Benthic Invertebrate Direct Contact HQs in Lakebed Habitat
Carbon Disulfide

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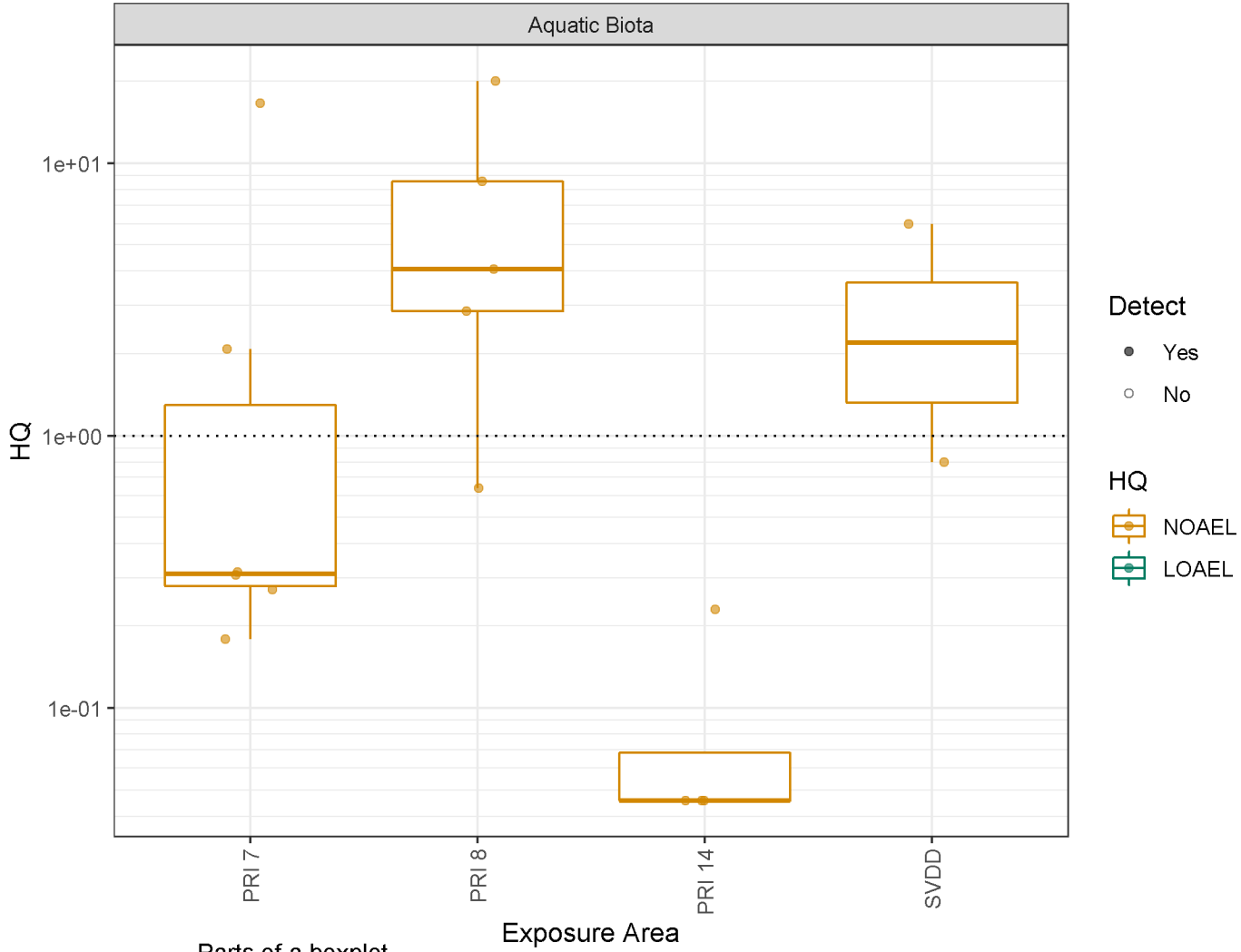

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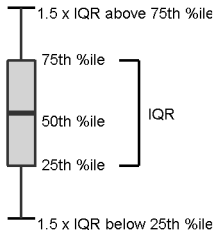

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3a
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Total PCBs

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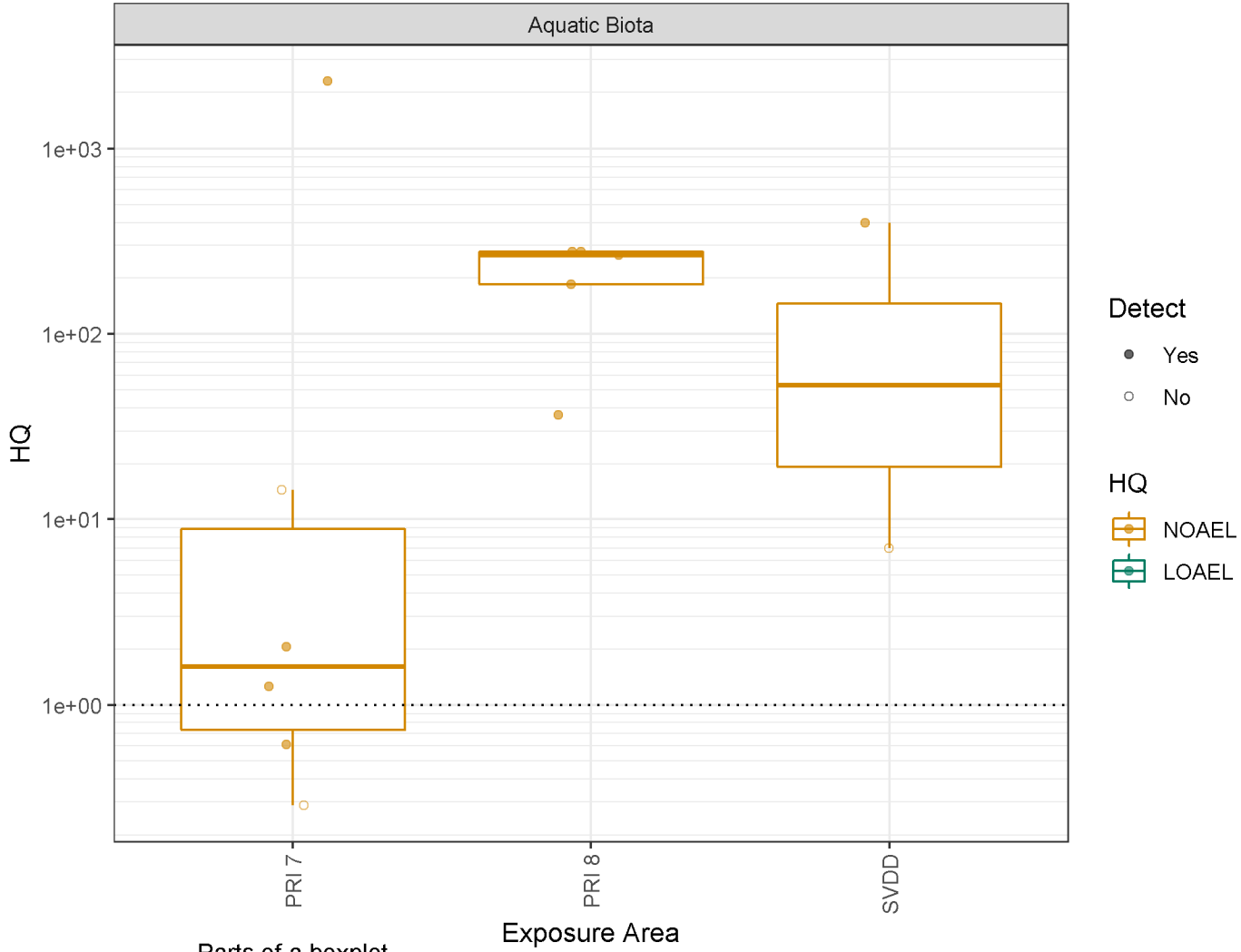
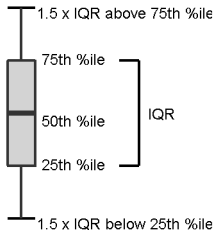


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3b
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Aluminum

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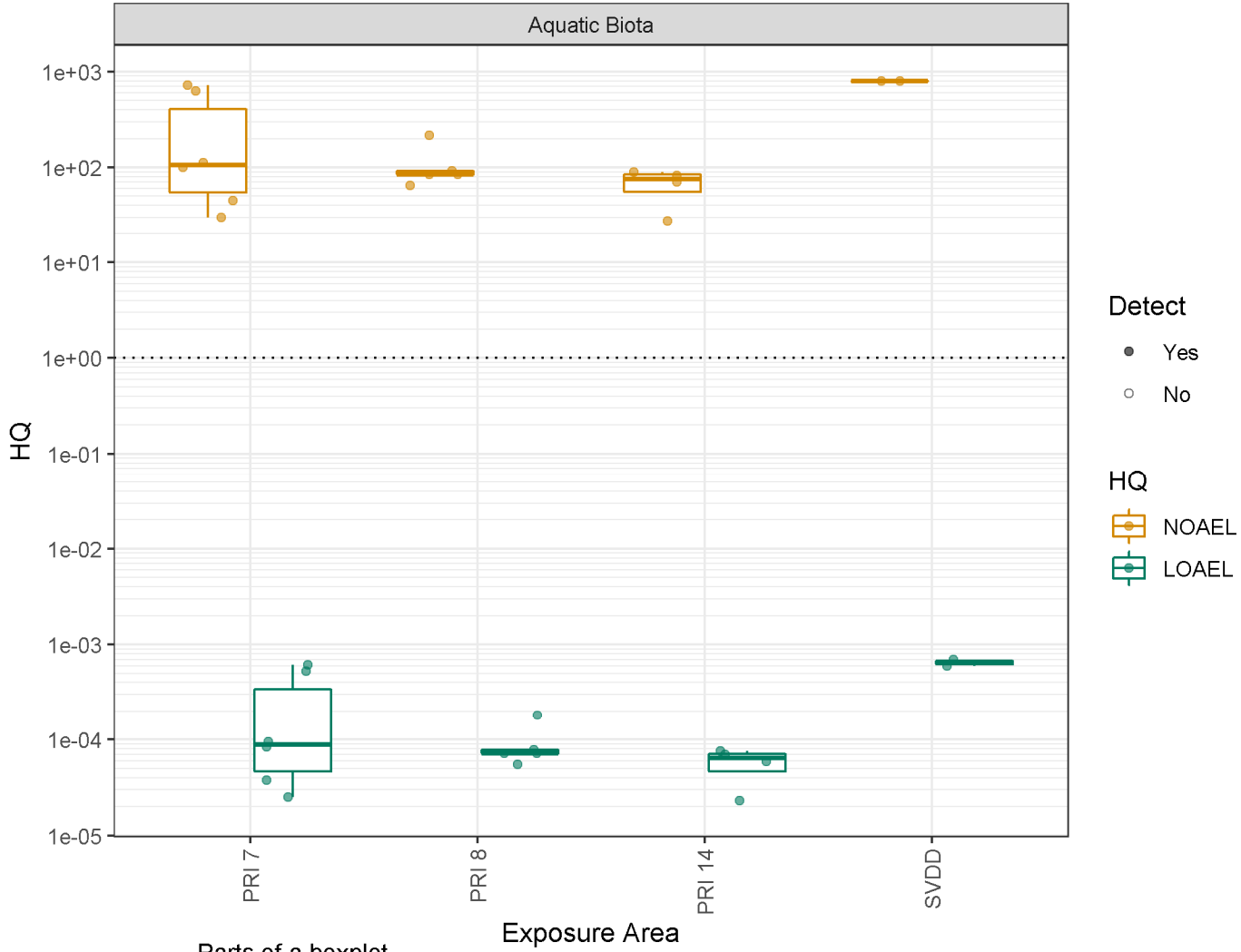

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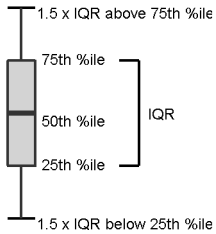

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3c
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Barium

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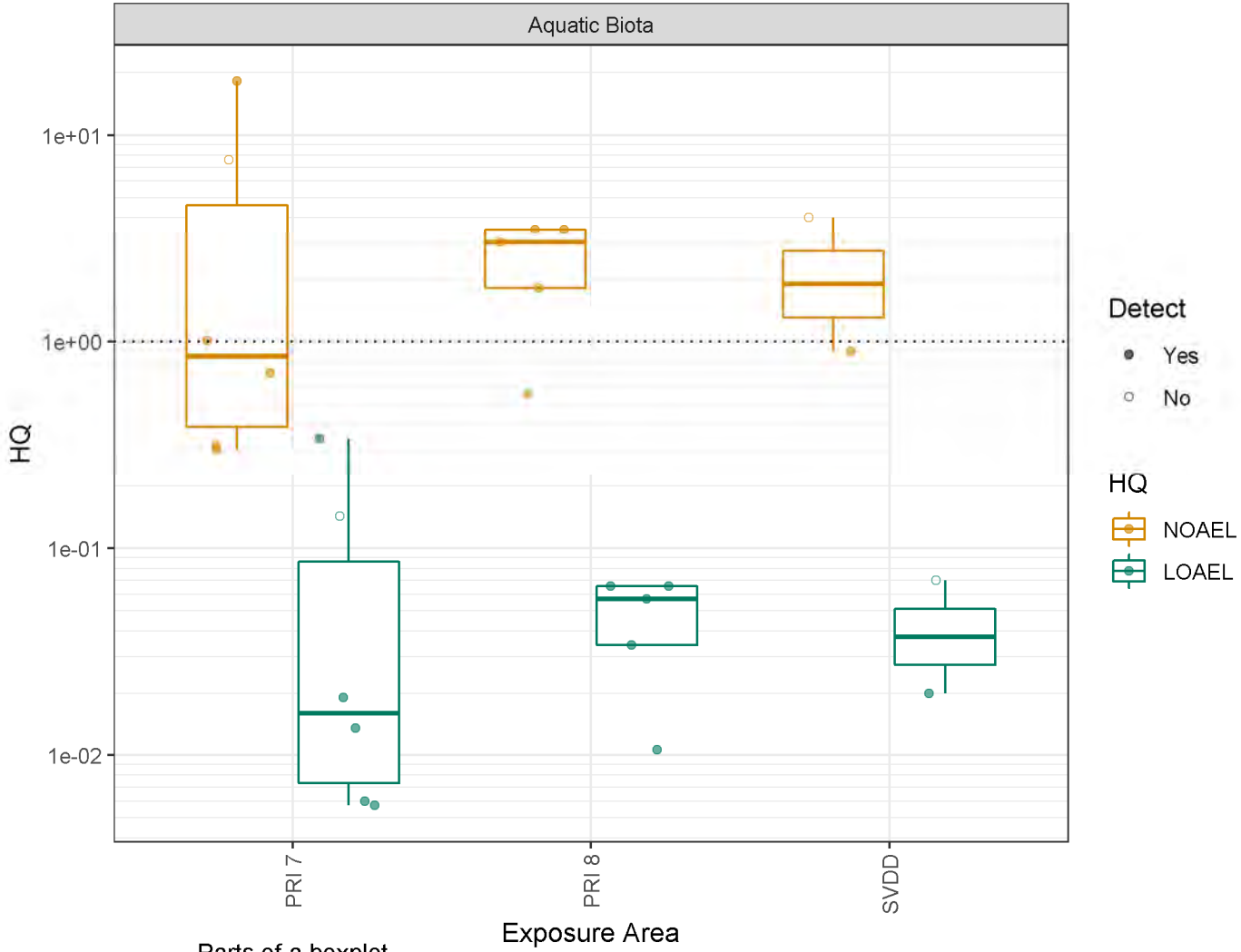
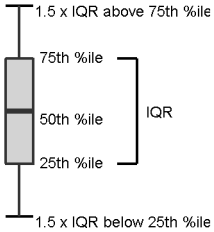


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3d
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Beryllium

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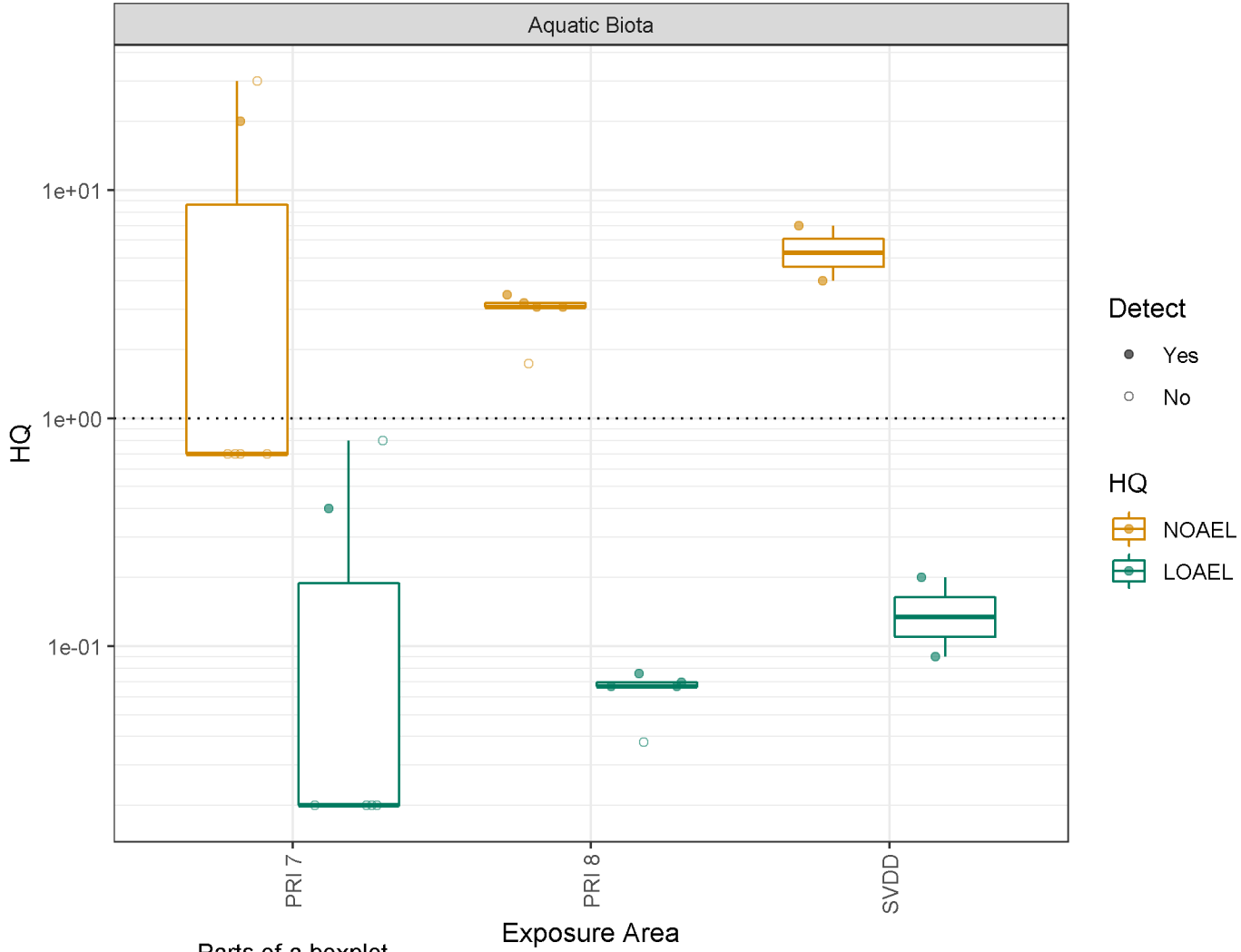

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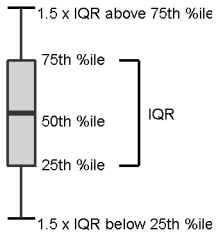

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3e
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Cadmium

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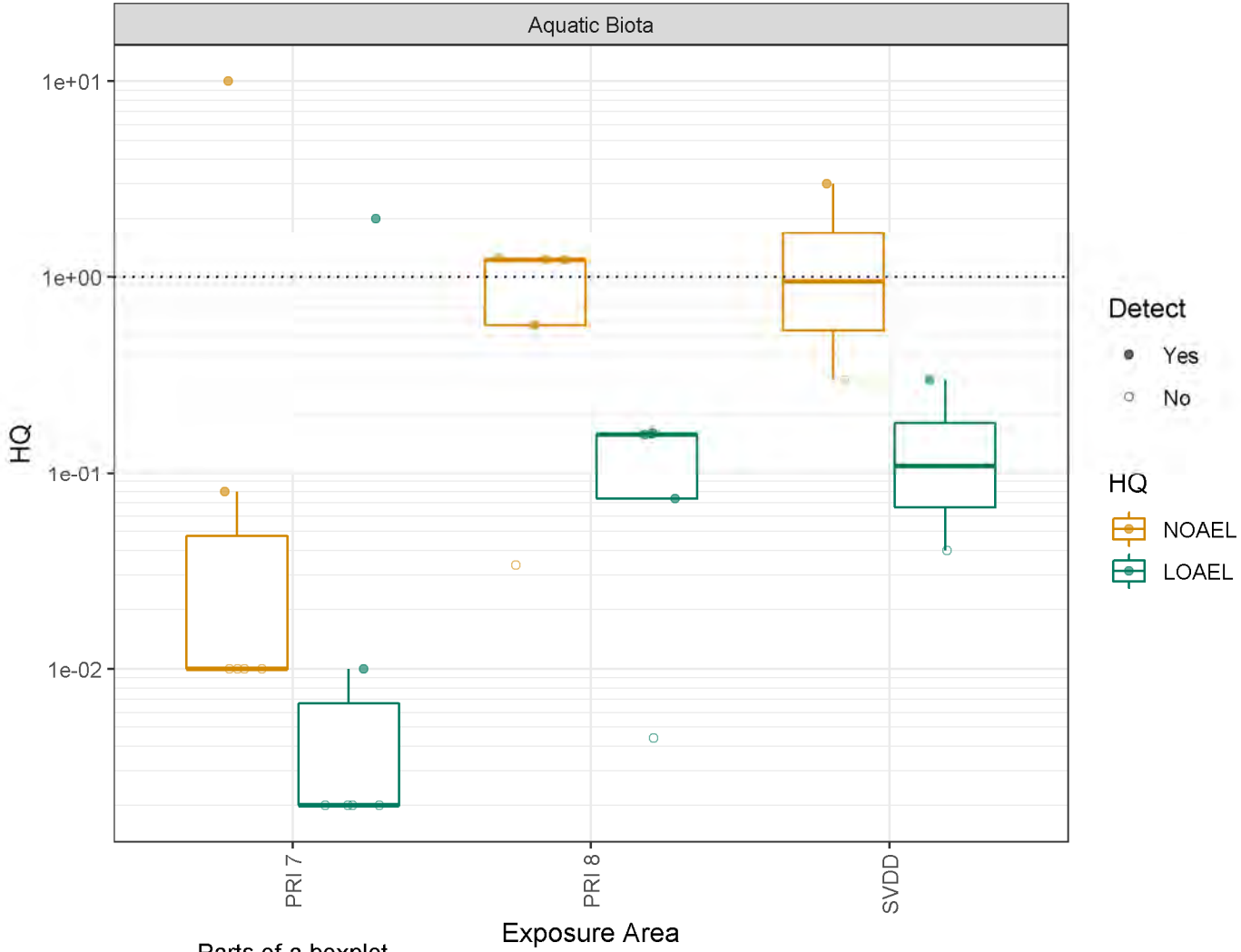
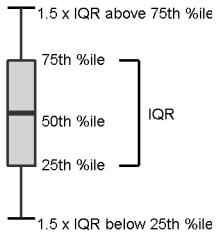


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3f
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Chromium

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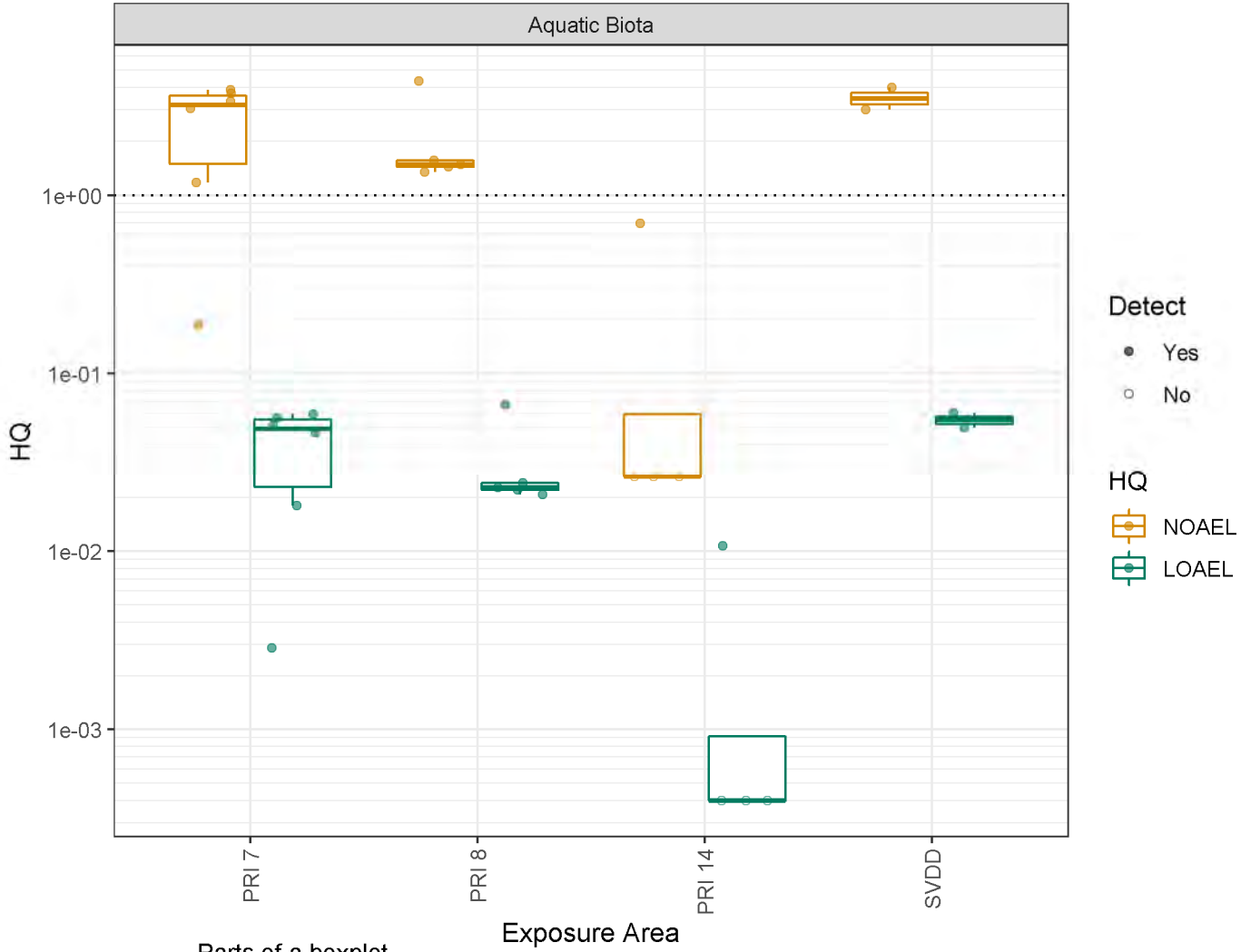

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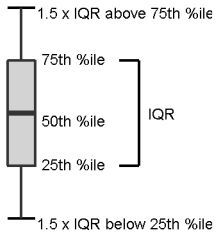

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3g
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Cobalt

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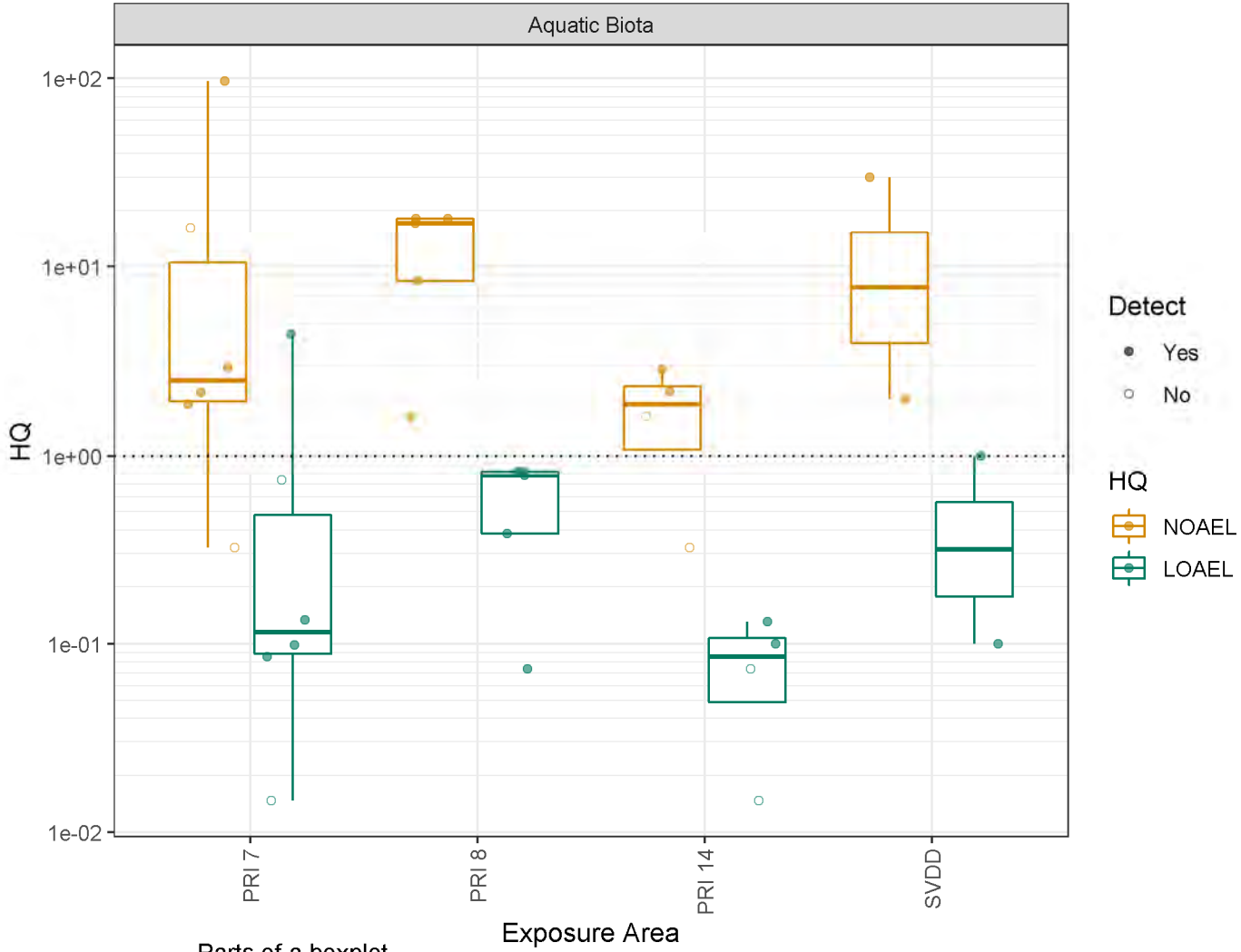
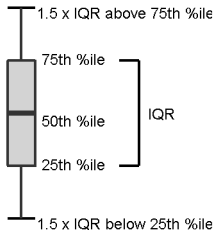


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3h
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Copper

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Tooele County, Utah

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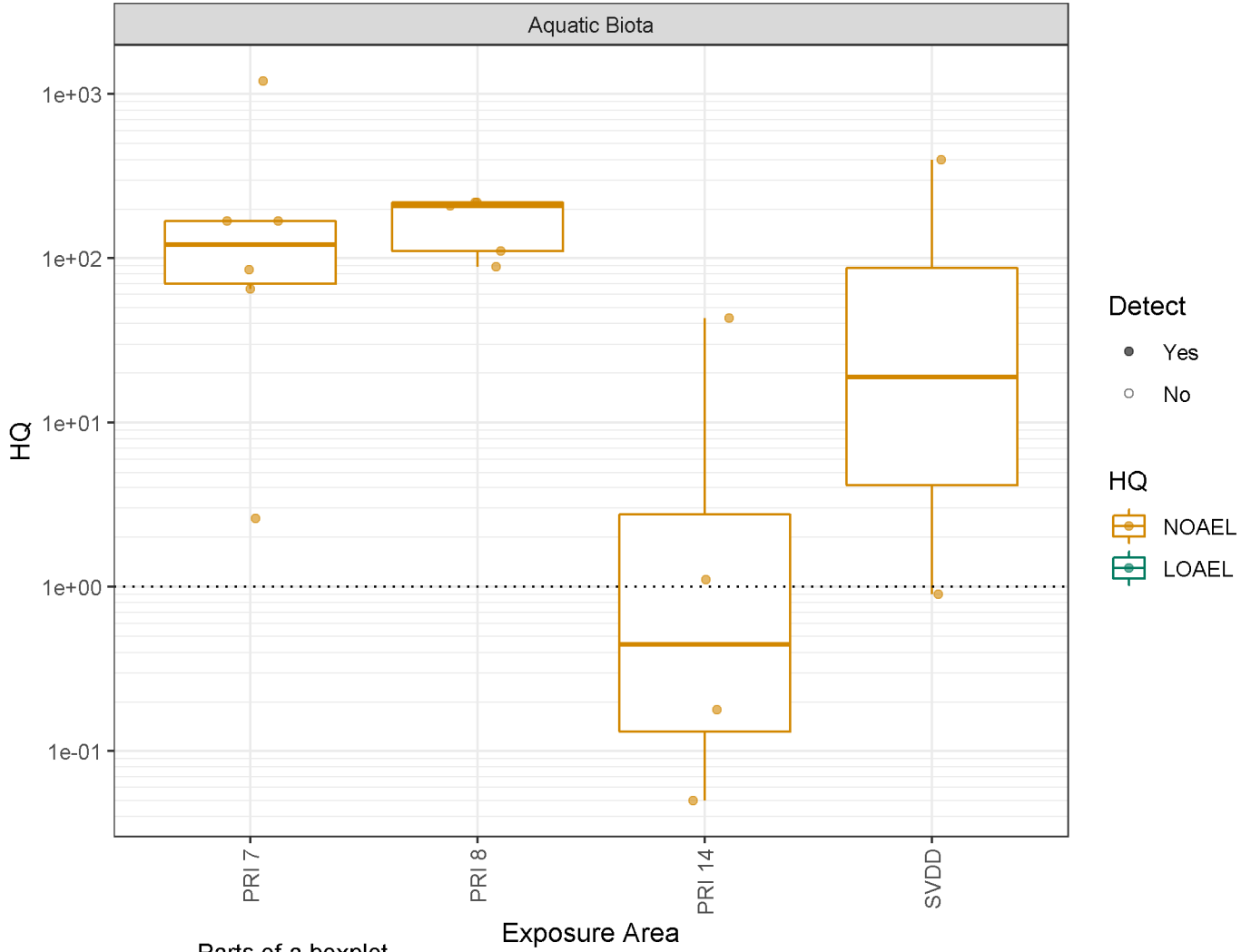

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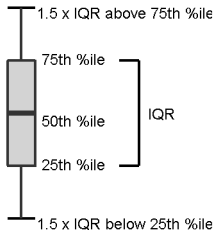

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3i
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Iron

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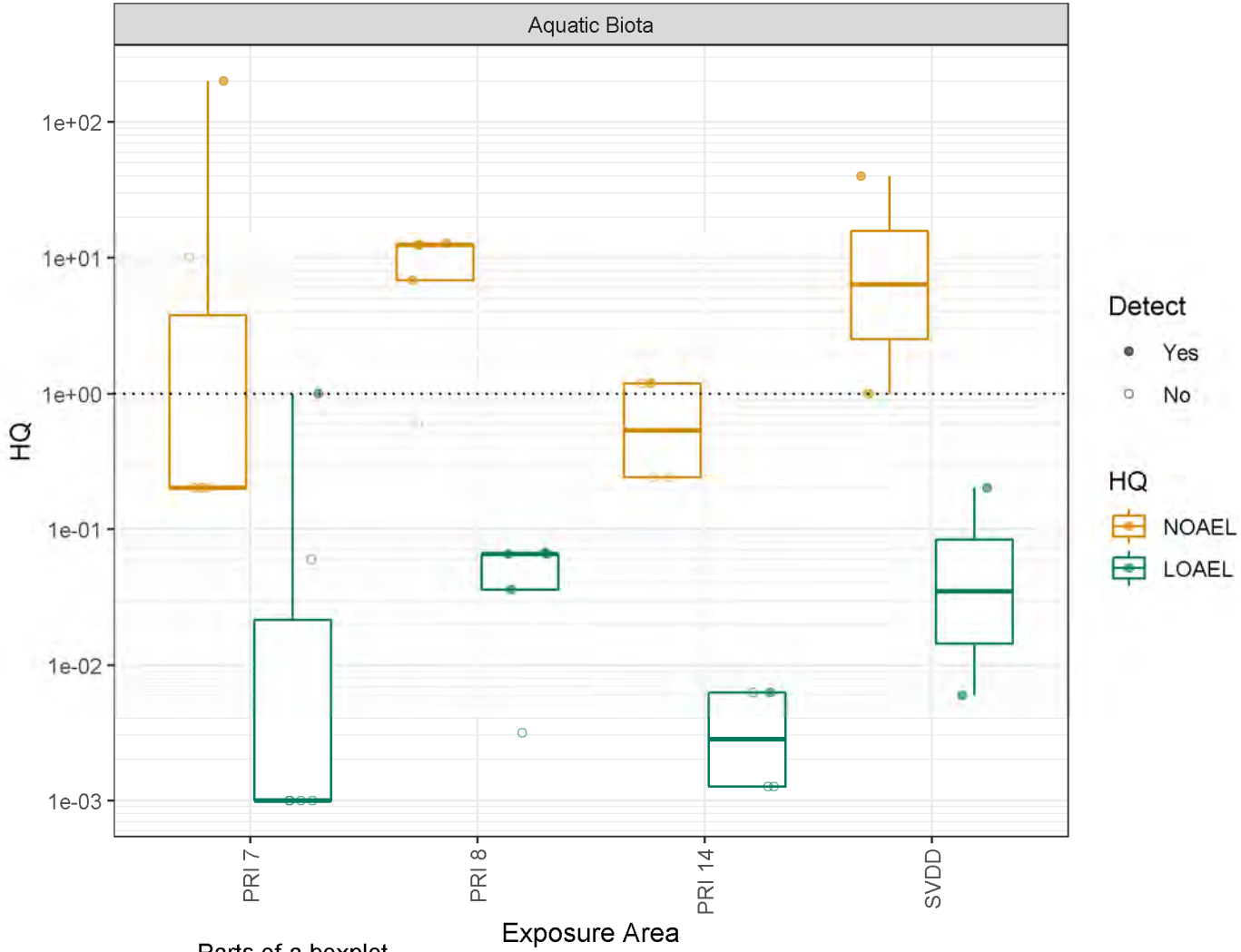

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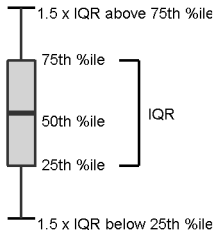

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3j
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Lead

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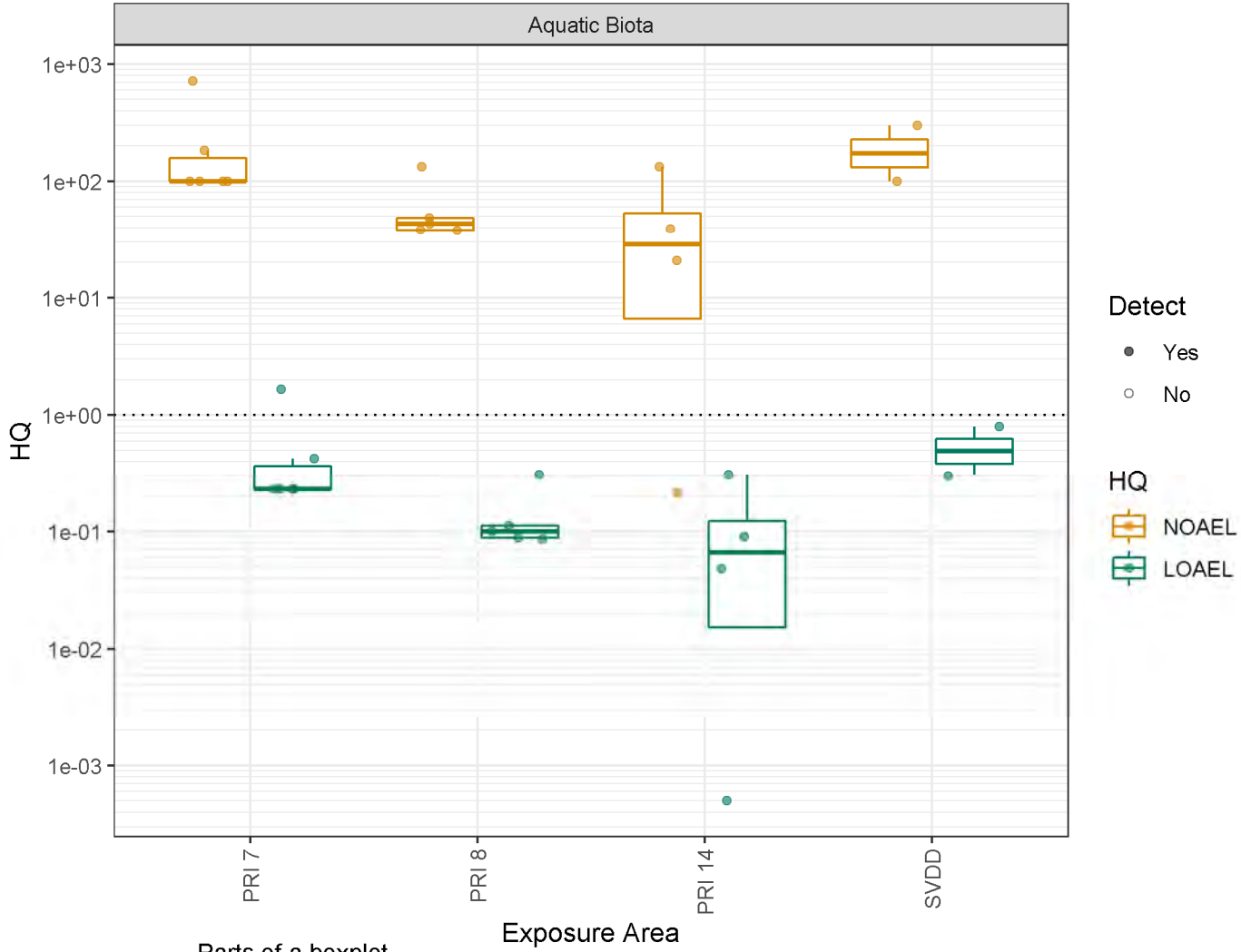

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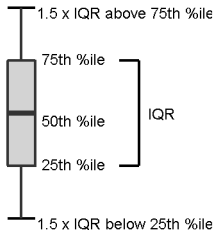

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3k
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Manganese

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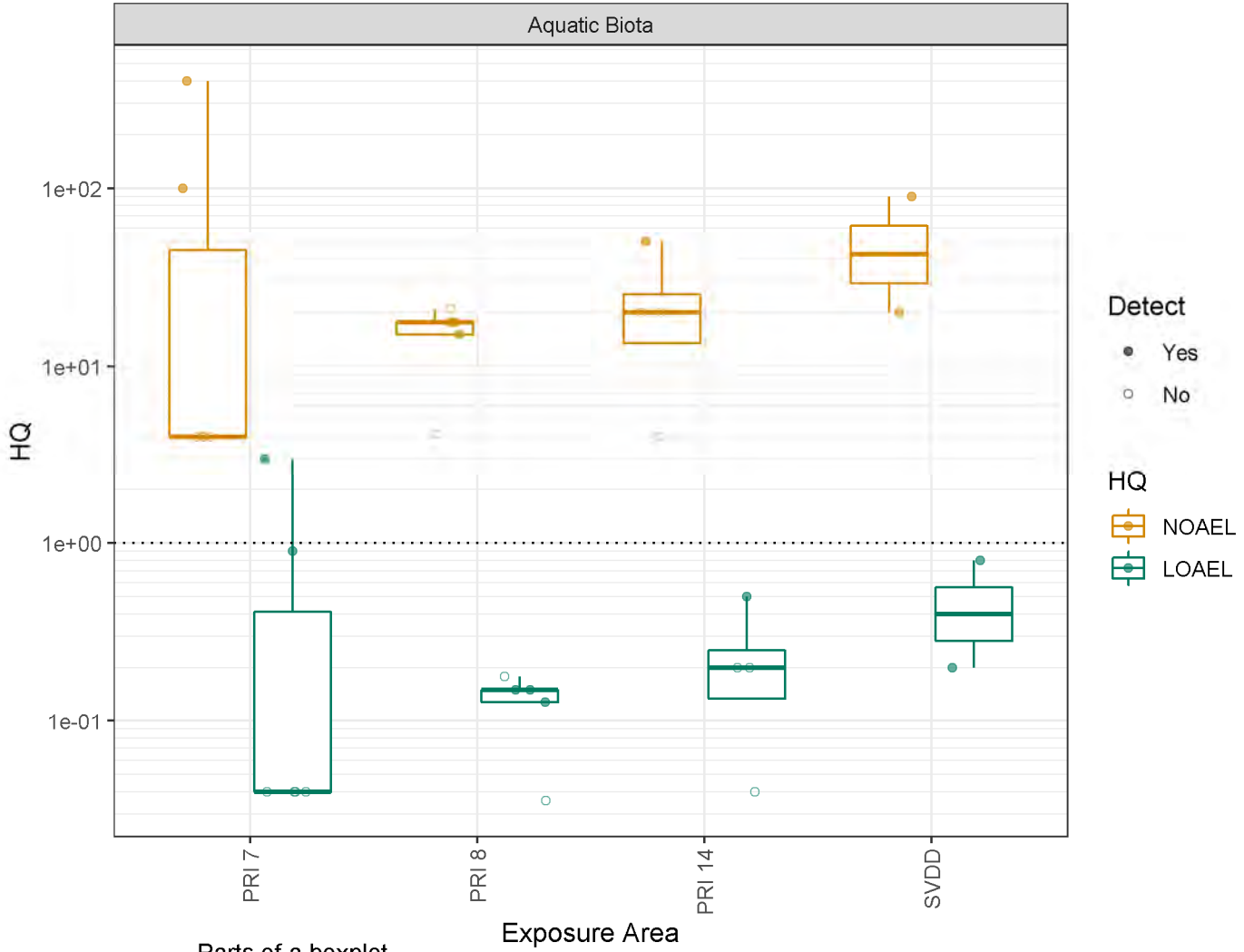

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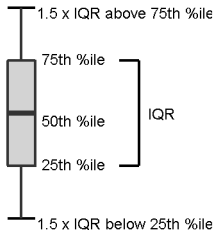

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3l
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Mercury

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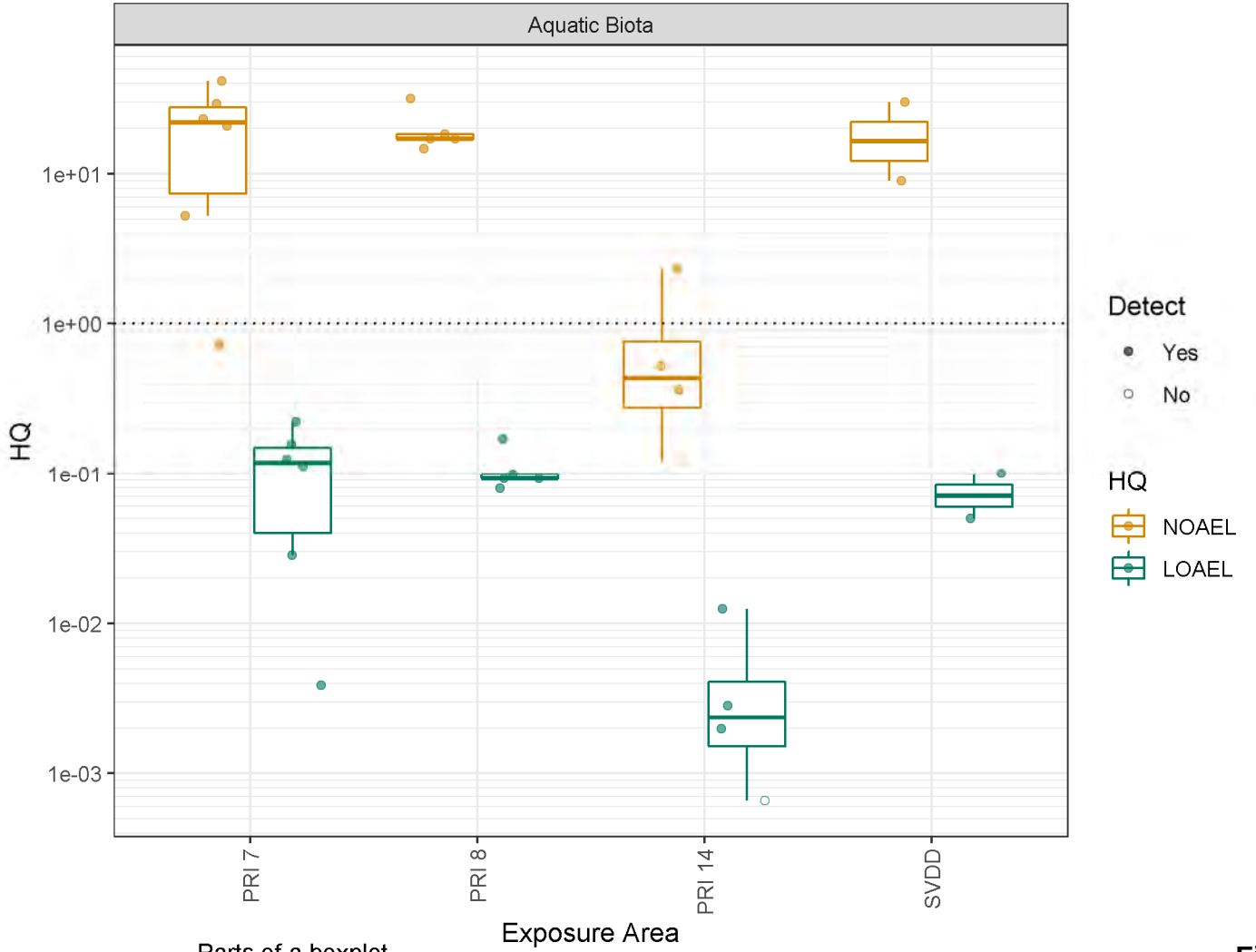
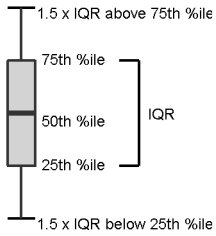


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3m
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Nickel

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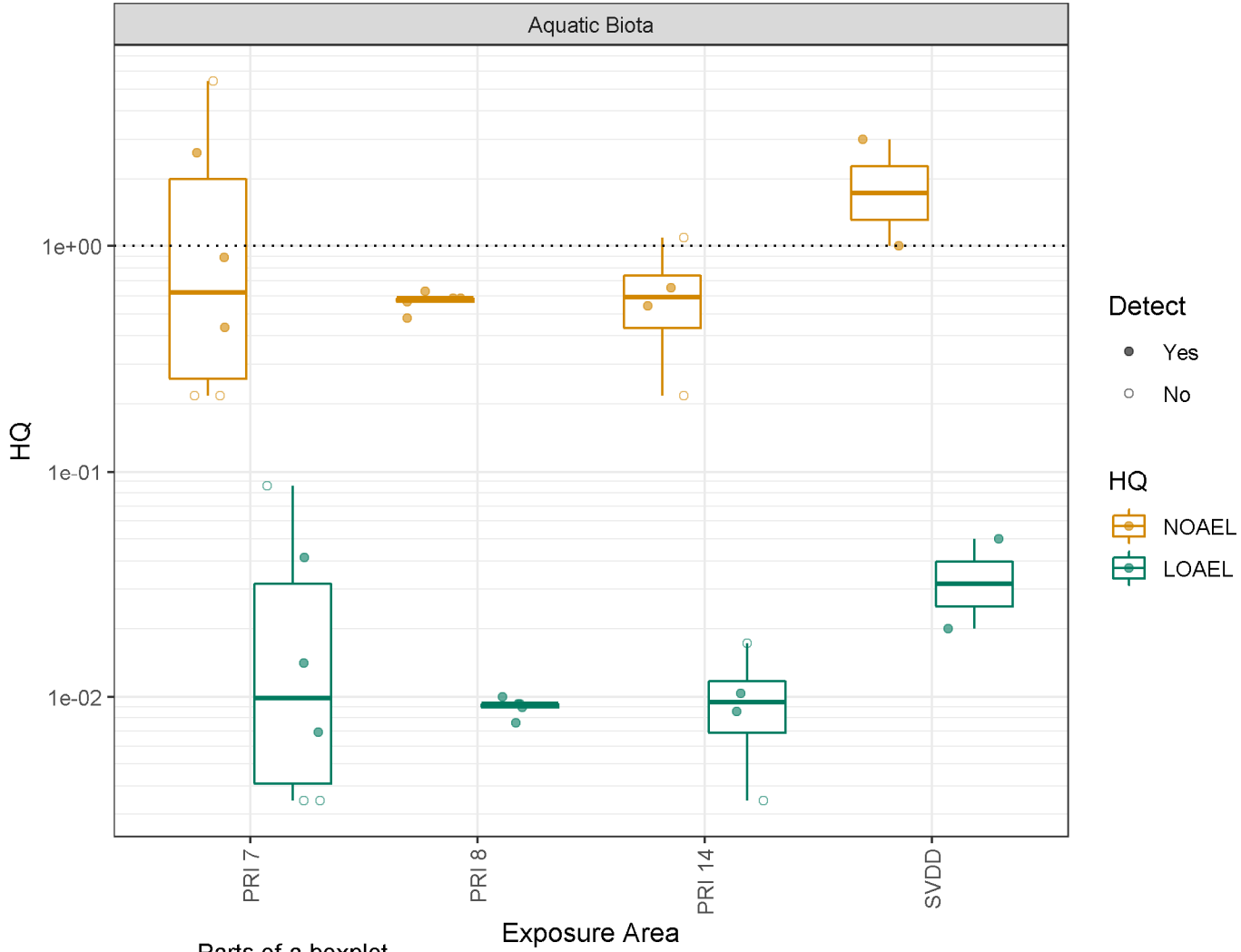
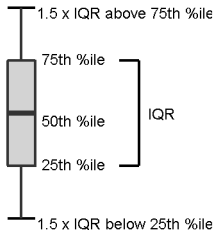


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3n
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Selenium

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Tooele County, Utah

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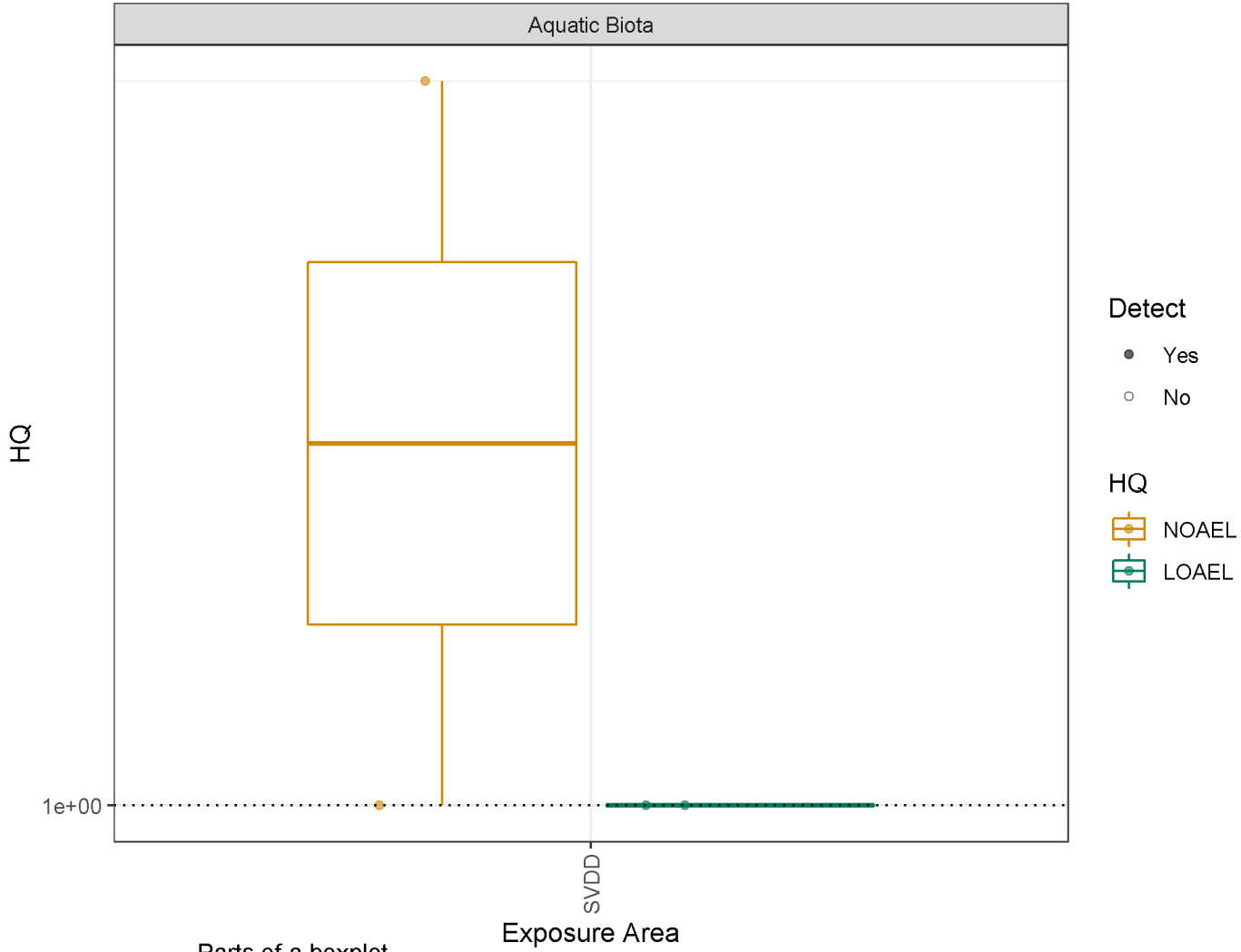

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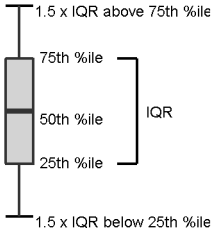

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3o
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Silver

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Tooele County, Utah

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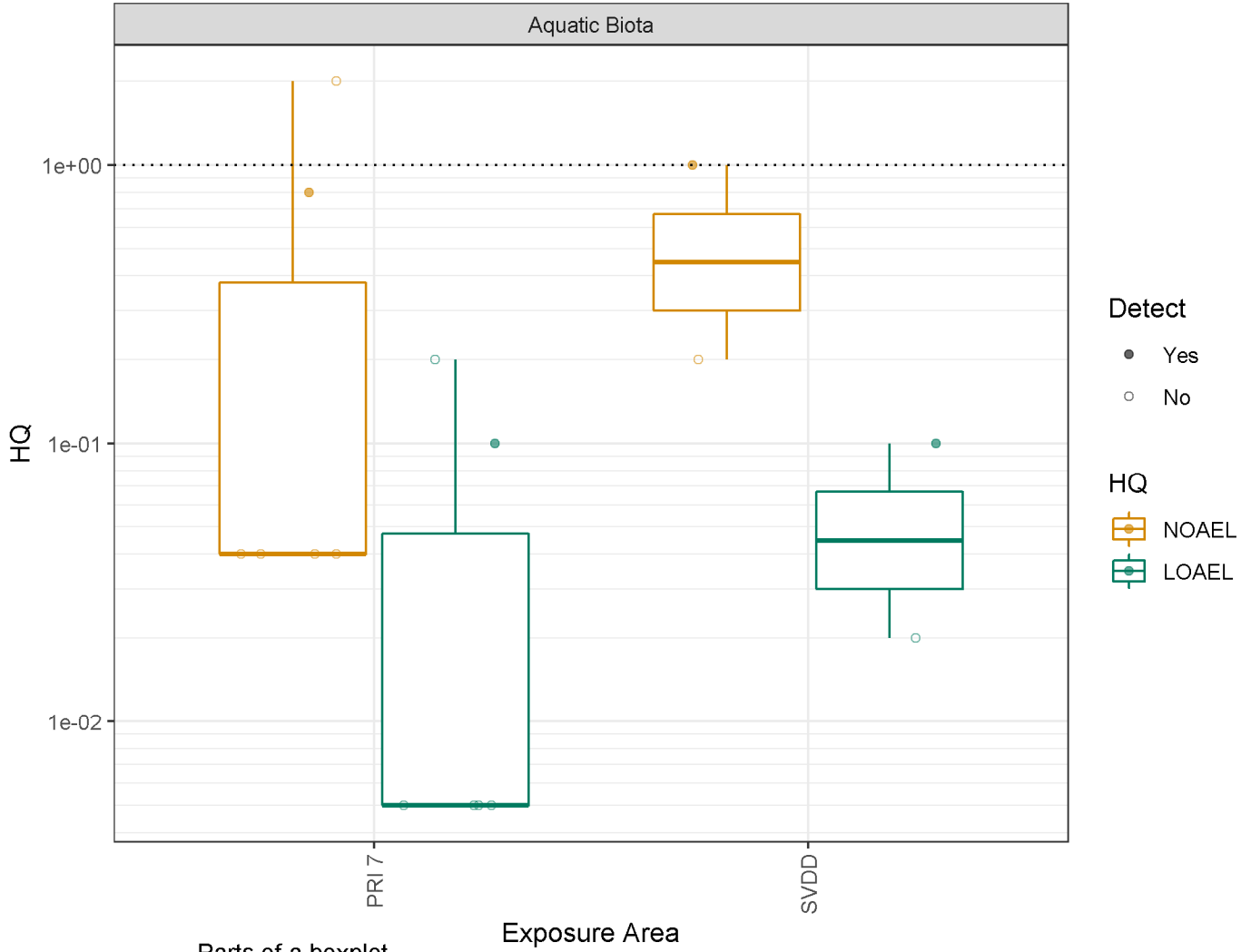

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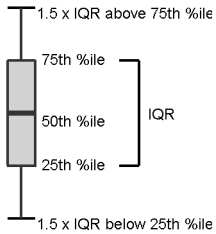

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3p
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Thallium

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Tooele County, Utah

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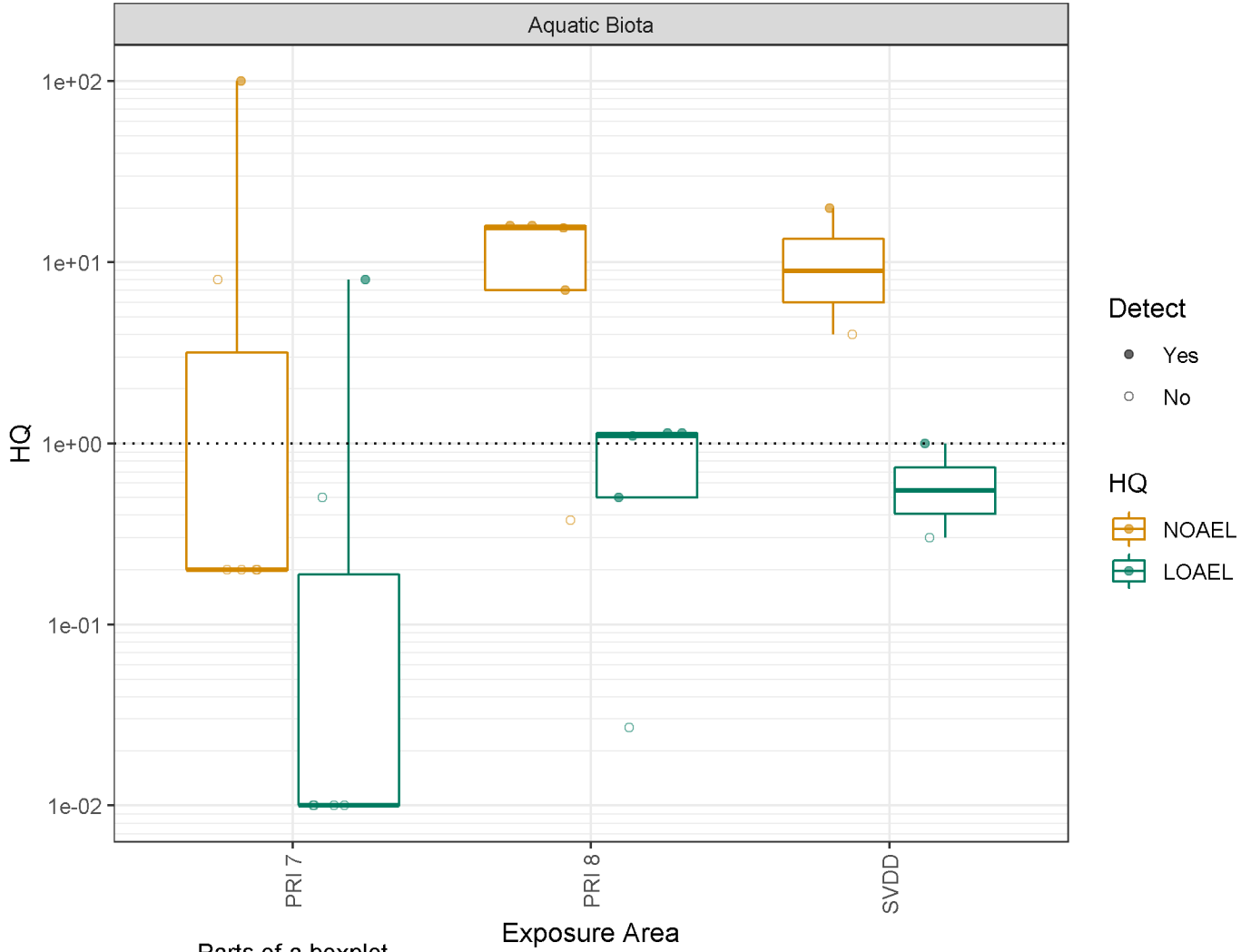

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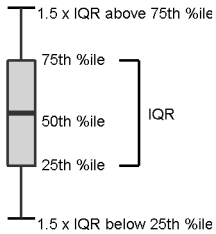

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3q
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Vanadium

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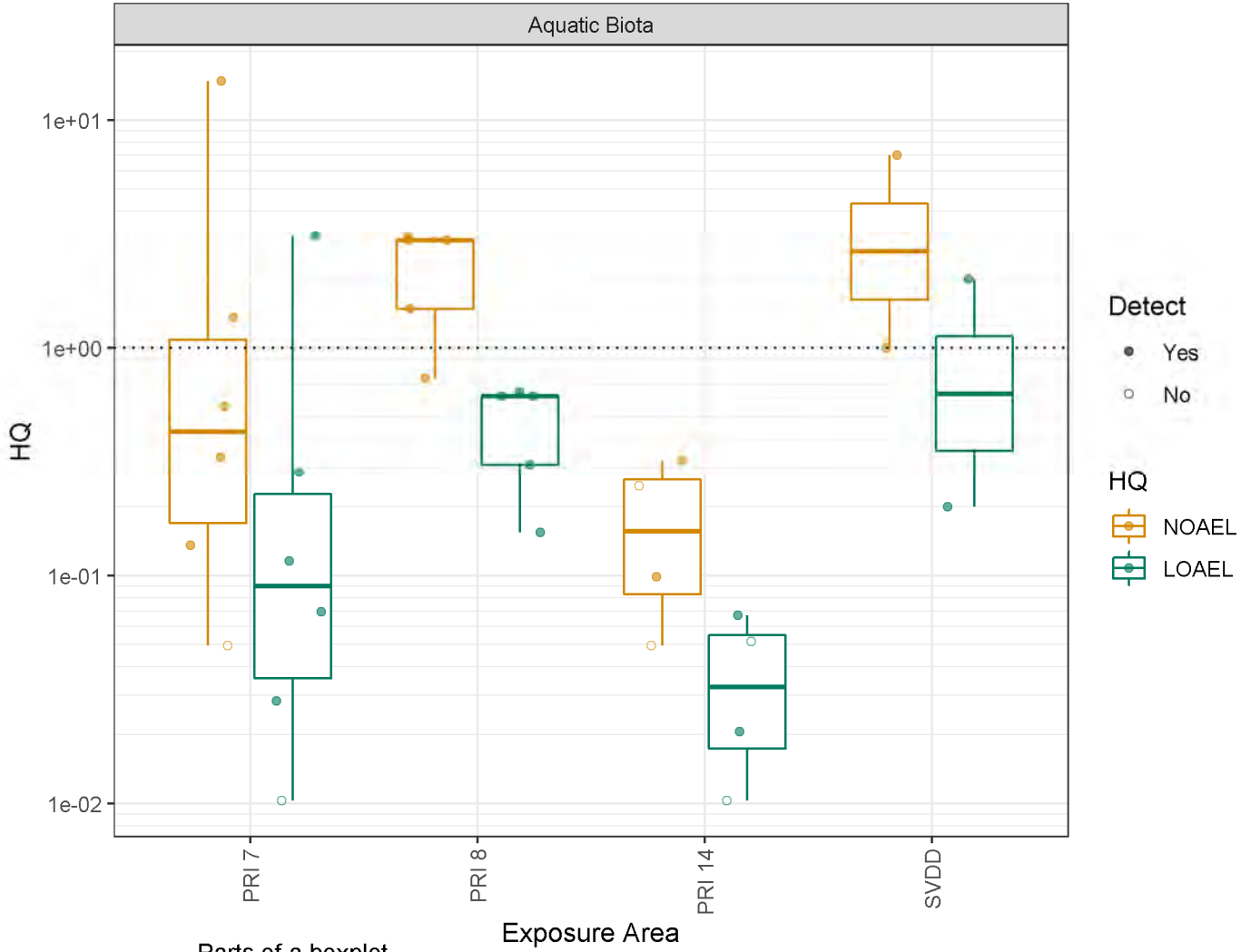
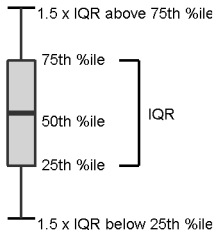


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3r
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Zinc

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US Magnesium LLC
Tooele County, Utah

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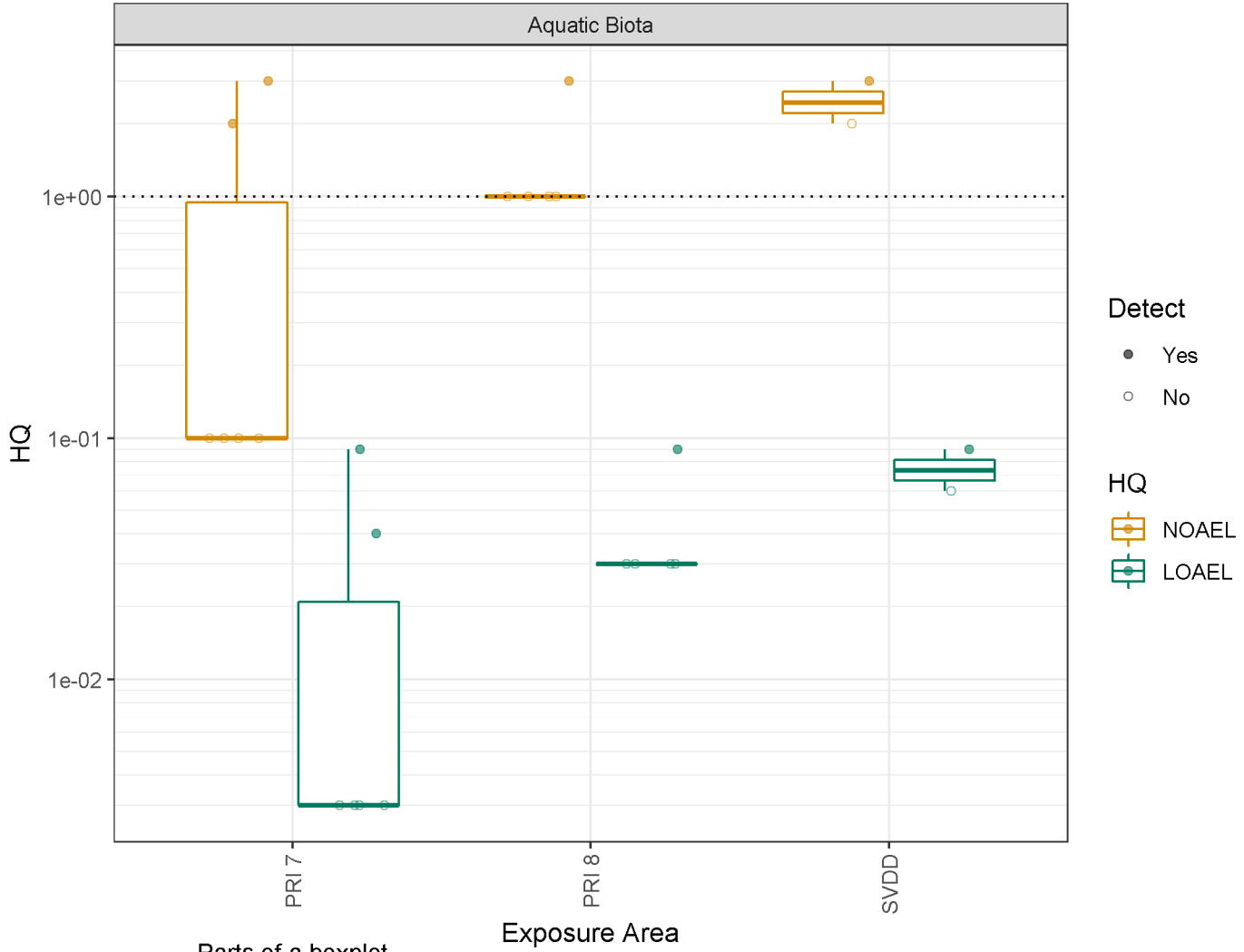
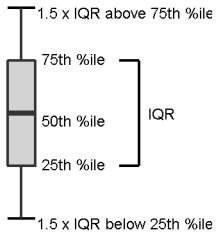


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3s
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Pentachlorophenol

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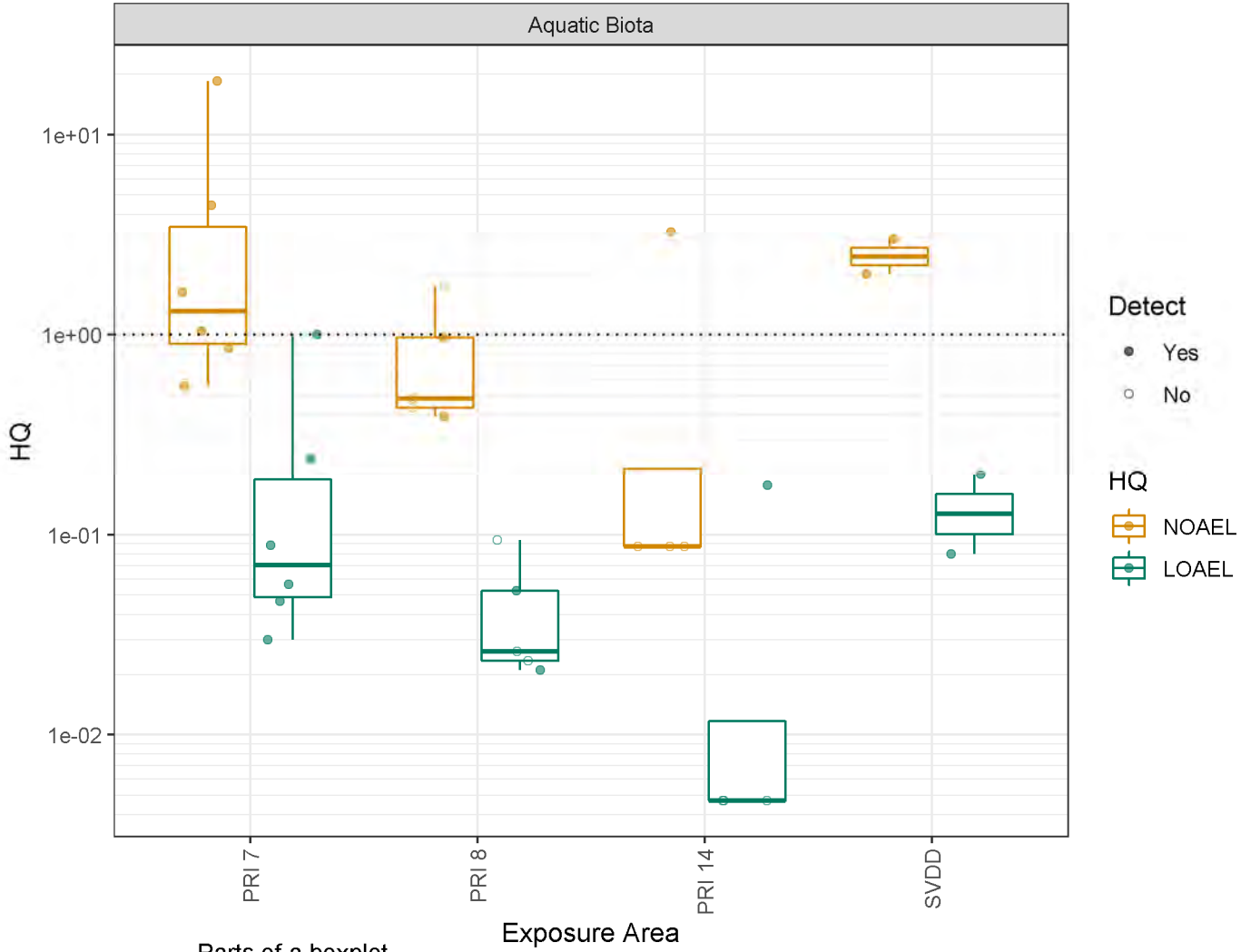
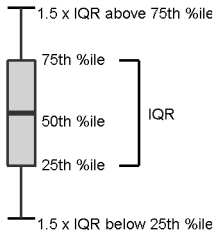


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3t
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Carbon Disulfide

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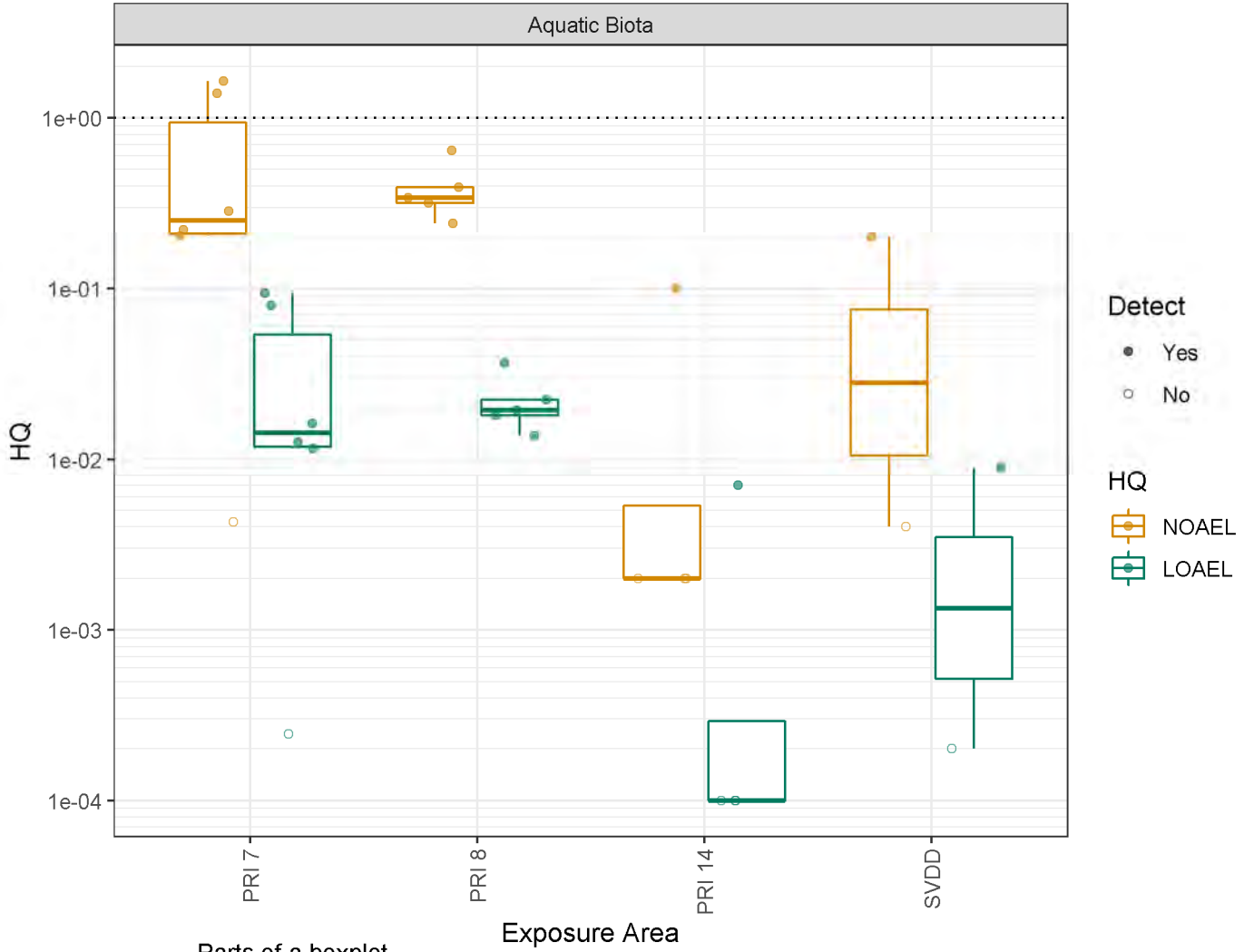

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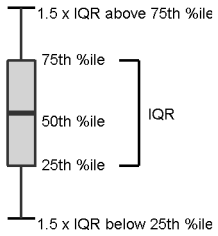

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3u
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Chloroform

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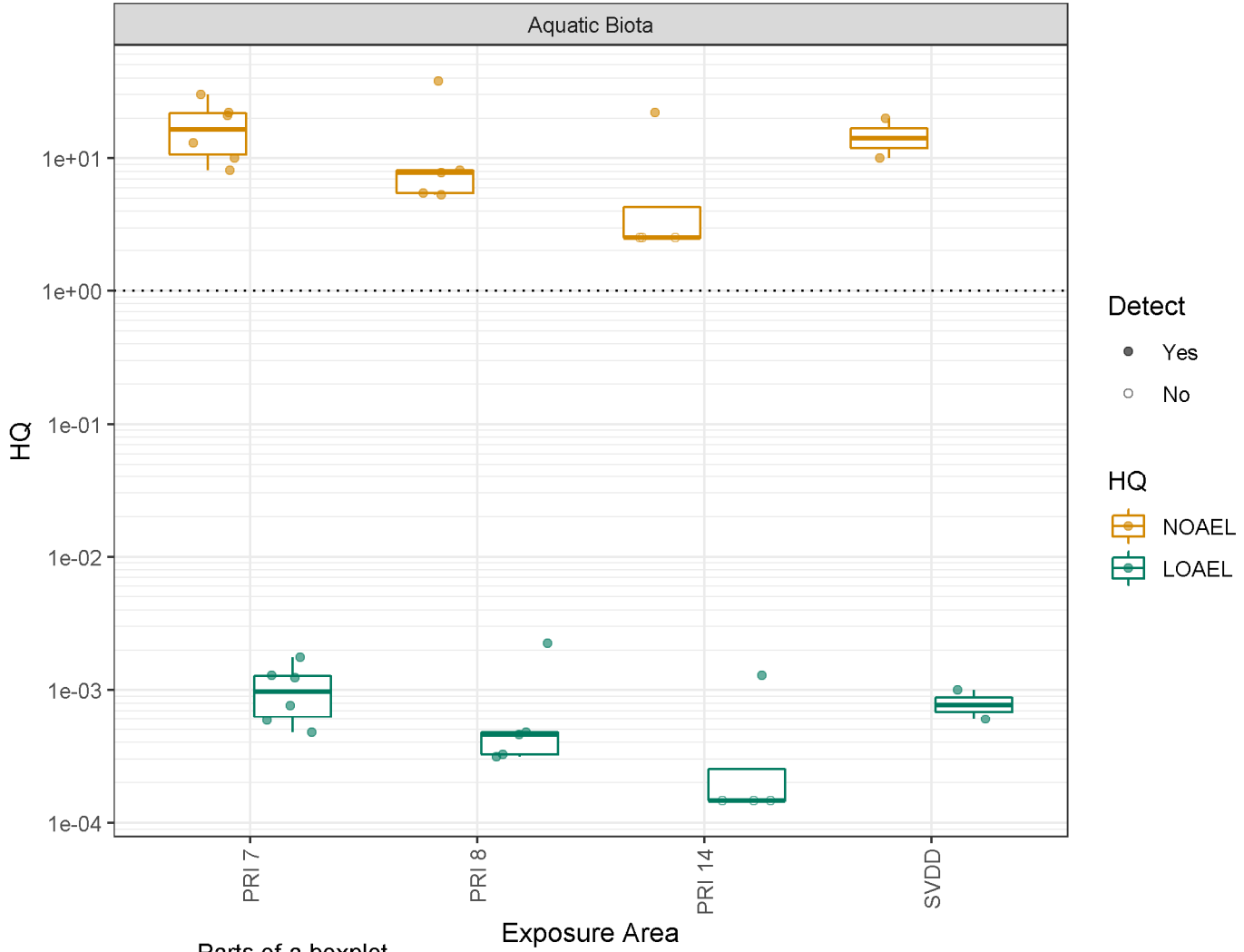

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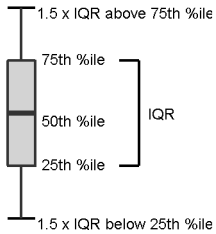

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3v
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Total Cyanide

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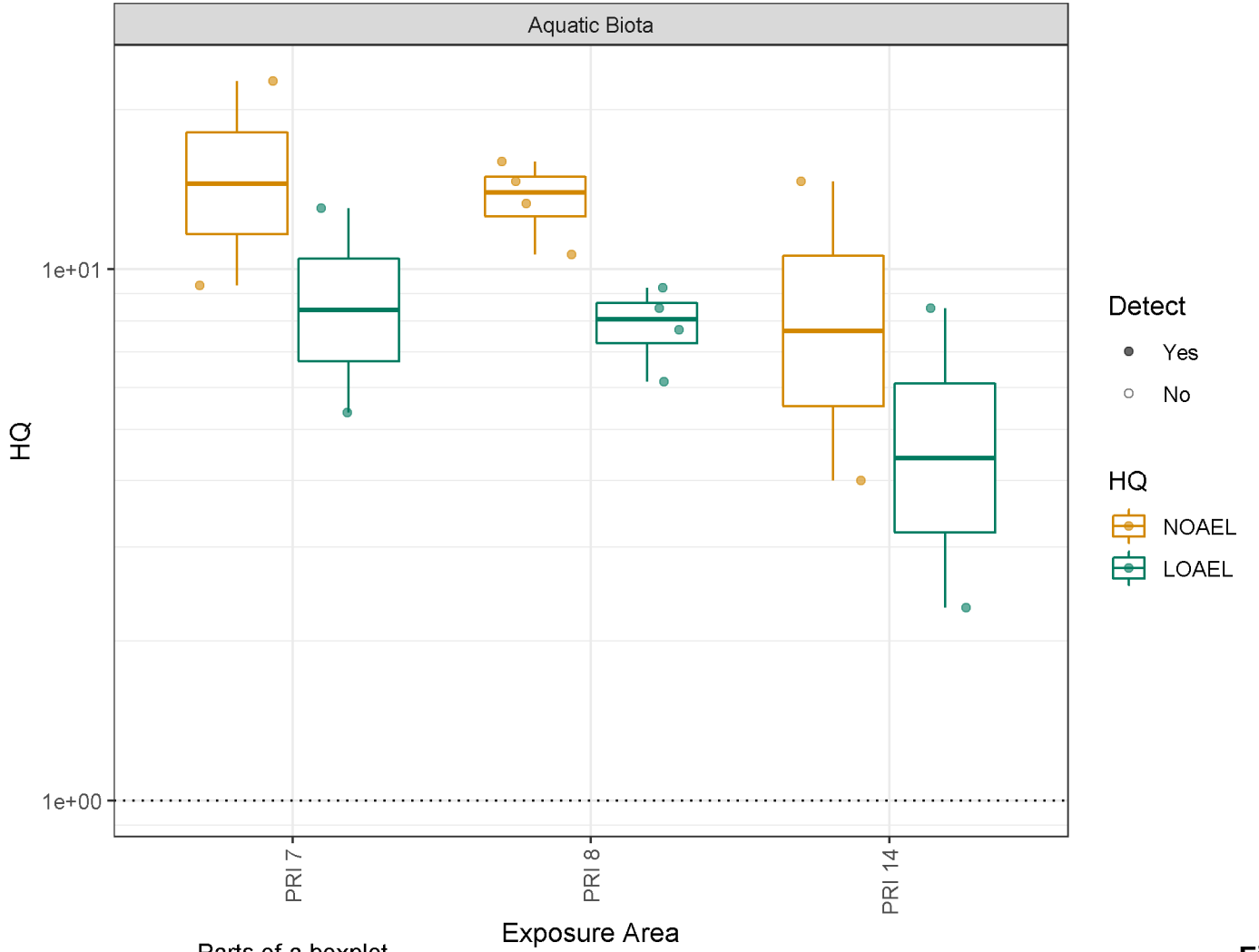
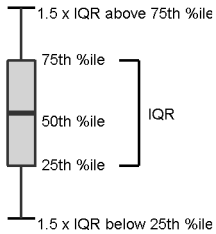


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile
#
The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-3w
Aquatic Biota Direct Contact HQs in Lakebed Habitat
Chlorine

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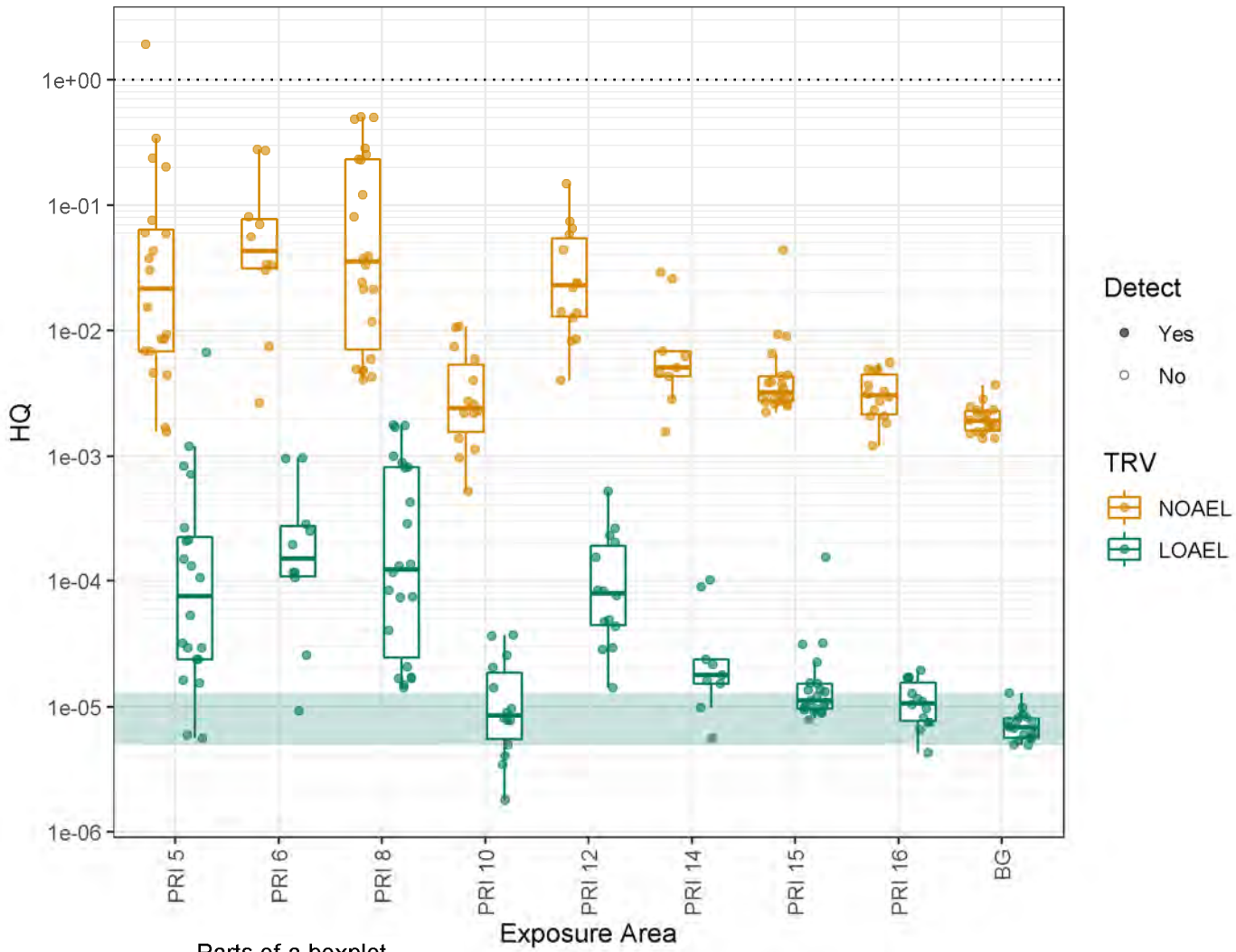

Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Parts of a boxplot

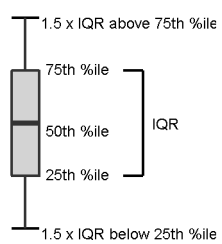

Figure 6-4
Modeled Tissue HQs for Soil Invertebrates
Total PCBs

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US Magnesium LLC
Tooele County, Utah

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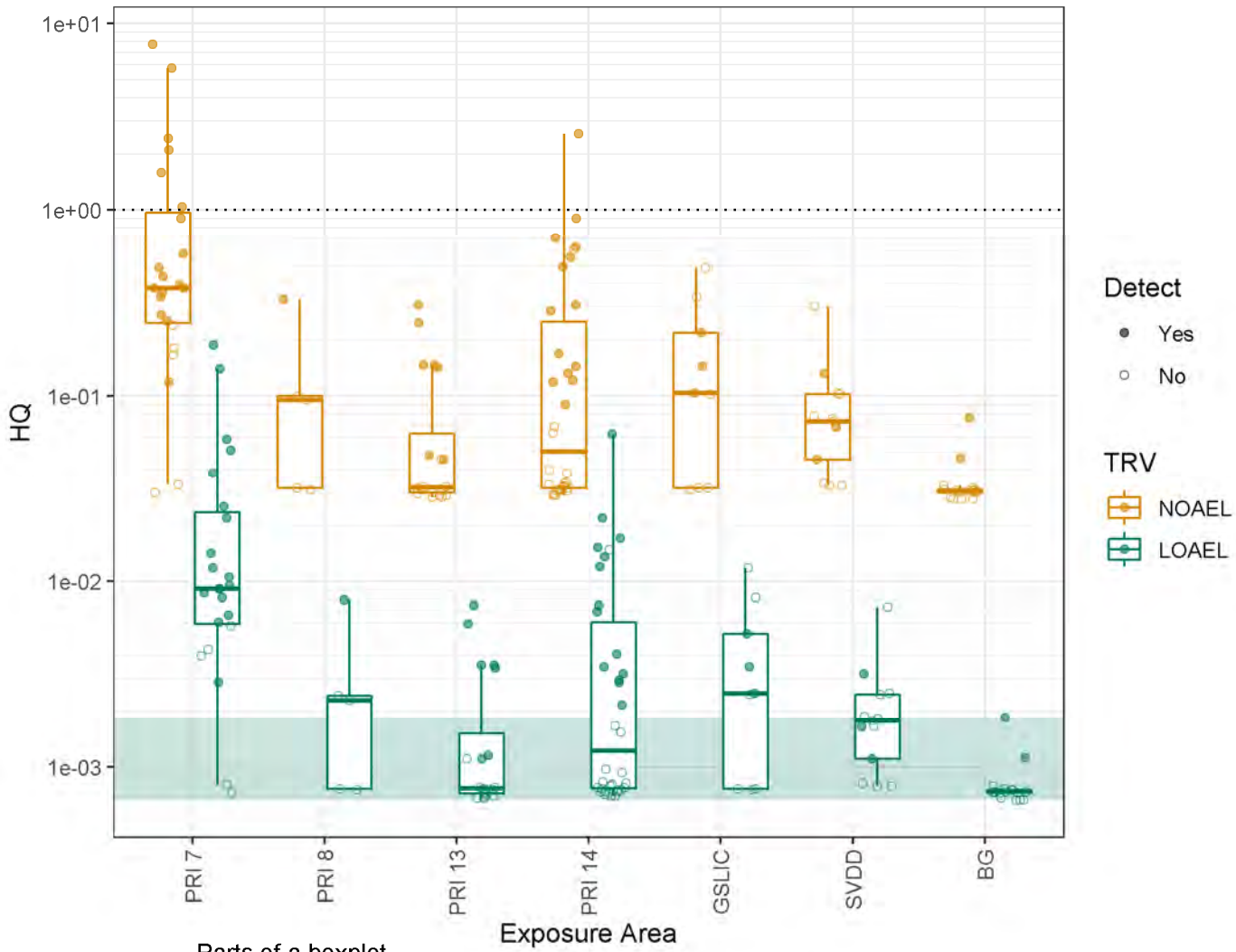
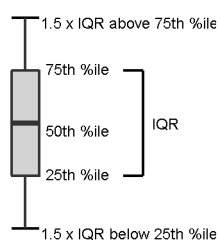


Parts of a boxplot



Notes:
BG = Background
IQR = Interquartile Range
%ile = percentile

The green shaded area illustrates the range of background LOAEL HQs.

Figure 6-5
Modeled Tissue HQs for Aquatic Invertebrates Hexachlorobenzene

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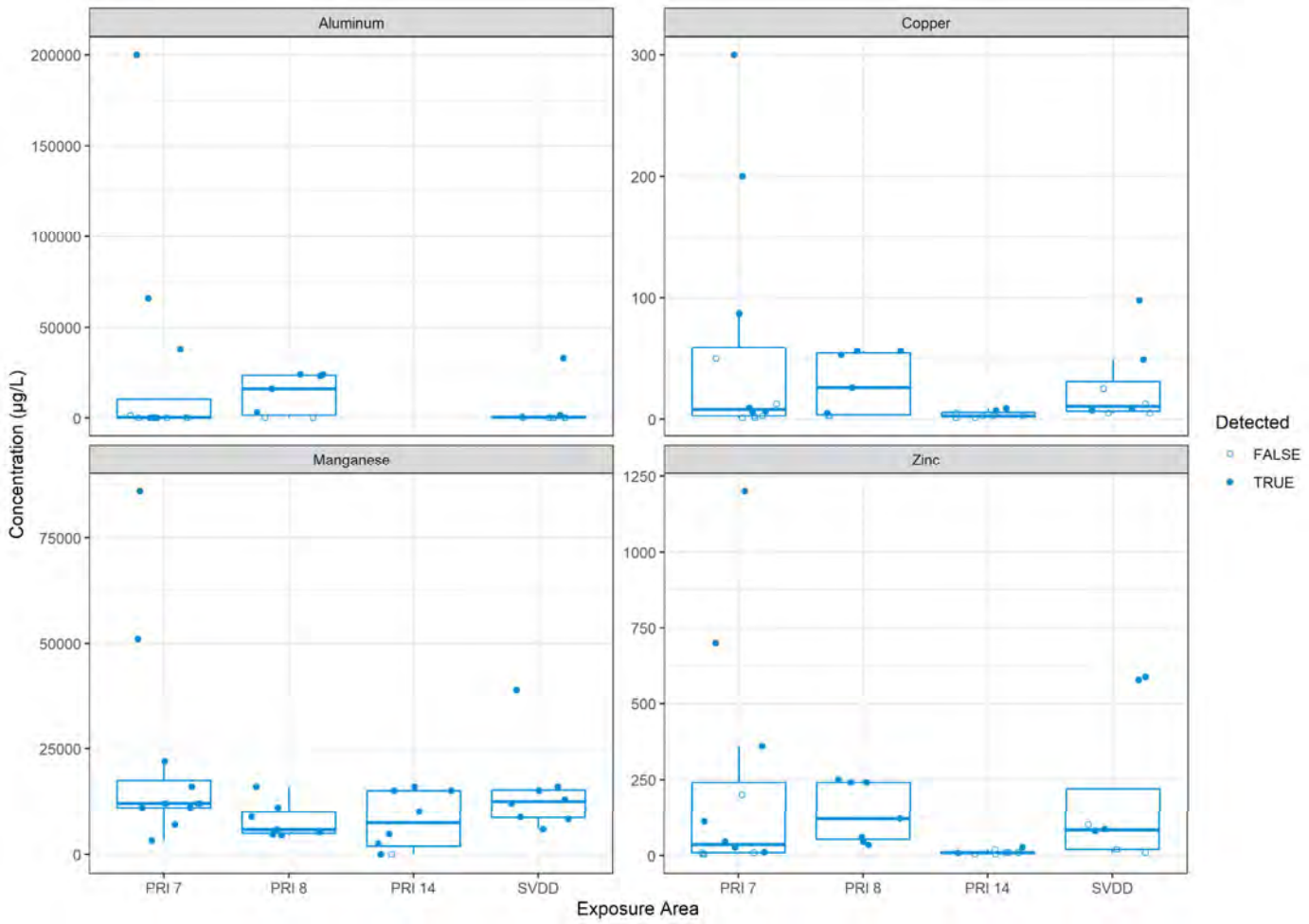

Figure 7-1
COPEC Concentration Variability in Site Surface Water
OU-1 BERA Report
US Magnesium LLC
Tooele County, Utah

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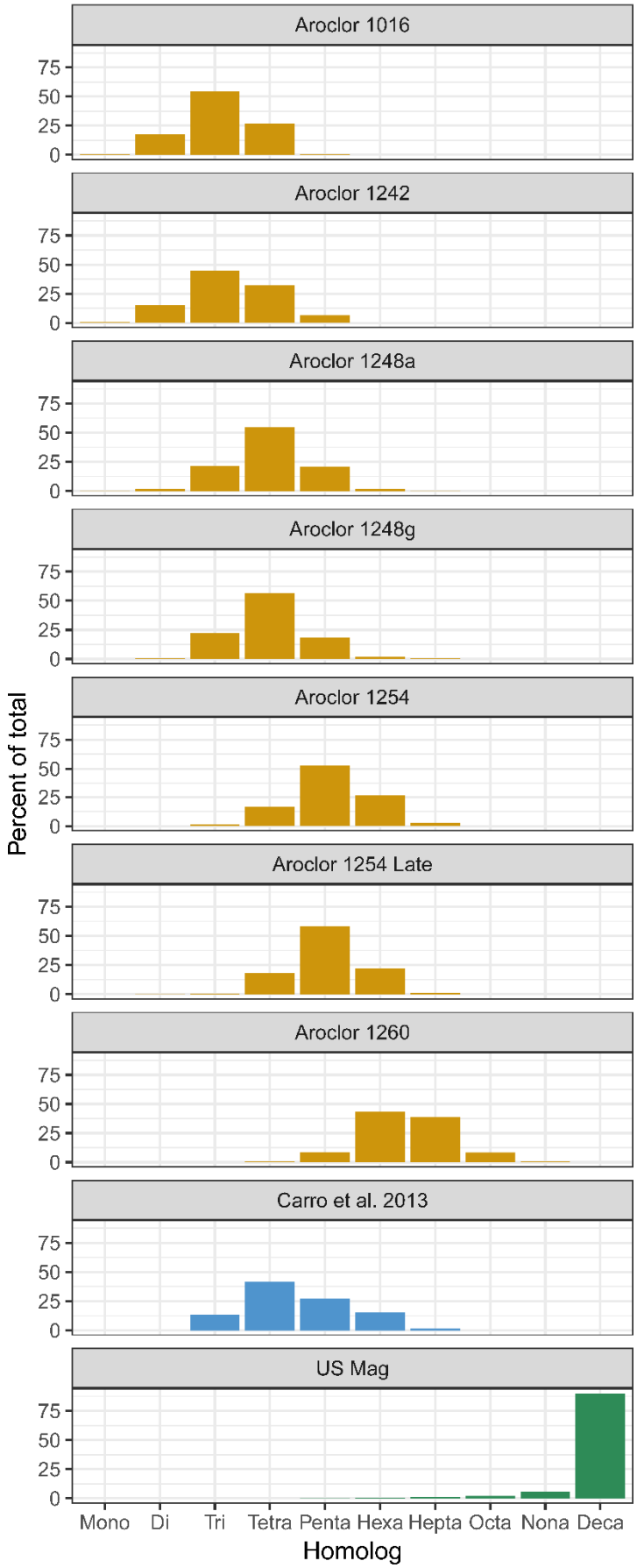

Figure 7-2

Comparison of PCB Mixtures

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US Magnesium LLC
Tooele County, Utah

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TABLES

Table ES-1
Summary of Risk Findings
US Magnesium LLC
Tooele County, Utah

Exposure Area	PRI 1	PRI 2	PRI 3	PRI 4	PRI 5		PRI 6		PRI 7	PRI 8		PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14		PRI 15	PRI 16	GSLIC	SVDD
Habitat	NA	Upland	NA	Upland	Upland	Lakebed	Upland	Lakebed	Lakebed	Upland	Lakebed	Upland	Upland	Upland	Upland	Lakebed	Upland	Lakebed	Upland	Upland	Lakebed	Lakebed
Birds	NA	-	NA	-	TEQ, HCB, Total PCBs	-	TEQ, HCB, Total PCBs	-	TEQ	TEQ	-	-	-	NA	-	-	-	TEQ	-	-	-	-
Mammals	NA	-	NA	-	TEQ	-	-	-	TEQ	TEQ	-	-	-	NA	-	-	-	-	-	-	-	-
Plants	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-
Soil Invertebrates	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-
Benthic Invertebrates	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-
Aquatic Biota	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-

Notes:
Constituents of potential ecological concern listed for a receptor and exposure unit were found to potentially result in risk based on Weight of Evidence findings.
NA = Not applicable because PRI was remediated (PRI 1 and 3) or no ecological habitat is present (PRI 11).
HCB = Hexachlorobenzene
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
TEQ = Dioxin/furan toxicity equivalence factor

Table 2-1
Data Quality Criteria for Biotic Chemistry, Ecological Field Survey, and Laboratory Toxicity Data
US Magnesium LLC
Tooele County, Utah

		Primary Criteria [a]		Secondary Criteria [b]			
Study Citation	**Type of Study**	**Hard copy or electronic copy of data report**	**Sufficient information on methodology (e.g. survey dates, duration)**	**Field coordinates, or sufficient location information such that survey or sample locations can be associated with a specific exposure area and habitat [c]**	**Available supporting documentation (e.g., field notebooks, photographs, laboratory data)**	**Conducted as part of the RI/FS process**	**Data use recommendation for OU1 BERA**
Biotic Chemistry Data							
MagCorp 2000	Tissue Collection	Yes	No	No	No	No	Not acceptable
Parametrix 2004	Tissue Collection	Yes	Yes	Yes	Yes	No	Acceptable
USEPA 2004, 2005, 2006	Tissue Collection	Yes	Yes	Yes	No	No	Conditionally acceptable
ERM 2018	Tissue Collection	Yes	Yes	Yes	Yes	Yes	Acceptable
Site-Specific Toxicity Studies							
Parametrix 2004	Laboratory Toxicity	Yes	Yes	Yes	Yes	No	Acceptable
Hooper et al. 2008	Laboratory Toxicity	Yes	Yes	Yes	Yes	No	Acceptable
Ecological Field Survey Data							
Thompson 1983	Field Survey	Yes	Yes	No	No	No	Conditionally acceptable
Glover 1983	Field Survey	Yes	Yes	No	No	No	Conditionally acceptable
USFWS 1998a, 1998b, 1998c	Field Visit	Yes	No	Partially	No	No	Not acceptable
Halford et al. 1999	Field Survey	Yes	Yes	Yes	Yes	No	Acceptable
BIO-Logic 2002	Field Survey	Yes	Yes	Yes	Yes	No	Acceptable
BIO-Logic 2003	Field Survey Data Analysis	Yes	Yes	Yes	Yes	No	Acceptable
BIO-Logic 2004	Field Survey	Yes	Yes	Yes	No	No	Conditionally acceptable
BIO-Logic 2006	Field Survey	Yes	Yes	Yes	No	No	Conditionally acceptable
Beltman and Stackhouse 2007	Field Survey	Yes	Yes	Yes	No	No	Conditionally acceptable
Cavitt 2008, 2010	Field Survey	Yes	Yes	Yes	Yes	No	Acceptable
ERM 2013, 2014	Field Survey	Yes	Yes	Yes	Yes	Yes	Acceptable
ERM 2015	Field Reconnaissance	Yes	Yes	Yes	Yes	Yes	Acceptable

Table 2-1
Data Quality Criteria for Biotic Chemistry, Ecological Field Survey, and Laboratory Toxicity Data
US Magnesium LLC
Tooele County, Utah

Notes:

[a] Primary criteria are essential to ensure the quality of the data for the OU1 BERA. Studies with a "No" for any of the primary criteria are deemed not acceptable for use in the OU1 BERA.

[b] Secondary criteria are informative, but not essential, to ensure the quality of the data for the OU1 BERA. Studies with a "No" for supporting documentation may be deemed conditionally acceptable. Studies with a "Yes" for the RI/FS process may be deemed acceptable, due to increased review and oversight by relevant parties (e.g., EPA and US Mag).

[c] Reports of activities at the active waste pond are considered applicable to lakebed habitat at both PRIs 5 and 6.

BERA = Baseline ecological risk assessment

OU1 = Operable Unit 1

PRI = Preliminary Risk Investigation

RI/FS = Remedial investigation / feasibility study

Citations:

Beltman and Stackhouse. 2007. Environmental Endangerment at the US Magnesium Facility, Rowley, Utah Final Expert Report. Prepared for U.S. Department of Justice (Washington, DC) by Douglas Beltman of Stratus Consulting Inc. (Boulder, CO) and Mark Stackhouse of Westwings, Inc. (Salt Lake City, UT) February 2007.

BIO-Logic. 2002. Bird Observations at US Magnesium Plant, Rowley, Utah.

BIO-Logic. 2003. Bird Exposure Assessment, US Magnesium Active Waste Water Pond, Rowley, Utah.

BIO-Logic. 2004. Preliminary Benthic Invertebrate Survey, US Magnesium Old Waste Pond and Borrow Pit, Tooele County. Memorandum from Steve Boyle (BIO-Logic) to Tom Tripp (US Magnesium).

BIO-Logic. 2006. Presence and Relative Abundance of Birds at the Old Waste Pond and Vicinity, Breeding Season 2006.

Cavitt, J.F. 2008. US Magnesium Avian Studies. Final Report. Prepared for US Magnesium.

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Glover, F.A. 1983. Report on Survey of Animals, AMAX Magnesium Plant, Rowley, Utah. Prepared for AMAX, Inc.

Halford, D.K., N.E. Korte, and W.J. Waugh. 1999. Report on the Preliminary Ecological Survey and Site Evaluation at Magnesium Corporation of America (MagCorp). Prepared for USEPA Region 8 Technical Enforcement Program.

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ERM-West, Inc. (ERM). 2013. Habitat and Wildlife Survey and Mapping Work Plan. Final. Prepared for US Magnesium LLC and USEPA Region 8.

ERM. 2014. Final Habitat and Wildlife Survey and Mapping Report. US Magnesium RI/FS, Rowley, Utah. June.

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Thompson, S.V. 1983. Vegetation Survey at AMAX Magnesium Processing Site at Rowley, Utah.

United States Environmental Protection Agency (USEPA). 2004. U.S. Magnesium: Biota and Sediment Sampling Standard Operating Procedures. Prepared for USEPA Region 8.

USEPA. 2005. Field Sampling Plan / Quality Assurance Project Plan for Sampling and Analysis of Bird Eggs at U.S. Magnesium Corporation, Rowley, Utah. Revision 3. Prepared for USEPA Region 8.

USEPA. 2006. Field Sampling Plan / Quality Assurance Project Plan for Sampling and Analysis of Bird Eggs at U.S. Magnesium Corporation, Rowley, Utah. Revision 4. Prepared for USEPA Region 8.

United States Fish and Wildlife Service (USFWS). 1998a. Report of Investigation, Magnesium Corporation of America. Investigative Period 7/8/98 – 8/31/98. Report made by Special Agent Bryce Findley.

USFWS. 1998b. Report of Investigation, Magnesium Corporation of America. Investigative Period 9/18/98 – 12/11/98. Report made by Special Agent Bryce Findley.

USFWS. 1998c. Memorandum: Observations of MagCorp Sample Collections for Dioxin Testing on Dec. 21, 1998. From Rex Sohn to Bryce Finley, USFWS Special Agent.

Table 2-2
PRI 8 Dataset Selection for BERA
US Magnesium LLC
Tooele County, Utah

Sampling Phase	Location	Sample ID	Included or Excluded from Dataset
Phase 1A	PRI8-001	PRI8-001-SS01-121713	Included
Phase 1A	PRI8-002	PRI8-002-SS01-121713	Included
Phase 1A	PRI8-003	PRI8-003-SS01-121713	Excluded (Resampled)
Phase 1A	PRI8-004	PRI8-004-SS01-121813	Excluded (Resampled)
Phase 1A	PRI8-005A	PRI8-005A-SS01-050814	Excluded (Resampled)
Phase 1A	PRI8-005B	PRI8-005B-SS01-050814	Excluded (Resampled)
Phase 1A	PRI8-006	PRI8-006-SS01-032514	Excluded (Resampled)
Phase 1A	PRI8-007	PRI8-007-SS01-121813	Included
Phase 1A	PRI8-008	PRI8-008-SS01-121813	Included
Phase 1A	PRI8-009	PRI8-009-SS01-121813	Excluded (Resampled)
Phase 1A	PRI8-010	PRI8-010-SS01-032614	Inaccessible in 2019 - Excluded Phase 1A sample
Phase 1A	PRI8-011	PRI8-011-SS01-121713	Included
Phase 1A	PRI8-012	PRI8-012-SS01-121713	Included
Phase 1A	PRI8-013	PRI8-013-SS01-121813	Included
Phase 1A	PRI8-014	PRI8-014-SS01-032614	Inaccessible in 2019 - Excluded Phase 1A sample
Phase 1A	PRI8-015	PRI8-015-SS01-032514	Inaccessible in 2019 - Excluded Phase 1A sample
Phase 1A	PRI8-016	PRI8-016-SS01-121913	Not sampled (2019) - Excluded Phase 1A sample
Phase 1A	PRI8-017	PRI8-017-SS01-032514	Inaccessible in 2019 - Excluded Phase 1A sample
Phase 2A	SL-09A	SL09A-SD-01-081216	Excluded (Resampled)
Phase 1A-B SAP Mod 4	PRI8-003	PRI8-003-SS-01-052119	Included
Phase 1A-B SAP Mod 4	PRI8-005B	PRI8-005B-SS-01-052119	Included
Phase 1A-B SAP Mod 4	PRI8-009	PRI8-009-SS-01-052119	Included
Phase 1A-B SAP Mod 5	8-22	8-22-SS-01-101019	Included
Phase 1A-B SAP Mod 5	8-23	8-23-SS-01-101019	Included
Phase 1A-B SAP Mod 5	8-24	8-24-SS-01-100919	Included
Phase 1A-B SAP Mod 6	8-25	8-25-SS-01-011320	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	8-26	8-26-SS-01-011320	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	8-27	8-27-SS-01-011320	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	8-28	8-28-SS-01-011420	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	8-29	8-29-SS-01-011420	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	PRI8-004	PRI8-004-SS-01-110619	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	PRI8-005A	PRI8-005A-SS-01-110619	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	PRI8-006	PRI8-006-SS-01-110619	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 6	SL-09A	SL-09-A-SS-01-110619	Included - replaced Phase 1A sample
Phase 1A-B SAP Mod 7	TTGP-A	TTGP-A-SS-01-112519	Included
Phase 1A-B SAP Mod 7	TTGP-A	TTGP-A-OW-SS-01-112519	Included
Phase 1A-B SAP Mod 7	TTGP-B	TTGP-B-SS-01-121819	Included
Phase 1A-B SAP Mod 7	TTGP-B	TTGP-B-OW-SS-01-112519	Included
Phase 1A-B SAP Mod 7	TTGP-C	TTGP-C-SS-01-121819	Included

Notes:
BERA = Baseline Ecological Risk Assessment
PRI = Preliminary Risk Investigation
TTGP = Truck Turnaround Gypsum Pile
SAP Mod = Sampling and Analysis Plan Modification

Table 2-3
Data Suitability Criteria for Laboratory Toxicity Data
US Magnesium LLC
Tooele County, Utah

Study Citation	Receptor Groups	Site-specific test media	Study Objective/Design	Study Duration	Endpoints assessed	Sample Size	Use of Appropriate Control	Appropriate use of data in OU1 BERA Laboratory Toxicity Studies LOE
Parametrix 2004	Birds	Facility process waste from the active pond (PRIs 5 and 6)	Assess effects of ingestion of wastewater on aquatic birds	48 hrs followed by a 72-hr recovery period	Mortality, food consumption, water ingestion, body weight	5	Yes	Yes
Hooper et al. 2008	Birds	Acidic pond water (PRIs 5 and 6)	Five studies to assess effects of acidic pond water via ingestion and dermal contact	2 to 48 hrs	Mortality, body weight, food consumption, water ingestion, pathophysiological or histological changes, egg discoloration and weight	5 to 10	Yes	Yes

Notes:
BERA = Baseline ecological risk assessment
hr = Hour
LOE = Line of evidence
OU1 = Operable Unit 1
PRI = Preliminary Remediation Investigation

Citations:
Hooper, M., Isanhart,J., and K. Kuhns. 2008. Avian consumption of an acid-contaminated water source: toxicological assessment of exposure, effects, and susceptibility. Texas Tech University, Lubbock, Texas. July 31, 2008.
Parametrix. 2004. Focused Ecological Risk Assessment for the US Magnesium, LLC Site. Rowley, Utah.

Table 2-4
Data Suitability Criteria for Ecological Field Survey Data
US Magnesium LLC
Tooele County, Utah

					Type of Ecological Data Reported					Appropriate Use of Data in OU1 BERA [a]		
Study Citation	Outcome from DQA (see Table 2-1)	Receptor Groups Assessed	Exposure Areas	Study Objective/Design	Presence/absence of specific species or receptor groups	Number of organisms observed	Bird contact with water	Measurement of biota (e.g., mass, eggshell thickness)	Compares site against reference or normal conditions	Identification of receptors and exposure pathways (Problem Formulation)	Interpretation of AHUF results	Ecological Field Studies LOE
Thompson 1983	Conditionally Acceptable	Plants	Limited descriptions of survey locations; PRIs 1 - 16 are assumed	Visual observations of vegetation over time	Yes	No	No	No	Yes	Yes	No	Yes
Glover 1983	Conditionally Acceptable	Birds, Mammals, Plants	Specific areas are not provided; PRIs 1 - 16 are assumed	Visual observations of environmental stress	Yes	No	No	No	Yes	Yes	No	Yes
Halford et al. 1999	Acceptable	Birds, Mammals, Plants	PRIs 5, 6, 7, 9, 10 and 15	Visual observations, trapping transects for small mammals	Yes	No	No	No	Yes	Yes	No	Yes
BIO-Logic 2002	Acceptable	Birds	PRIs 1, 5, 6, and 7	Visual observations	Yes	Yes	Yes	No	No	Yes	Yes	No
BIO-Logic 2003	Acceptable	Birds, Aquatic Invertebrates	PRIs 5 and 6	Analysis of previous visual observations (BIO-Logic 2002)	Yes	Yes	Yes	No	No	Yes	Yes	No
BIO-Logic 2004	Conditionally Acceptable	Aquatic Invertebrates	PRIs 6 and 7	Visual observations	Yes	Yes	No	No	No	Yes	No	No
BIO-Logic 2006	Conditionally Acceptable	Birds	PRIs 5, 6, 8, 10, 13, 14, and 15, GSLIC, and SVDD	Visual observations of relative abundance and reproduction	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Beltman and Stackhouse 2007	Conditionally Acceptable	Birds	PRIs 1, 5, 6, and 7	Visual observations	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Cavitt 2008, 2010	Acceptable	Birds, Aquatic Invertebrates	PRIs 5, 6, 7, 13, 14, an area east of PRIs 13 and 14, and reference areas	Comparisons of avian reproductive success between Site and reference	Yes	Yes	No	Yes	Yes	Yes	No	Yes
ERM 2013, 2014	Acceptable	Birds, Mammals, Plants, Invertebrates	PRIs 1-10 and 12	Visual observations to support ERA problem formulation	Yes	No	Yes	No	No	Yes	Yes	No
ERM 2015	Acceptable	Birds, Mammals, Plants, Invertebrates	Background locations	Visual observations	Yes	No	No	No	No	No	No	No

Notes:
[a] Different ways in which field studies may contribute to ecological risk assessments are described in EPA 1994.
AHUF = Acid habitat utilization factor
BERA = Baseline ecological risk assessment
GSLIC = Great Salt Lake intake canal
LOE = Line of evidence
OU1 = Operable Unit 1
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversionary ditch

Citations:

Beltman and Stackhouse. 2007. Environmental Endangerment at the US Magnesium Facility, Rowley, Utah Final Expert Report. Prepared for U.S. Department of Justice (Washington, DC) by Douglas Beltman of Stratus Consulting Inc. (Boulder, CO) and Mark Stackhouse of Westwings, Inc. (Salt Lake City, UT). February 2007.
BIO-Logic. 2002. Bird Observations at US Magnesium Plant, Rowley, Utah.
BIO-Logic. 2003. Bird Exposure Assessment, US Magnesium Active Waste Water Pond, Rowley, Utah.
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USEPA. 2005. Field Sampling Plan / Quality Assurance Project Plan for Sampling and Analysis of Bird Eggs at U.S. Magnesium Corporation, Rowley, Utah. Revision 3. Prepared for USEPA Region 8.
USEPA. 2006. Field Sampling Plan / Quality Assurance Project Plan for Sampling and Analysis of Bird Eggs at U.S. Magnesium Corporation, Rowley, Utah. Revision 4. Prepared for USEPA Region 8.

Table 2-5
Sample Numbers per PRI
US Magnesium, LLC
Tooele County, Utah

Exposure Area	Lakebed					Upland				
	Solids		Water		Tissue (egg)	Solids		Water		Tissue (egg)
	Number of Sample Locations	Number of Samples	Number of Sample Locations	Number of Samples	Number of Samples	Number of Sample Locations	Number of Samples	Number of Sample Locations	Number of Samples	Number of Samples
PRI 2	-	-	-	-	-	14	14	-	-	-
PRI 4	-	-	-	-	-	17	17	2	4	-
PRI 5	15	15	6	20	1	20	20	-	-	1
PRI 6	11	11	5	16	-	10	10	-	-	-
PRI 7	23	23	6	17	13	-	-	-	-	-
PRI 8	5	5	5	14	-	22	22	-	-	-
PRI 9	-	-	-	-	-	16	16	-	-	-
PRI 10	-	-	-	-	-	14	14	-	-	-
PRI 11	-	-	-	-	-	14	14	-	-	-
PRI 12	-	-	-	-	-	14	14	-	-	-
PRI 13	20	20	-	-	-	-	-	-	-	-
PRI 14	34	37	4	16	9	9	9	-	-	5
PRI 15	-	-	-	-	-	21	21	-	-	-
PRI 16	-	-	-	-	-	14	14	-	-	-
GSLIC	9	9	-	-	-	-	-	-	-	-
SVDD	13	13	2	14	-	-	-	-	-	-
Background	33	33	-	-	15	33	33	-	-	1
Background - Bear River	5	5	-	-	-	-	-	-	-	-

Notes:
Sample numbers only apply to the BERA dataset.
Habitats for egg tissue samples were based on receptor nesting behaviors with American avocet and snowy plover representing lakebed habitat, and horned lark and sage thrasher representing upland habitat.
- = No samples were collected
BERA = Baseline ecological risk assessment
GSLIC = Great Salt Lake intake canal
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversionary ditch

Table 2-6
Modifications to Sample Exposure Unit Designation
US Magnesium LLC
Tooele County, Utah

Original Exposure Unit Designation	Sample Location	New Exposure Unit Designation
PRI 13	SL-11-B	GSLIC
PRI 13	SL-11-A	GSLIC
PRI 13	IC-2	GSLIC
PRI 13	IC-3	GSLIC
PRI 13	IC-4	GSLIC
PRI 13	IC-6	GSLIC
PRI 13	IC-7	GSLIC
PRI 13	IC-8	GSLIC
PRI 13	PRI13-015	SVDD
PRI 13	SL-10-A	SVDD
PRI 13	SL-10-B	SVDD
PRI 13	SV-1	SVDD
PRI 13	SV-2	SVDD
PRI 13	SV-3	SVDD
PRI 13	SV-4	SVDD
PRI 14	IC-1	GSLIC
PRI 5	SM-X-A	SVDD
PRI 5	5-19	SVDD
PRI 5	PRI5-500	SVDD
PRI 5	PRI5-501	SVDD
PRI 5	SM-X-B	SVDD
PRI 5	PRI5-019	SVDD
PRI 7	PRI7-018	SVDD

Notes:
GSLIC = Great Salt Lake Inlet Canal
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley Diversion Ditch

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 2	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	14	14	100%	3300	2130	2.92	21000	5330	4340	10300	18900	8383	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 2	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	14	14	100%	10300	7150	6.7	66000	16700	13100	31900	59200	27022	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 2	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	14	14	100%	80200	53500	44.5	516000	131000	103000	248000	462000	213412	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 2	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	14	14	100%	1630	945	1.6	9900	2520	2340	5020	8920	4103	95 UCL
PRI 2	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	14	14	100%	1.47	0.675	0.0012	11	2.81	1.87	5.08	9.82	3.731	95 UCL
PRI 2	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	14	14	100%	0.671	0.655	0.23	1	0.222	0.957	0.993	0.999	0.777	95 UCL
PRI 2	Upland	Solids	Metals	Chromium	7440-47-3	mg/kg	14	14	100%	14	7.2	0.86	51	14.4	33.1	39.9	48.8	24.54	95 UCL
PRI 2	Upland	Solids	Metals	Copper	7440-50-8	mg/kg	14	14	100%	30.2	22	1.2	120	32	62.6	86.2	113	56.91	95 UCL
PRI 2	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	14	14	100%	4.26	3.2	0.48	16	4.25	9.32	12.7	15.3	7.187	95 UCL
PRI 2	Upland	Solids	Metals	Nickel	7440-02-0	mg/kg	14	14	100%	11.4	7.1	3.5	59	14.1	15.1	31	53.4	16.74	95 UCL
PRI 2	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	14	14	100%	16.3	15	2.3	41	9.09	24.8	31.2	39	22.76	95 UCL
PRI 2	Upland	Solids	Metals	Zinc	7440-66-6	mg/kg	14	14	100%	30.8	20.5	6.9	80	22.2	56.7	65	77	46.73	95 UCL
PRI 2	Upland	Solids	SVOCs	Benzyl butyl phthalate	85-68-7	mg/kg	14	1	7%	0.387	0.46	0.05	0.55	0.189	0.55	0.55	0.55	0.55	Max (too few samples or detects)
PRI 2	Upland	Solids	SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	14	1	7%	0.42	0.475	0.05	1.1	0.287	0.55	0.742	1.03	1.1	Max (too few samples or detects)
PRI 2	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	14	14	100%	7.77	5.15	0.0042	50	12.7	10	24	44.8	20.71	95 UCL
PRI 2	Upland	Solids	PAHs	HPAH, ND=0	hpah-0	mg/kg	14	13	93%	0.0372	0.0091	0	0.31	0.0811	0.0625	0.15	0.278	0.253	95 UCL
PRI 2	Upland	Solids	PAHs	HPAH, ND=1/2DL	hpah-5	mg/kg	14	13	93%	0.039	0.011	0.00175	0.31	0.0804	0.0628	0.15	0.278	0.133	95 UCL
PRI 4	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	17	17	100%	7310	6600	81.8	17400	5200	13800	16100	17100	9759	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 4	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	17	17	100%	24700	20600	194	85800	19900	42500	53000	79200	33843	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 4	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	17	17	100%	199000	151000	1320	770000	176000	331000	463000	709000	274683	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 4	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	17	17	100%	3950	3200	54	9300	2890	7580	8020	9040	5179	95 UCL
PRI 4	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	17	17	100%	1.14	0.847	0.047	3.14	0.822	1.92	2.2	2.95	1.484	95 UCL
PRI 4	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	17	17	100%	2.32	1.8	0.26	8.5	1.86	3.72	5.06	7.81	3.305	95 UCL
PRI 4	Upland	Solids	Metals	Arsenic	7440-38-2	mg/kg	17	17	100%	17.9	18	4.8	30	5.82	23.5	25.4	29.1	20.36	95 UCL
PRI 4	Upland	Solids	Metals	Mercury	7439-97-6	mg/kg	17	15	88%	0.0576	0.053	0.005	0.24	0.0538	0.086	0.119	0.216	0.0937	95 UCL
PRI 4	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	17	17	100%	2.48	2.3	0.59	4.6	0.993	3.64	4.36	4.55	2.896	95 UCL
PRI 4	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	17	17	100%	45.6	41.7	18	89	20.8	79.4	84.2	88	54.41	95 UCL
PRI 4	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	17	16	94%	19.4	14	0.125	76	17.4	32	45.6	69.9	26.76	95 UCL
PRI 4	Upland	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	2	1	50%	1460	1460	25	2900	2030	-	-	-	2900	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	2	2	100%	11.3	11.3	5.6	17	8.06	-	-	-	17	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	2	2	100%	285	285	240	330	63.6	-	-	-	330	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	2	2	100%	2550	2550	2400	2700	212	-	-	-	2700	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	2	1	50%	0.41	0.41	0.1	0.72	0.438	-	-	-	0.72	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	2	2	100%	4.85	4.85	4.7	5	0.212	-	-	-	5	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	2	1	50%	26	26	1	51	35.4	-	-	-	51	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	2	1	50%	2.19	2.19	0.755	3.63	2.03	-	-	-	3.63	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	2	1	50%	4.3	4.3	0.6	8	5.23	-	-	-	8	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	2	2	100%	14	14	11	17	4.24	-	-	-	17	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	2	1	50%	110000	110000	25	220000	156000	-	-	-	220000	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	2	2	100%	19.5	19.5	15	24	6.36	-	-	-	24	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	2	2	100%	2220	2220	350	4100	2650	-	-	-	4100	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	2	1	50%	0.925	0.925	0.05	1.8	1.24	-	-	-	1.8	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	2	1	50%	3.75	3.75	0.6	6.9	4.45	-	-	-	6.9	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	2	2	100%	165	165	140	190	35.4	-	-	-	190	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	2	2	100%	6.1	6.1	5.6	6.6	0.707	-	-	-	6.6	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Silver	7440-22-4	µg/L	2	2	100%	2.45	2.45	2.3	2.6	0.212	-	-	-	2.6	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Thallium	7440-28-0	µg/L	2	2	100%	7	7	6.9	7.1	0.141	-	-	-	7.1	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	2	1	50%	132	132	3	260	182	-	-	-	260	Max (too few samples or detects)
PRI 4	Upland	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	2	2	100%	325	325	230	420	134	-	-	-	420	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	2	2	100%	0.021	0.021	0.00062	0.0413	0.0288	-	-	-	0.0413	Avian TEQ = Max (too few samples or detects), HCB = Max (too few samples or detects)
PRI 4	Upland	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	2	2	100%	0.202	0.202	0.00197	0.401	0.282	-	-	-	0.4013	Avian TEQ = Max (too few samples or detects), HCB = Max (too few samples or detects)
PRI 4	Upland	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	2	2	100%	2.01	2.01	0.0155	4	2.82	-	-	-	4.0013	Avian TEQ = Max (too few samples or detects), HCB = Max (too few samples or detects)
PRI 4	Upland	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	2	2	100%	0.000635	0.000635	0.00036	0.00091	0.000389	-	-	-	0.00091	Max (too few samples or detects)
PRI 4	Upland	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	2	2	100%	0.41	0.41	0.16	0.66	0.354	-	-	-	0.66	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Aluminum	7429-90-5	µg/L	2	2	100%	6450	6450	3500	9400	4170	-	-	-	9400	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Antimony	7440-36-0	µg/L	2	2	100%	17.5	17.5	16	19	2.12	-	-	-	19	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Arsenic	7440-38-2	µg/L	2	2	100%	360	360	330	390	42.4	-	-	-	390	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Barium	7440-39-3	µg/L	2	2	100%	2850	2850	2800	2900	70.7	-	-	-	2900	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Beryllium	7440-41-7	µg/L	2	2	100%	1.5	1.5	1.2	1.8	0.424	-	-	-	1.8	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Cadmium	7440-43-9	µg/L	2	2	100%	4.7	4.7	4.7	4.7	0	-	-	-	4.7	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Chromium	7440-47-3	µg/L	2	2	100%	67	67	50	84	24	-	-	-	84	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Cobalt	7440-48-4	µg/L	2	2	100%	11	11	8.1	14	4.17	-	-	-	14	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Copper	7440-50-8	µg/L	2	2	100%	26.5	26.5	25	28	2.12	-	-	-	28	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Iron	7439-89-6	µg/L	2	2	100%	260000	260000	220000	300000	56600	-	-	-	300000	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Lead	7439-92-1	µg/L	2	2	100%	43	43	28	58	21.2	-	-	-	58	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Manganese	7439-96-5	µg/L	2	2	100%	4500	4500	3700	5300	1130	-	-	-	5300	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Mercury	7439-97-6	µg/L	2	1	50%	1.32	1.32	0.05	2.6	1.8	-	-	-	2.6	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	2	2	100%	20.7	20.7	5.4	36	21.6	-	-	-	36	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Nickel	7440-02-0	µg/L	2	2	100%	300	300	230	370	99	-	-	-	370	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Selenium	7782-49-2	µg/L	2	2	100%	8.5	8.5	8.5	8.5	0	-	-	-	8.5	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Silver	7440-22-4	µg/L	2	2	100%	2.35	2.35	2.3	2.4	0.0707	-	-	-	2.4	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Thallium	7440-28-0	µg/L	2	2	100%	6.95	6.95	6.6	7.3	0.495	-	-	-	7.3	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Vanadium	7440-62-2	µg/L	2	2	100%	385	385	200	570	262	-	-	-	570	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Metals	Zinc	7440-66-6	µg/L	2	2	100%	595	595	450	740	205	-	-	-	740	Max (too few samples or detects)

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 4	Upland	Water, Total	SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	µg/L	2	1	50%	8	8	5	11	4.24	-	-	-	11	Max (too few samples or detects)
PRI 4	Upland	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	2	2	100%	201	201	1.5	400	282	-	-	-	400	Max (too few samples or detects)
PRI 4	Upland	Water, Total	VOCs	Bromoform	75-25-2	µg/L	2	2	100%	545	545	100	990	629	-	-	-	990	Max (too few samples or detects)
PRI 4	Upland	Water, Total	VOCs	Chloroform	67-66-3	µg/L	2	2	100%	18.6	18.6	4.3	33	20.3	-	-	-	33	Max (too few samples or detects)
PRI 4	Upland	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	2	2	100%	16	16	11	21	7.07	-	-	-	21	Max (too few samples or detects)
PRI 4	Upland	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	2	2	100%	195000000	195000000	190000000	200000000	7070000	-	-	-	200000000	Max (too few samples or detects)
PRI 4	Upland	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	2	2	100%	0	0	0	0	0	-	-	-	0	Max (too few samples or detects)
PRI 4	Upland	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	2	2	100%	3900	3900	3800	4000	141	-	-	-	4000	Max (too few samples or detects)
PRI 5	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	15	15	100%	91900	5100	14.5	1150000	294000	88800	421000	1e+06	767784	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	15	15	100%	488000	14100	59.5	6010000	1540000	530000	2260000	5260000	3638784	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	15	15	100%	4450000	112000	510	54600000	14000000	4940000	20700000	47800000	32348784	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	15	15	100%	33000	1500	5.2	430000	110000	24200	149000	374000	315887	95 UCL
PRI 5	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	15	15	100%	16.7	0.997	0.00547	172	44.3	32.7	77	153	61.78	95 UCL
PRI 5	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	15	14	93%	1.62	0.57	0.14	9.3	2.43	3.9	5.8	8.6	4.357	95 UCL
PRI 5	Lakebed	Solids	Metals	Arsenic	7440-38-2	mg/kg	15	15	100%	23.5	5.7	2.6	210	52.2	25.6	84	185	82.18	95 UCL
PRI 5	Lakebed	Solids	Metals	Barium	7440-39-3	mg/kg	15	15	100%	585	380	200	1900	528	1420	1620	1840	1180	95 UCL
PRI 5	Lakebed	Solids	Metals	Chromium	7440-47-3	mg/kg	15	15	100%	15	9.3	3.3	53	12.8	26.8	35.5	49.5	22.53	95 UCL
PRI 5	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	15	15	100%	15.6	8.7	0.17	110	26.8	18	47	97.4	32.66	95 UCL
PRI 5	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	15	11	73%	0.31	0.23	0.065	0.8	0.222	0.648	0.758	0.792	0.362	95 UCL
PRI 5	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	15	15	100%	49.7	21.7	6.7	440	109	50	170	386	172.3	95 UCL
PRI 5	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	15	13	87%	441	11	0.05	5400	1380	490	2050	4730	3190	95 UCL
PRI 5	Lakebed	Solids	SVOCs	Hexachlorobutadiene	87-68-3	mg/kg	14	1	7%	10.7	0.215	0.0095	125	33.4	16.2	58.7	112	125	Max (too few samples or detects)
PRI 5	Lakebed	Solids	SVOCs	Pentachlorobenzene	608-93-5	mg/kg	12	4	33%	19.3	0.9	0.0335	210	60.1	10.3	101	188	186.5	95 UCL
PRI 5	Lakebed	Solids	SVOCs	Phenol	108-95-2	mg/kg	14	6	43%	57.2	25.5	0.047	210	73.9	179	204	209	85.9	95 UCL
PRI 5	Lakebed	Solids	VOCs	1,1-Dichloroethane	75-34-3	mg/kg	12	2	17%	0.00139	0.000282	0.000185	0.013	0.00366	0.000644	0.00621	0.0116	0.013	Max (too few samples or detects)
PRI 5	Lakebed	Solids	VOCs	1,2,4-Trichlorobenzene	120-82-1	mg/kg	12	1	8%	0.00235	0.000725	0.00048	0.018	0.00496	0.00229	0.00942	0.0163	0.018	Max (too few samples or detects)
PRI 5	Lakebed	Solids	VOCs	2-Butanone	78-93-3	mg/kg	12	9	75%	0.0175	0.0125	0.0013	0.05	0.0164	0.0414	0.0461	0.0492	0.0263	95 UCL
PRI 5	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	12	8	67%	0.0672	0.053	0.00135	0.18	0.0592	0.12	0.147	0.173	0.0983	95 UCL
PRI 5	Lakebed	Solids	VOCs	Bromodichloromethane	75-27-4	mg/kg	12	9	75%	0.309	0.021	0.0005	3.4	0.974	0.107	1.59	3.04	3.15	95 UCL
PRI 5	Lakebed	Solids	VOCs	Bromoform	75-25-2	mg/kg	12	11	92%	1.14	0.115	0.0004	12	3.42	0.506	5.69	10.7	11.01	95 UCL
PRI 5	Lakebed	Solids	VOCs	Carbon disulfide	75-15-0	mg/kg	12	5	42%	0.00449	0.0009	0.000315	0.024	0.00712	0.0108	0.0168	0.0226	0.00846	95 UCL
PRI 5	Lakebed	Solids	VOCs	Chloroform	67-66-3	mg/kg	12	5	42%	0.083	0.00338	0.00026	0.83	0.237	0.0833	0.422	0.748	1.406	95 UCL
PRI 5	Lakebed	Solids	VOCs	Dibromochloromethane	124-48-1	mg/kg	12	11	92%	0.575	0.0555	0.00021	6.1	1.74	0.237	2.88	5.46	5.599	95 UCL
PRI 5	Lakebed	Solids	VOCs	Tetrachloroethene	127-18-4	mg/kg	12	3	25%	0.0409	0.000625	0.00039	0.48	0.138	0.00389	0.218	0.428	0.125	95 UCL
PRI 5	Lakebed	Solids	Cyanide	Total cyanide	74-90-8	mg/kg	14	3	21%	0.354	0.178	0.115	1.5	0.467	1.05	1.44	1.49	0.626	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	6	6	100%	58300	72000	870	120000	46800	1e+05	110000	118000	69838	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	6	6	100%	15	11.5	2.3	33	10.9	27.5	30.2	32.4	18.84	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	6	6	100%	301	340	28	440	141	390	415	435	339.9	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	6	6	100%	672	760	170	950	274	880	915	943	719.7	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	6	5	83%	3.06	4.05	0.33	4.9	2.08	4.7	4.8	4.88	3.544	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	6	4	67%	1.6	1.5	0.5	2.5	0.699	2.35	2.42	2.48	1.969	KM Student's t
PRI 5	Lakebed	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	6	5	83%	234	270	5	320	115	305	312	318	278.4	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	6	6	100%	5.25	4.2	0.18	14.2	5.32	11	12.6	13.9	11.95	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	6	6	100%	26.7	29.5	8.1	40	11.2	36.5	38.2	39.6	28.8	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	6	5	83%	116	145	5	180	68	170	175	179	133.5	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	6	6	100%	824000	885000	4700	1300000	433000	1150000	1220000	1280000	897354	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	6	5	83%	46	60.5	3	83	33.3	73	78	82	55.61	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	6	6	100%	4940	3400	530	15000	5090	9650	12300	14500	7557	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	6	5	83%	0.728	0.82	0.05	1.6	0.563	1.26	1.43	1.57	0.924	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	6	6	100%	172	195	20	270	83.8	235	252	266	191.3	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	6	6	100%	204	220	71	270	69.4	255	262	268	216.1	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	6	5	83%	5.05	5.3	2.5	6.5	1.38	6.15	6.32	6.46	5.908	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Thallium	7440-28-0	µg/L	6	3	50%	1.43	1.6	0.5	2.5	0.797	2.2	2.35	2.47	1.787	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	6	5	83%	1100	1200	15	1700	574	1550	1620	1680	1225	95 UCL
PRI 5	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	6	6	100%	331	395	76	560	182	485	522	552	410.2	95 UCL
PRI 5	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	6	6	100%	0.076	0.00386	0.000053	0.437	0.177	0.224	0.33	0.416	0.48035	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	6	6	100%	0.214	0.0125	0.000341	1.22	0.493	0.629	0.925	1.16	1.3565	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	6	6	100%	1.6	0.0989	0.00322	9.05	3.65	4.68	6.87	8.61	10.118	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	6	6	100%	0.0397	0.00175	0.00001	0.23	0.0932	0.117	0.174	0.219	0.252	95 UCL
PRI 5	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	6	6	100%	11.6	3	0.061	50	19.4	31.7	40.8	48.2	27.6	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Aluminum	7429-90-5	µg/L	6	5	83%	69100	80000	125	130000	55700	125000	128000	130000	89573	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	6	6	100%	17.5	11.5	2	37	14.4	35.5	36.2	36.8	30.65	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	6	6	100%	325	350	28	460	153	440	450	458	388.5	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	6	6	100%	698	775	200	1000	289	950	975	995	823.7	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Beryllium	7440-41-7	µg/L	6	5	83%	3.01	3.8	0.47	5.2	2.03	4.75	4.98	5.16	3.913	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Cadmium	7440-43-9	µg/L	6	4	67%	1.63	1.75	0.5	2.5	0.68	2.25	2.38	2.48	1.907	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Chromium	7440-47-3	µg/L	6	5	83%	268	290	5	450	146	380	415	443	329.1	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	6	6	100%	26.9	30.5	8.5	40	11.3	36.5	38.2	39.6	31.76	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	6	6	100%	120	150	11	180	65.9	170	175	179	149.9	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	6	6	100%	858000	965000	5700	1300000	440000	1150000	1220000	1280000	1027460	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	6	5	83%	46.2	61	3	83	33.4	73	78	82	62.1	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	6	6	100%	4910	3450	540	15000	5100	9550	12300	14500	8349	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Mercury	7439-97-6	µg/L	6	5	83%	0.647	0.83	0.05	1.1	0.436	1.01	1.06	1.09	0.813	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	6	6	100%	193	205	19	300	99.1	285	292	298	227.4	95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 5	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	6	6	100%	212	230	74	270	71.5	265	268	270	240.4	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Selenium	7782-49-2	µg/L	6	5	83%	5.25	5.4	3.1	7.1	1.4	6.6	6.85	7.05	5.944	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Thallium	7440-28-0	µg/L	6	4	67%	1.93	2.05	0.5	2.7	0.776	2.6	2.65	2.69	2.321	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Vanadium	7440-62-2	µg/L	6	5	83%	1140	1250	15	1800	600	1600	1700	1780	1381	95 UCL
PRI 5	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	6	6	100%	370	420	77	580	207	570	575	579	472.5	95 UCL
PRI 5	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	6	5	83%	153	9.6	0.32	870	351	450	660	828	973.5	95 UCL
PRI 5	Lakebed	Water, Total	SVOCs	Hexachlorobutadiene	87-68-3	µg/L	6	1	17%	1.05	0.4	0.036	3.2	1.23	2.53	2.86	3.13	3.2	Max (too few samples or detects)
PRI 5	Lakebed	Water, Total	SVOCs	Pentachlorobenzene	608-93-5	µg/L	6	1	17%	11.3	2.3	0.205	50	19.3	30.2	40.1	48	50	Max (too few samples or detects)
PRI 5	Lakebed	Water, Total	SVOCs	Pentachlorophenol	87-86-5	µg/L	6	2	33%	33.6	10	0.9	140	53	85.5	113	135	99.27	95 UCL
PRI 5	Lakebed	Water, Total	PAHs	Naphthalene	91-20-3	µg/L	6	1	17%	0.0857	0.025	0.024	0.29	0.108	0.208	0.249	0.282	0.375	Max (too few samples or detects)
PRI 5	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	6	6	100%	53.5	32.5	9.8	120	49.3	115	118	120	84.01	95 UCL
PRI 5	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	6	2	33%	0.465	0.4	0.4	0.65	0.107	0.595	0.622	0.645	0.676	95 UCL
PRI 5	Lakebed	Water, Total	VOCs	Carbon tetrachloride	56-23-5	µg/L	6	2	33%	3.37	0.375	0.075	9.6	4.75	9.5	9.55	9.59	6.336	95 UCL
PRI 5	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	6	6	100%	7.3	3.6	1	26	9.51	16.9	21.4	25.1	15.69	95 UCL
PRI 5	Lakebed	Water, Total	VOCs	Methyl bromide	74-83-9	µg/L	6	2	33%	2.2	0.75	0.145	8.6	3.21	5.4	7	8.28	6.176	95 UCL
PRI 5	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	6	4	67%	9.13	9.4	2.5	17	6.12	15.5	16.2	16.8	13.07	95 UCL
PRI 5	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	6	6	100%	43200000	42000000	37000000	52000000	5810000	49500000	50800000	51800000	42975616	95 UCL
PRI 5	Lakebed	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	6	6	100%	31.7	0	0	190	77.6	95	142	181	169.7	95 UCL
PRI 5	Lakebed	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	6	5	83%	3600	3550	220	6700	2090	5550	6120	6580	4139	95 UCL
PRI 5	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	20	20	100%	848	13.7	0.585	14600	3250	529	2070	12100	7702.6	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	20	20	100%	1990	40.2	1.62	33500	7470	1120	5670	27900	14800	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	20	20	100%	13500	337	12	222000	49700	8170	41600	186000	85774	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 5	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	20	20	100%	451	4.3	0.19	7900	1760	281	1010	6520	4366	95 UCL
PRI 5	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	20	20	100%	0.344	0.0096	0.00019	5.7	1.27	0.299	0.732	4.71	3.162	95 UCL
PRI 5	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	20	15	75%	0.243	0.17	0.043	0.99	0.236	0.564	0.62	0.916	0.308	95 UCL
PRI 5	Upland	Solids	Metals	Arsenic	7440-38-2	mg/kg	20	20	100%	7.17	5.05	3.6	18	3.98	13.2	15.2	17.4	8.763	95 UCL
PRI 5	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	20	20	100%	252	280	120	383	80.8	361	371	381	282.9	95 UCL
PRI 5	Upland	Solids	Metals	Chromium	7440-47-3	mg/kg	20	20	100%	7.68	5.4	2	22	5.37	15	15.4	20.7	10.26	95 UCL
PRI 5	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	20	19	95%	2.98	0.525	0.0485	32	7.2	5.24	10.3	27.7	10	95 UCL
PRI 5	Upland	Solids	Metals	Selenium	7782-49-2	mg/kg	20	11	55%	0.27	0.14	0.043	1.9	0.423	0.536	0.827	1.69	0.369	95 UCL
PRI 5	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	20	20	100%	14.9	9.6	4.5	41	10.7	29.7	36.2	40	20.47	95 UCL
PRI 5	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	20	14	70%	1.27	0.0295	0.00115	21	4.69	0.805	4	17.6	7.886	95 UCL
PRI 5	Upland	Solids	VOCs	2-Butanone	78-93-3	mg/kg	13	3	23%	0.00508	0.001	0.0007	0.037	0.00996	0.0088	0.0204	0.0337	0.011	95 UCL
PRI 5	Upland	Solids	VOCs	Acetone	67-64-1	mg/kg	13	4	31%	0.018	0.001	0.00065	0.16	0.0436	0.0286	0.0832	0.145	0.0414	95 UCL
PRI 5	Upland	Solids	VOCs	Bromodichloromethane	75-27-4	mg/kg	13	1	8%	0.00583	0.000325	0.000255	0.072	0.0199	0.000414	0.0291	0.0634	0.072	Max (too few samples or detects)
PRI 5	Upland	Solids	VOCs	Bromoform	75-25-2	mg/kg	13	4	31%	0.0194	0.000265	0.00019	0.24	0.0663	0.0052	0.0996	0.212	0.195	95 UCL
PRI 5	Upland	Solids	VOCs	Chloroform	67-66-3	mg/kg	13	1	8%	0.00596	0.00016	0.000125	0.075	0.0207	0.00069	0.0305	0.0661	0.075	Max (too few samples or detects)
PRI 5	Upland	Solids	VOCs	Dibromochloromethane	124-48-1	mg/kg	13	1	8%	0.0125	0.00013	0.0001	0.16	0.0443	0.000789	0.0645	0.141	0.16	Max (too few samples or detects)
PRI 5	Upland	Solids	Cyanide	Total cyanide	74-90-8	mg/kg	14	3	21%	0.214	0.115	0.008	1.3	0.329	0.368	0.76	1.19	0.356	95 UCL
PRI 6	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	11	11	100%	8970	7400	58.7	39000	10800	11500	25200	36300	20315	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	11	11	100%	47700	35300	198	237000	66600	62800	150000	220000	138035	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	11	11	100%	435000	314000	1590	2220000	626000	584000	1400000	2050000	1315235	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	11	11	100%	2860	2600	24	10000	2770	4600	7300	9460	4373	95 UCL
PRI 6	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	11	11	100%	2.15	2.08	0.019	7.47	2.12	3.6	5.54	7.08	3.31	95 UCL
PRI 6	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	11	11	100%	1.46	1.4	0.38	2.5	0.715	2.3	2.4	2.48	1.846	95 UCL
PRI 6	Lakebed	Solids	Metals	Barium	7440-39-3	mg/kg	11	11	100%	493	530	176	840	230	740	790	830	619.2	95 UCL
PRI 6	Lakebed	Solids	Metals	Mercury	7439-97-6	mg/kg	11	10	91%	0.0228	0.019	0.0055	0.052	0.012	0.032	0.042	0.05	0.0295	95 UCL
PRI 6	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	11	11	100%	11.5	12	3.8	16	3.23	15	15.5	15.9	13.29	95 UCL
PRI 6	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	11	8	73%	0.214	0.14	0.0435	0.61	0.176	0.46	0.535	0.595	0.317	95 UCL
PRI 6	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	11	10	91%	43	31	0.155	220	62.2	58	139	204	130.8	95 UCL
PRI 6	Lakebed	Solids	SVOCs	Pentachlorobenzene	608-93-5	mg/kg	8	1	12%	1.28	1.02	0.75	3.5	0.907	1.85	2.68	3.34	3.5	Max (too few samples or detects)
PRI 6	Lakebed	Solids	SVOCs	Phenol	108-95-2	mg/kg	9	3	33%	9.38	7.5	0.6	22	6.32	15.6	18.8	21.4	13.66	95 UCL
PRI 6	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	8	5	62%	0.0653	0.0785	0.0145	0.12	0.0419	0.106	0.113	0.119	0.0951	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	5	5	100%	119000	110000	90000	180000	35800	156000	168000	178000	130400	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	5	5	100%	13.7	10	9.7	28	8	21.2	24.6	27.3	18.46	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	5	5	100%	472	430	380	640	102	580	610	634	504.7	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	5	5	100%	980	850	770	1600	351	1320	1460	1570	1079	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	5	5	100%	5.52	5.6	4.8	6.4	0.676	6.2	6.3	6.38	5.718	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	5	5	100%	1.84	1.8	1.8	2	0.0894	1.92	1.96	1.99	1.916	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	5	5	100%	378	310	300	640	147	520	580	628	466.7	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	5	5	100%	3.89	6.11	0.22	6.62	3.34	6.48	6.55	6.61	4.766	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	5	5	100%	44.2	41	39	54	6.3	51.2	52.6	53.7	45.61	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	5	5	100%	184	170	160	230	27.9	214	222	228	191.5	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	5	5	100%	1180000	1100000	1000000	1400000	164000	1360000	1380000	1400000	1226699	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	5	5	100%	85.4	81	69	120	20.1	105	113	119	90.81	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	5	5	100%	4840	5000	4400	5100	288	5060	5080	5100	4920	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	5	5	100%	0.898	0.87	0.8	1.1	0.116	1.01	1.05	1.09	0.94	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	5	5	100%	256	230	210	360	59.8	316	338	356	275.9	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	5	5	100%	274	250	240	360	50.8	328	344	357	285.5	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	5	5	100%	6.2	5.6	5.1	7.8	1.22	7.56	7.68	7.78	6.733	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Thallium	7440-28-0	µg/L	5	4	80%	2.08	2.3	1.5	2.5	0.449	2.46	2.48	2.5	2.288	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	5	5	100%	1520	1400	1300	2000	277	1800	1900	1980	1594	95 UCL
PRI 6	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	5	5	100%	552	520	440	760	123	676	718	752	600.4	95 UCL
PRI 6	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	5	5	100%	0.013	0.007	0.00355	0.028	0.0113	0.0257	0.0268	0.0278	0.55599	Avian TEQ = 95 UCL, HCB = 95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 6	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	5	5	100%	0.0661	0.0295	0.0221	0.145	0.0557	0.129	0.137	0.143	5.47809	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	5	5	100%	0.597	0.281	0.202	1.32	0.5	1.16	1.24	1.3	54.69909	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	5	5	100%	0.00449	0.0029	0.00045	0.0099	0.00418	0.0091	0.0095	0.00982	0.00579	95 UCL
PRI 6	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	5	5	100%	5.14	3.3	2	14.8	5.44	10.3	12.5	14.3	9.765	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Aluminum	7429-90-5	µg/L	5	5	100%	121000	99000	90000	210000	50200	170000	190000	206000	162290	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	5	5	100%	14.1	11	9.6	28	7.81	21.6	24.8	27.4	18.62	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	5	5	100%	476	440	400	650	99.6	574	612	642	508	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	5	5	100%	1290	830	800	2800	860	2160	2480	2740	1825	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Beryllium	7440-41-7	µg/L	5	3	60%	4.97	4.6	3.15	8.2	2.04	7.12	7.66	8.09	5.969	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Cadmium	7440-43-9	µg/L	5	5	100%	1.86	1.8	1.7	2.1	0.152	2.02	2.06	2.09	1.988	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Chromium	7440-47-3	µg/L	5	5	100%	390	340	300	640	141	524	582	628	455.3	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	5	5	100%	46.6	45	40	58	6.88	53.6	55.8	57.6	48.42	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	5	5	100%	192	190	170	230	22.8	214	222	228	198.5	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	5	5	100%	1180000	1100000	1100000	1400000	130000	1320000	1360000	1390000	1237135	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	5	5	100%	89.2	85	69	120	19.3	109	115	119	95.3	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	5	5	100%	4900	5000	4400	5300	354	5220	5260	5290	4992	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Mercury	7439-97-6	µg/L	5	5	100%	1.4	0.88	0.85	3.5	1.17	2.46	2.98	3.4	2.627	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	5	5	100%	260	240	220	360	57	316	338	356	279.3	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	5	5	100%	280	270	240	360	46.4	324	342	356	292	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Selenium	7782-49-2	µg/L	5	5	100%	7.84	7.8	7.2	8.4	0.477	8.32	8.36	8.39	8.09	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Thallium	7440-28-0	µg/L	5	5	100%	2.6	2.7	2.2	2.8	0.255	2.8	2.8	2.8	2.73	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Vanadium	7440-62-2	µg/L	5	5	100%	1560	1500	1400	2000	251	1800	1900	1980	1637	95 UCL
PRI 6	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	5	5	100%	566	510	480	810	137	694	752	798	616.8	95 UCL
PRI 6	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	5	5	100%	59	28	20	130	49.4	115	122	128	5469	95 UCL
PRI 6	Lakebed	Water, Total	SVOCs	Pentachlorophenol	87-86-5	µg/L	5	1	20%	13.8	10	10	29	8.5	21.4	25.2	28.2	29	Max (too few samples or detects)
PRI 6	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	5	5	100%	25.2	18	15	48	13.7	40	44	47.2	33.34	95 UCL
PRI 6	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	5	1	20%	0.56	0.4	0.4	1.2	0.358	0.88	1.04	1.17	1.2	Max (too few samples or detects)
PRI 6	Lakebed	Water, Total	VOCs	Carbon tetrachloride	56-23-5	µg/L	5	1	20%	0.54	0.375	0.375	1.2	0.369	0.87	1.03	1.17	0.941	95 UCL
PRI 6	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	5	5	100%	2.16	2.2	1.5	2.7	0.513	2.66	2.68	2.7	2.243	95 UCL
PRI 6	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	5	3	60%	17.1	8.4	2.5	61	24.8	41	51	59	29.22	95 UCL
PRI 6	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	5	5	100%	37200000	42000000	8400	61000000	22400000	53800000	57400000	60300000	45661378	95 UCL
PRI 6	Lakebed	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	5	5	100%	0	0	0	0	0	0	0	0	0	Max (too few samples or detects)
PRI 6	Lakebed	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	5	5	100%	3400	3400	3400	3400	0	3400	3400	3400	3554	95 UCL
PRI 6	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	10	10	100%	136	65.2	0.97	559	179	341	450	537	434.9	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	10	10	100%	319	180	2.05	932	357	912	922	930	748.1	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	10	10	100%	2150	902	12.8	9030	2890	4880	6960	8620	3880.1	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 6	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	10	10	100%	71.6	16.5	0.48	300	102	210	255	291	249.8	95 UCL
PRI 6	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	10	10	100%	0.0878	0.0249	0.00041	0.35	0.137	0.341	0.346	0.349	0.319	95 UCL
PRI 6	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	10	9	90%	0.366	0.315	0.11	0.92	0.229	0.542	0.731	0.882	0.497	95 UCL
PRI 6	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	10	10	100%	327	335	210	390	59.7	390	390	390	361.8	95 UCL
PRI 6	Upland	Solids	Metals	Mercury	7439-97-6	mg/kg	10	6	60%	0.0549	0.016	0.0041	0.22	0.0876	0.22	0.22	0.22	0.18	95 UCL
PRI 6	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	10	10	100%	6.33	1.45	0.063	27	10.7	26.1	26.6	26.9	39.92	95 UCL
PRI 6	Upland	Solids	Metals	Selenium	7782-49-2	mg/kg	10	9	90%	0.378	0.225	0.055	1.7	0.473	0.512	1.11	1.58	0.622	95 UCL
PRI 6	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	10	6	60%	0.204	0.0775	0.0012	0.9	0.286	0.441	0.67	0.854	0.348	95 UCL
PRI 6	Upland	Solids	VOCs	Acetone	67-64-1	mg/kg	7	2	29%	0.00831	0.0056	0.00075	0.0255	0.00953	0.0204	0.0229	0.025	0.00827	95 UCL
PRI 7	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	23	23	100%	3600	599	1.82	40700	9360	4450	21100	36800	15809	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 7	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	23	23	100%	9860	770	3.03	119000	27500	10700	61400	108000	45914	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 7	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	23	23	100%	72500	2570	15.2	902000	209000	83900	466000	815000	346964	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 7	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	23	23	100%	1650	350	0.79	19000	4250	2190	8710	16900	7184	95 UCL
PRI 7	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	23	23	100%	0.387	0.106	0.0011	2.38	0.601	0.88	1.77	2.27	0.716	95 UCL
PRI 7	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	23	22	96%	0.553	0.42	0.048	1.9	0.421	0.958	1.18	1.75	0.769	95 UCL
PRI 7	Lakebed	Solids	Metals	Arsenic	7440-38-2	mg/kg	23	23	100%	16.5	14	5	32.7	7.52	28	29	31.9	19.19	95 UCL
PRI 7	Lakebed	Solids	Metals	Cadmium	7440-43-9	mg/kg	23	20	87%	0.162	0.17	0.0265	0.425	0.0996	0.24	0.357	0.413	0.182	95 UCL
PRI 7	Lakebed	Solids	Metals	Chromium	7440-47-3	mg/kg	23	23	100%	22.8	17	1.6	64	17.2	42.4	61.9	64	28.95	95 UCL
PRI 7	Lakebed	Solids	Metals	Iron	7439-89-6	mg/kg	23	23	100%	17000	13000	1300	48800	12500	31000	38200	46600	21452	95 UCL
PRI 7	Lakebed	Solids	Metals	Manganese	7439-96-5	mg/kg	23	23	100%	205	190	57	520	132	389	390	491	252.6	95 UCL
PRI 7	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	23	23	100%	7.02	7.1	0.33	21.2	4.8	12	12.4	19.3	8.742	95 UCL
PRI 7	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	23	23	100%	0.399	0.31	0.13	2.3	0.441	0.436	0.809	1.98	0.8	95 UCL
PRI 7	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	23	23	100%	23.1	23	4.3	49	12.3	38.7	47.1	48.8	27.49	95 UCL
PRI 7	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	23	18	78%	6.96	0.21	0.00135	87	20.2	8.18	45	78.6	33.45	95 UCL
PRI 7	Lakebed	Solids	SVOCs	Pentachlorobenzene	608-93-5	mg/kg	20	1	5%	0.422	0.095	0.008	5.6	1.23	0.464	0.75	4.63	5.6	Max (too few samples or detects)
PRI 7	Lakebed	Solids	VOCs	1,1-Dichloroethane	75-34-3	mg/kg	20	1	5%	0.000284	0.000248	0.00018	0.00092	0.000159	0.000339	0.000445	0.000825	0.00092	Max (too few samples or detects)
PRI 7	Lakebed	Solids	VOCs	1,2,4-Trichlorobenzene	120-82-1	mg/kg	20	9	45%	0.0157	0.001	0.0005	0.15	0.0387	0.0325	0.103	0.14	0.0542	95 UCL
PRI 7	Lakebed	Solids	VOCs	2-Butanone	78-93-3	mg/kg	19	15	79%	0.028	0.027	0.0021	0.085	0.0226	0.0498	0.067	0.0814	0.037	95 UCL
PRI 7	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	20	19	95%	0.108	0.108	0.0012	0.37	0.0947	0.205	0.256	0.347	0.145	95 UCL
PRI 7	Lakebed	Solids	VOCs	Carbon disulfide	75-15-0	mg/kg	20	14	70%	0.0291	0.00385	0.00034	0.17	0.0504	0.121	0.132	0.162	0.0678	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	6	4	67%	33600	145	25	200000	81500	101000	150000	190000	57379	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	6	6	100%	2.2	1.9	0.71	5	1.57	3.9	4.45	4.89	3.273	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	6	6	100%	190	48.5	27	660	258	495	578	644	465.5	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	6	6	100%	1090	425	120	2900	1260	2700	2800	2880	1789	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	6	5	83%	3.09	0.57	0.2	12	4.74	8.5	10.2	11.7	3.868	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	6	1	17%	6.67	0.5	0.5	25	10.3	19	22	24.4	4.705	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	6	2	33%	185	1	1	1100	448	553	826	1050	338.2	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	6	1	17%	0.46	0.398	0.25	0.83	0.221	0.714	0.772	0.818	0.83	Max (too few samples or detects)

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 7	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	6	6	100%	58.7	73.5	4.3	89	34.7	87	88	88.8	59.64	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	6	4	67%	62.1	7.9	1	300	118	175	238	288	106.2	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	6	6	100%	282000	128000	2600	1200000	454000	685000	942000	1150000	743402	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	6	1	17%	105	0.6	0.6	600	243	315	458	572	178	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	6	6	100%	26000	12000	12000	86000	29700	54000	70000	82800	41572	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	6	2	33%	0.967	0.05	0.05	4.3	1.71	2.8	3.55	4.15	1.305	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	6	6	100%	48.4	18.5	4.6	170	64.9	122	146	165	119.7	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	6	6	100%	165	180	5.9	340	124	290	315	335	193.8	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	6	3	50%	7.52	3.05	1	25	9.52	18.5	21.8	24.4	5.511	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Thallium	7440-28-0	µg/L	6	1	17%	6.17	0.5	0.5	25	9.98	17.5	21.2	24.2	25	Max (too few samples or detects)
PRI 7	Lakebed	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	6	1	17%	377	3	3	2100	846	1120	1610	2000	700.5	95 UCL
PRI 7	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	6	5	83%	233	36	4	1200	475	655	928	1150	414.7	95 UCL
PRI 7	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	6	6	100%	0.000203	8.52E-06	0.0000044	0.000835	0.000339	0.000595	0.000715	0.000811	0.0005171	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 7	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	6	6	100%	0.000328	0.0000384	0.0000341	0.00115	0.000476	0.00091	0.00103	0.00113	0.0008321	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 7	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	6	6	100%	0.00158	0.000345	0.00032	0.0043	0.00193	0.00406	0.00418	0.00428	0.0039821	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 7	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	6	6	100%	0.000114	2.45E-06	5.6E-07	0.00051	0.000205	0.00034	0.000425	0.000493	0.00030732	95 UCL
PRI 7	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	6	6	100%	0.046	0.00434	0.0025	0.232	0.0917	0.13	0.181	0.222	0.251	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Aluminum	7429-90-5	µg/L	6	5	83%	11200	255	91	66000	26800	33300	49700	62700	83139	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	6	6	100%	2.06	1.75	0.41	4.8	1.66	3.95	4.38	4.72	2.888	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	6	6	100%	146	50	30	420	167	355	388	414	355.2	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	6	6	100%	737	450	130	2000	728	1600	1800	1960	1149	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Beryllium	7440-41-7	µg/L	6	4	67%	1.04	0.595	0.25	2.5	0.97	2.25	2.38	2.48	1.109	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Cadmium	7440-43-9	µg/L	6	1	17%	1.2	0.875	0.5	3.2	1.05	2.22	2.71	3.1	3.2	Max (too few samples or detects)
PRI 7	Lakebed	Water, Total	Metals	Chromium	7440-47-3	µg/L	6	1	17%	80.1	1.75	1	450	181	238	344	429	1831	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	6	6	100%	59.9	72	4.4	100	35.9	91	95.5	99.1	63.28	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	6	1	17%	38.4	1.75	1	200	79.7	112	156	191	148.7	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	6	6	100%	209000	130000	950	730000	263000	455000	592000	703000	293112	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	6	1	17%	24.1	1.05	0.6	140	56.8	70.8	105	133	349.3	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	6	6	100%	19000	12500	11000	52000	16200	33000	42500	50100	26003	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Mercury	7439-97-6	µg/L	6	2	33%	0.335	0.05	0.05	1.2	0.479	0.905	1.05	1.17	0.553	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	6	6	100%	42.1	19.5	6.2	160	59.1	100	130	154	159.7	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	6	6	100%	164	165	5.4	310	123	300	305	309	183.1	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Selenium	7782-49-2	µg/L	6	3	50%	3.95	2.3	1	11	3.93	8.55	9.78	10.8	5.345	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Vanadium	7440-62-2	µg/L	6	1	17%	199	5.25	3	1100	443	588	844	1050	831.2	95 UCL
PRI 7	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	6	4	67%	134	47	4	560	215	350	455	539	232.4	95 UCL
PRI 7	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	6	0	0%	0.139	0.0342	0.0315	0.35	0.164	0.35	0.35	0.35	0.35	Max (too few samples or detects)
PRI 7	Lakebed	Water, Total	SVOCs	Pentachlorophenol	87-86-5	µg/L	6	2	33%	7.29	0.975	0.9	27	10.8	20	23.5	26.3	19.02	95 UCL
PRI 7	Lakebed	Water, Total	PAHs	Naphthalene	91-20-3	µg/L	6	2	33%	0.421	0.175	0.007	1.5	0.58	1.08	1.29	1.46	0.442	95 UCL
PRI 7	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	6	3	50%	14.3	1.25	0.05	64	25.5	41.5	52.8	61.8	19.59	95 UCL
PRI 7	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	6	6	100%	4.14	1.23	0.51	17	6.43	10.6	13.8	16.4	21.84	95 UCL
PRI 7	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	6	5	83%	17.5	7.1	0.12	46	19.7	42.5	44.2	45.7	40.55	95 UCL
PRI 7	Lakebed	Water, Total	VOCs	m,p-Xylenes	179601-23-1	µg/L	6	1	17%	0.547	0.315	0.09	1.8	0.655	1.24	1.52	1.74	1.8	Max (too few samples or detects)
PRI 7	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	6	6	100%	17.4	17	8.1	30	8.41	26	28	29.6	17.55	95 UCL
PRI 7	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	6	6	100%	114000000	44000000	26000000	340000000	129000000	2.7e+08	3.05e+08	3.33e+08	188000000	95 UCL
PRI 7	Lakebed	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	5	5	100%	48	0	0	170	74.6	130	150	166	119.2	95 UCL
PRI 7	Lakebed	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	6	1	17%	1890	110	110	5900	2770	5450	5680	5860	2116	95 UCL
CWP	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	26	26	100%	56800	5700	14.5	1150000	224000	49500	96000	890000	408311	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	26	26	100%	302000	18800	59.5	6010000	1170000	288000	578000	4670000	2507111	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	26	26	100%	2750000	158000	510	54600000	10700000	2670000	5390000	42500000	23495111	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	26	26	100%	20200	2450	5.2	430000	83800	13500	26000	330000	122877	95 UCL
CWP	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	26	26	100%	10.6	1.76	0.00547	172	34	17.4	34.1	138	52.21	95 UCL
CWP	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	26	25	96%	1.55	0.915	0.14	9.3	1.88	2.9	4.05	8.05	2.507	95 UCL
CWP	Lakebed	Solids	Metals	Arsenic	7440-38-2	mg/kg	26	26	100%	18	6.8	2.6	210	39.9	24.5	30.3	165	52.12	95 UCL
CWP	Lakebed	Solids	Metals	Barium	7440-39-3	mg/kg	26	26	100%	546	420	176	1900	424	1070	1450	1800	697.7	95 UCL
CWP	Lakebed	Solids	Metals	Chromium	7440-47-3	mg/kg	26	26	100%	13.5	10.5	3.3	53	9.99	23	27.2	46.8	16.87	95 UCL
CWP	Lakebed	Solids	Metals	Mercury	7439-97-6	mg/kg	25	24	96%	0.0274	0.023	0.0055	0.11	0.0197	0.0384	0.0496	0.0961	0.0364	95 UCL
CWP	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	26	26	100%	13.9	11	0.17	110	20.2	15.5	19	87.5	31.17	95 UCL
CWP	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	26	19	73%	0.269	0.215	0.0435	0.8	0.206	0.56	0.707	0.785	0.318	95 UCL
CWP	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	26	26	100%	37.5	15	6.7	440	83.3	49	60.7	346	108.7	95 UCL
CWP	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	26	23	88%	272	15.5	0.05	5400	1050	265	535	4200	2332	95 UCL
CWP	Lakebed	Solids	SVOCs	Hexachlorobutadiene	87-68-3	mg/kg	23	1	4%	6.66	0.285	0.0095	125	26.2	0.562	20.8	103	125	Max (too few samples or detects)
CWP	Lakebed	Solids	SVOCs	Pentachlorobenzene	608-93-5	mg/kg	20	5	25%	12.1	1	0.0335	210	46.6	4.52	21	172	87.77	95 UCL
CWP	Lakebed	Solids	SVOCs	Phenol	108-95-2	mg/kg	23	9	39%	38.5	8	0.047	210	61.7	121	193	208	74.61	95 UCL
CWP	Lakebed	Solids	VOCs	1,1-Dichloroethane	75-34-3	mg/kg	20	2	10%	0.000972	0.000328	0.000185	0.013	0.00283	0.000512	0.00128	0.0107	0.00646	95 UCL
CWP	Lakebed	Solids	VOCs	1,2,4-Trichlorobenzene	120-82-1	mg/kg	20	1	5%	0.00176	0.00085	0.00048	0.018	0.00384	0.00141	0.00318	0.015	0.018	Max (too few samples or detects)
CWP	Lakebed	Solids	VOCs	2-Butanone	78-93-3	mg/kg	20	17	85%	0.0172	0.015	0.0013	0.05	0.0133	0.0286	0.0434	0.0487	0.0225	95 UCL
CWP	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	20	13	65%	0.0665	0.0655	0.00135	0.18	0.0518	0.12	0.123	0.169	0.0854	95 UCL
CWP	Lakebed	Solids	VOCs	Bromodichloromethane	75-27-4	mg/kg	20	14	70%	0.194	0.021	0.0005	3.4	0.755	0.0785	0.275	2.77	0.939	95 UCL
CWP	Lakebed	Solids	VOCs	Bromoform	75-25-2	mg/kg	20	19	95%	0.736	0.11	0.0004	12	2.65	0.394	1.09	9.82	3.327	95 UCL
CWP	Lakebed	Solids	VOCs	Carbon disulfide	75-15-0	mg/kg	20	13	65%	0.00402	0.00172	0.000315	0.024	0.00563	0.00884	0.0117	0.0215	0.0103	95 UCL
CWP	Lakebed	Solids	VOCs	Chloroform	67-66-3	mg/kg	20	9	45%	0.0535	0.00402	0.00026	0.83	0.184	0.0377	0.126	0.689	0.238	95 UCL
CWP	Lakebed	Solids	VOCs	Dibromochloromethane	124-48-1	mg/kg	20	19	95%	0.372	0.0555	0.00021	6.1	1.35	0.213	0.533	4.99	1.69	95 UCL
CWP	Lakebed	Solids	VOCs	Tetrachloroethene	127-18-4	mg/kg	20	3	15%	0.0248	0.000725	0.00039	0.48	0.107	0.00137	0.028	0.39	0.0744	95 UCL
CWP	Lakebed	Solids	Cyanide	Total cyanide	74-90-8	mg/kg	23	3	13%	0.285	0.185	0.115	1.5	0.369	0.235	1.28	1.48	0.455	95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
CWP	Lakebed	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	11	11	100%	86100	90000	870	180000	51200	120000	150000	174000	91428	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	11	11	100%	14.4	11	2.3	33	9.22	28	30.5	32.5	21.72	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	11	11	100%	379	380	28	640	148	490	565	625	396.4	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	11	11	100%	812	790	170	1600	335	950	1280	1540	823.2	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	11	10	91%	4.18	4.8	0.33	6.4	2	5.9	6.15	6.35	4.329	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	11	9	82%	1.71	1.8	0.5	2.5	0.513	2.2	2.35	2.47	1.868	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	11	10	91%	300	300	5	640	145	340	490	610	344.1	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	11	11	100%	4.64	6.11	0.18	14.2	4.37	7.74	11	13.6	6.24	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	11	11	100%	34.6	39	8.1	54	12.7	47	50.5	53.3	35.56	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	11	10	91%	147	160	5	230	62.3	190	210	226	152.2	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	11	11	100%	986000	1000000	4700	1400000	373000	1300000	1350000	1390000	982117	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	11	10	91%	63.9	69	3	120	33.8	83	102	116	68.15	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	11	11	100%	4890	4400	530	15000	3600	5100	10000	14000	5514	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	11	10	91%	0.805	0.85	0.05	1.6	0.414	1.1	1.35	1.55	0.882	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	11	11	100%	210	210	20	360	82.9	270	315	351	216.2	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	11	11	100%	236	240	71	360	69.2	280	320	352	235.9	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	11	10	91%	5.57	5.6	2.5	7.8	1.38	7.2	7.5	7.74	5.988	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Thallium	7440-28-0	µg/L	11	7	64%	1.73	1.7	0.5	2.5	0.716	2.5	2.5	2.5	1.887	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	11	10	91%	1290	1400	15	2000	493	1700	1850	1970	1301	95 UCL
CWP	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	11	11	100%	431	440	76	760	189	560	660	740	480.1	95 UCL
CWP	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	11	11	100%	0.0474	0.0041	0.000053	0.437	0.13	0.028	0.232	0.396	0.27007	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	11	11	100%	0.147	0.0288	0.000341	1.22	0.359	0.145	0.682	1.11	0.7657	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	11	11	100%	1.14	0.254	0.00322	9.05	2.65	1.32	5.18	8.28	5.722	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	11	11	100%	0.0237	0.0018	0.00001	0.23	0.0685	0.0099	0.12	0.208	0.141	95 UCL
CWP	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	11	11	100%	8.68	3.3	0.061	50	14.6	14.8	32.4	46.5	18.07	95 UCL
CWP	Lakebed	Water, Total	Metals	Aluminum	7429-90-5	µg/L	11	10	91%	92800	97000	125	210000	57400	130000	170000	202000	102130	95 UCL
CWP	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	11	11	100%	16	11	2	37	11.5	34	35.5	36.7	25.02	95 UCL
CWP	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	11	11	100%	393	420	28	650	148	460	555	631	422.9	95 UCL
CWP	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	11	11	100%	967	820	200	2800	658	1200	2000	2640	1122	95 UCL
CWP	Lakebed	Water, Total	Metals	Beryllium	7440-41-7	µg/L	11	8	73%	3.9	4	0.47	8.2	2.18	5.5	6.85	7.93	4.405	95 UCL
CWP	Lakebed	Water, Total	Metals	Cadmium	7440-43-9	µg/L	11	9	82%	1.74	1.8	0.5	2.5	0.505	2.1	2.3	2.46	1.892	95 UCL
CWP	Lakebed	Water, Total	Metals	Chromium	7440-47-3	µg/L	11	10	91%	323	310	5	640	150	450	545	621	373.9	95 UCL
CWP	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	11	11	100%	35.9	40	8.5	58	13.7	47	52.5	56.9	38.68	95 UCL
CWP	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	11	11	100%	153	170	11	230	61.6	190	210	226	164.7	95 UCL
CWP	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	11	11	100%	1000000	1100000	5700	1400000	363000	1300000	1350000	1390000	1057992	95 UCL
CWP	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	11	10	91%	65.7	69	3	120	34.8	93	106	117	74.17	95 UCL
CWP	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	11	11	100%	4900	4400	540	15000	3610	5300	10200	14000	5689	95 UCL
CWP	Lakebed	Water, Total	Metals	Mercury	7439-97-6	µg/L	11	10	91%	0.99	0.87	0.05	3.5	0.895	1.1	2.3	3.26	1.632	95 UCL
CWP	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	11	11	100%	224	230	19	360	86.2	300	330	354	235.5	95 UCL
CWP	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	11	11	100%	243	260	74	360	68.3	270	315	351	253.3	95 UCL
CWP	Lakebed	Water, Total	Metals	Selenium	7782-49-2	µg/L	11	10	91%	6.43	7.1	3.1	8.4	1.7	8.2	8.3	8.38	6.777	95 UCL
CWP	Lakebed	Water, Total	Metals	Thallium	7440-28-0	µg/L	11	9	82%	2.24	2.5	0.5	2.8	0.67	2.8	2.8	2.8	2.46	95 UCL
CWP	Lakebed	Water, Total	Metals	Vanadium	7440-62-2	µg/L	11	10	91%	1330	1400	15	2000	504	1800	1900	1980	1404	95 UCL
CWP	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	11	11	100%	459	510	77	810	199	580	695	787	514.9	95 UCL
CWP	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	11	10	91%	111	25	0.32	870	255	130	500	796	550.7	95 UCL
CWP	Lakebed	Water, Total	SVOCs	Hexachlorobutadiene	87-68-3	µg/L	11	1	9%	0.753	0.4	0.036	3.2	0.933	1.85	2.53	3.07	3.2	Max (too few samples or detects)
CWP	Lakebed	Water, Total	SVOCs	Pentachlorobenzene	608-93-5	µg/L	11	1	9%	7.19	2.3	0.205	50	14.4	10.5	30.2	46.1	50	Max (too few samples or detects)
CWP	Lakebed	Water, Total	SVOCs	Pentachlorophenol	87-86-5	µg/L	11	3	27%	24.6	10	0.9	140	39.3	31	85.5	129	28.75	95 UCL
CWP	Lakebed	Water, Total	PAHs	Naphthalene	91-20-3	µg/L	11	1	9%	0.0694	0.025	0.024	0.29	0.0861	0.15	0.22	0.276	0.375	Max (too few samples or detects)
CWP	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	11	11	100%	40.6	19	9.8	120	38.9	110	115	119	74.1	95 UCL
CWP	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	11	3	27%	0.508	0.4	0.4	1.2	0.244	0.65	0.925	1.14	0.614	95 UCL
CWP	Lakebed	Water, Total	VOCs	Carbon tetrachloride	56-23-5	µg/L	11	3	27%	2.08	0.375	0.075	9.6	3.68	9.4	9.5	9.58	3.888	95 UCL
CWP	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	11	11	100%	4.96	2.2	1	26	7.24	7.8	16.9	24.2	9.619	95 UCL
CWP	Lakebed	Water, Total	VOCs	Methyl bromide	74-83-9	µg/L	11	2	18%	1.54	0.75	0.145	8.6	2.39	2.2	5.4	7.96	3.659	95 UCL
CWP	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	11	7	64%	12.7	8.4	2.5	61	16.8	17	39	56.6	32.67	95 UCL
CWP	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	11	11	100%	40500000	42000000	8400	61000000	15100000	5.2e+07	56500000	60100000	43584764	95 UCL
CWP	Lakebed	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	11	11	100%	17.3	0	0	190	57.3	0	95	171	92.56	95 UCL
CWP	Lakebed	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	11	10	91%	3510	3400	220	6700	1480	4400	5550	6470	4310	95 UCL
CWP	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	30	30	100%	610	26.5	0.585	14600	2660	444	1030	10800	3507.2	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	30	30	100%	1440	72.5	1.62	33500	6110	912	2730	25000	7064	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	30	30	100%	9680	351	12	222000	40600	5860	21700	167000	42632	Avian TEQ = 95 UCL, HCB = 95 UCL
CWP	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	30	30	100%	324	10	0.19	7900	1440	246	492	5800	1963	95 UCL
CWP	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	30	30	100%	0.258	0.016	0.00019	5.7	1.04	0.341	0.417	4.18	1.439	95 UCL
CWP	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	30	24	80%	0.284	0.22	0.043	0.99	0.237	0.564	0.776	0.97	0.343	95 UCL
CWP	Upland	Solids	Metals	Arsenic	7440-38-2	mg/kg	30	30	100%	6.96	5.05	3.6	18	3.78	13.2	15.5	17.4	8.167	95 UCL
CWP	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	30	30	100%	277	280	120	390	81.8	384	390	390	302.2	95 UCL
CWP	Upland	Solids	Metals	Chromium	7440-47-3	mg/kg	30	30	100%	9.81	8.5	2	37	7.39	16	19.3	32.7	12.1	95 UCL
CWP	Upland	Solids	Metals	Mercury	7439-97-6	mg/kg	28	15	54%	0.0284	0.0125	0.0039	0.22	0.0561	0.0451	0.17	0.22	0.0764	95 UCL
CWP	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	30	29	97%	4.1	0.82	0.0485	32	8.48	10.9	26.6	30.6	10.85	95 UCL
CWP	Upland	Solids	Metals	Selenium	7782-49-2	mg/kg	30	20	67%	0.306	0.2	0.043	1.9	0.435	0.536	1.28	1.84	0.658	95 UCL
CWP	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	30	30	100%	16.9	14	4.5	49	11.2	29.7	38.7	46.7	20.98	95 UCL
CWP	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	30	20	67%	0.917	0.0315	0.00115	21	3.84	0.585	2.11	15.8	3.952	95 UCL
CWP	Upland	Solids	VOCs	2-Butanone	78-93-3	mg/kg	20	5	25%	0.00631	0.0018	0.0007	0.037	0.0105	0.0151	0.0342	0.0364	0.0106	95 UCL
CWP	Upland	Solids	VOCs	Acetone	67-64-1	mg/kg	20	6	30%	0.0146	0.00295	0.00065	0.16	0.0354	0.0262	0.0384	0.136	0.0528	95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
CWP	Upland	Solids	VOCs	Bromodichloromethane	75-27-4	mg/kg	20	1	5%	0.00393	0.000328	0.000255	0.072	0.016	0.000468	0.00441	0.0585	0.072	Max (too few samples or detects)
CWP	Upland	Solids	VOCs	Bromoform	75-25-2	mg/kg	20	6	30%	0.0135	0.0003	0.00019	0.24	0.0534	0.0068	0.0253	0.197	0.0991	95 UCL
CWP	Upland	Solids	VOCs	Chloroform	67-66-3	mg/kg	20	2	10%	0.00515	0.000162	0.000125	0.075	0.0171	0.0045	0.0247	0.0649	0.0281	95 UCL
CWP	Upland	Solids	VOCs	Dibromochloromethane	124-48-1	mg/kg	20	1	5%	0.00829	0.000135	0.0001	0.16	0.0357	0.00101	0.0099	0.13	0.16	Max (too few samples or detects)
CWP	Upland	Solids	Cyanide	Total cyanide	74-90-8	mg/kg	22	3	14%	0.178	0.115	0.008	1.3	0.264	0.13	0.453	1.13	0.242	95 UCL
PRI 8	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	5	5	100%	54.8	23.4	21.1	126	47	108	117	124	106.28	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 8	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	5	5	100%	89.3	35.5	22.4	270	105	200	235	263	250.28	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 8	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	5	5	100%	434	157	35.5	1710	718	1120	1410	1650	1690.28	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 8	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	5	5	100%	23.6	13	12	41	15.4	40.6	40.8	41	76.36	95 UCL
PRI 8	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	5	5	100%	0.0173	0.0036	0.000746	0.0438	0.0208	0.0406	0.0422	0.0435	0.0371	95 UCL
PRI 8	Lakebed	Solids	Metals	Aluminum	7429-90-5	mg/kg	5	5	100%	13800	13000	7000	20000	5650	19600	19800	20000	19164	95 UCL
PRI 8	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	5	5	100%	0.852	0.73	0.5	1.3	0.336	1.22	1.26	1.29	1.172	95 UCL
PRI 8	Lakebed	Solids	Metals	Barium	7440-39-3	mg/kg	5	5	100%	302	270	210	420	97.3	408	414	419	394.8	95 UCL
PRI 8	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	5	5	100%	43	43	27	64	16	59.6	61.8	63.6	58.24	95 UCL
PRI 8	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	5	1	20%	0.0383	0.0135	0.00145	0.16	0.0683	0.102	0.131	0.154	0.16	Max (too few samples or detects)
PRI 8	Lakebed	Solids	VOCs	Chloroform	67-66-3	mg/kg	5	1	20%	0.000367	0.00018	0.000165	0.0011	0.00041	0.000744	0.000922	0.00106	0.0011	Max (too few samples or detects)
PRI 8	Lakebed	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	5	5	100%	18000	23000	3200	24000	8940	24000	24000	24000	21581	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	5	5	100%	2.55	2.8	0.75	4	1.33	3.8	3.9	3.98	3.095	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	5	5	100%	84.2	96	65	98	17.1	97.2	97.6	97.9	90.45	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	5	5	100%	434	340	260	860	242	664	762	840	656.5	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	5	5	100%	1.63	2	0.37	2.3	0.838	2.3	2.3	2.3	1.973	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	5	4	80%	2.09	2.2	1.25	2.5	0.485	2.42	2.46	2.49	2.55	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	5	4	80%	63.5	90	2.5	92	40.2	91.6	91.8	92	7741	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	5	4	80%	0.511	0.531	0.388	0.615	0.0826	0.582	0.598	0.612	0.514	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	5	5	100%	46.8	34	31	100	29.8	74.4	87.2	97.4	72.73	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	5	5	100%	39.2	53	5	56	22.9	56	56	56	48.48	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	5	5	100%	170000	210000	88000	220000	65000	220000	220000	220000	193299	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	5	4	80%	22.5	31	1.5	32	13.3	31.6	31.8	32	697.8	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	5	5	100%	7220	5200	4500	16000	4940	11900	14000	15600	11132	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	5	3	60%	0.18	0.21	0.05	0.25	0.0768	0.234	0.242	0.248	0.2	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	5	5	100%	34.8	44	15	48	15.5	47.2	47.6	47.9	40.5	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	5	5	100%	162	140	120	260	55.9	216	238	256	201.9	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	5	5	100%	2.62	2.7	2.2	2.9	0.259	2.82	2.86	2.89	2.845	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	5	4	80%	220	310	7.5	320	141	320	320	320	40191	95 UCL
PRI 8	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	5	5	100%	182	240	60	250	86.7	246	248	250	214.2	95 UCL
PRI 8	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	5	5	100%	0.000135	0.0000945	0.000071	0.000285	0.0000869	0.000225	0.000255	0.000279	0.00017256	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 8	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	5	5	100%	0.000445	0.000401	0.000386	0.0006	0.0000906	0.00054	0.00057	0.000594	0.00048756	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 8	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	5	5	100%	0.00354	0.00354	0.00331	0.00375	0.000159	0.00369	0.00372	0.00374	0.00363756	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 8	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	5	5	100%	0.0000442	0.000035	0.000017	0.00011	0.0000382	8.24e-05	9.62e-05	0.000107	0.000060767	95 UCL
PRI 8	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	5	5	100%	0.101	0.057	0.00895	0.28	0.108	0.216	0.248	0.274	0.147	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Aluminum	7429-90-5	µg/L	5	5	100%	18500	22000	4400	25000	8450	24600	24800	25000	21832	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	5	5	100%	2.5	2.7	1.2	3.8	1.05	3.52	3.66	3.77	2.902	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	5	5	100%	85.2	94	65	97	15.1	97	97	97	90.7	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	5	5	100%	492	350	280	1100	342	816	958	1070	722.7	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Beryllium	7440-41-7	µg/L	5	5	100%	1.56	2	0.38	2.1	0.731	2.06	2.08	2.1	2.017	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Cadmium	7440-43-9	µg/L	5	4	80%	2.09	2.1	1.25	2.6	0.515	2.52	2.56	2.59	2.554	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Chromium	7440-47-3	µg/L	5	4	80%	65.1	88	12.5	92	35.8	91.2	91.6	91.9	7590	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	5	5	100%	54.6	34	31	140	47.8	98	119	136	125.6	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	5	5	100%	40.6	52	15	56	18.8	55.2	55.6	55.9	48.3	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	5	5	100%	174000	210000	88000	220000	57600	216000	218000	220000	200980	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	5	4	80%	22.5	30	1.5	32	13.3	32	32	32	28.21	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	5	5	100%	7800	5000	4500	19000	6280	13700	16400	18500	12380	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Mercury	7439-97-6	µg/L	5	3	60%	0.188	0.22	0.05	0.25	0.0792	0.238	0.244	0.249	0.212	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	5	5	100%	33.2	44	8.2	48	17.7	46.8	47.4	47.9	40.07	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	5	5	100%	176	140	110	350	98.1	266	308	342	242.2	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Selenium	7782-49-2	µg/L	5	4	80%	4.84	3	2.7	12.5	4.29	8.78	10.6	12.1	3.149	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Vanadium	7440-62-2	µg/L	5	4	80%	224	310	37.5	320	128	316	318	320	38820	95 UCL
PRI 8	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	5	5	100%	196	240	120	250	65	246	248	250	219.7	95 UCL
PRI 8	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	5	0	0%	0.344	0.35	0.325	0.35	0.0108	0.35	0.35	0.35	0.35	Max (too few samples or detects)
PRI 8	Lakebed	Water, Total	SVOCs	Pentachlorophenol	87-86-5	µg/L	5	1	20%	13.4	10	10	27	7.6	20.2	23.6	26.3		
PRI 8	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	5	5	100%	29.6	30	2.9	56	19.5	48.4	52.2	55.2	37.47	95 UCL
PRI 8	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	5	2	40%	0.739	0.445	0.36	1.6	0.527	1.32	1.46	1.57	0.953	95 UCL
PRI 8	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	5	5	100%	10.9	9.6	6.8	18	4.27	15.2	16.6	17.7	12.58	95 UCL
PRI 8	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	5	5	100%	12.9	7.8	5.3	38	14.1	26	32	36.8	31.34	95 UCL
PRI 8	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	5	5	100%	35000000	22000000	20000000	89000000	30200000	62600000	75800000	86400000	55807354	95 UCL
PRI 8	Lakebed	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	5	5	100%	82	100	0	120	48.2	116	118	120	127.9	95 UCL
PRI 8	Lakebed	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	5	4	80%	926	1000	220	1400	436	1280	1340	1390	1229	95 UCL
PRI 8	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	22	22	100%	582	24.6	0.69	5200	1190	1450	2080	4550	2633.3	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 8	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	22	22	100%	2130	52	1.86	21400	4840	4300	9150	18900	7424	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 8	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	22	22	100%	17700	378	13.5	183000	41600	35400	80000	162000	55331	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 8	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	22	22	100%	243	12.5	0.33	2000	470	732	826	1750	1240	95 UCL
PRI 8	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	22	22	100%	0.177	0.0175	0.00076	0.836	0.283	0.741	0.819	0.833	0.777	95 UCL
PRI 8	Upland	Solids	Metals	Aluminum	7429-90-5	mg/kg	22	22	100%	12400	13000	4400	17000	3410	16000	17000	17000	13660	95 UCL
PRI 8	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	22	16	73%	0.407	0.33	0.06	1.3	0.269	0.655	0.736	1.18	0.517	95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 8	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	22	22	100%	276	280	43	760	140	340	368	678	406.2	95 UCL
PRI 8	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	22	22	100%	28.7	26	11	69	14.5	44.7	56.4	66.5	34.05	95 UCL
PRI 8	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	22	14	64%	1.72	0.0365	0.00125	18	4.08	3.46	7.87	15.9	5.323	95 UCL
PRI 8	Upland	Solids	SVOCs	Pentachlorophenol	87-86-5	mg/kg	22	3	14%	1.25	0.0332	0.0125	18.5	3.96	1.17	4.05	15.5	0.322	95 UCL
PRI 8	Upland	Solids	VOCs	Acetone	67-64-1	mg/kg	15	6	40%	0.0391	0.0027	0.00105	0.22	0.0758	0.168	0.192	0.214	0.0758	95 UCL
PRI 8	Upland	Solids	VOCs	Chloroform	67-66-3	mg/kg	15	8	53%	0.00407	0.0007	0.00016	0.02	0.00669	0.0147	0.0193	0.0199	0.00725	95 UCL
PRI 9	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	16	16	100%	32	8.03	0.55	128	46.6	108	125	127	82.57	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 9	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	16	16	100%	70.2	29.8	1.79	377	101	182	240	350	197.77	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 9	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	16	16	100%	452	192	13.9	3260	793	736	1470	2900	1349.77	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 9	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	16	16	100%	17.3	3.55	0.14	92	28.5	60	68	87.2	45.74	95 UCL
PRI 9	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	16	16	100%	0.0199	0.00595	0.000114	0.079	0.0276	0.0685	0.073	0.0778	0.0478	95 UCL
PRI 9	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	16	4	25%	0.333	0.158	0.065	2.1	0.502	0.625	1.01	1.88	0.767	95 UCL
PRI 9	Upland	Solids	Metals	Beryllium	7440-41-7	mg/kg	16	15	94%	20.9	0.625	0.059	200	51.4	56.5	95	179	149	95 UCL
PRI 9	Upland	Solids	Metals	Chromium	7440-47-3	mg/kg	16	16	100%	16.2	12.4	4.1	59	13.7	28	40.2	55.2	23.53	95 UCL
PRI 9	Upland	Solids	Metals	Cobalt	7440-48-4	mg/kg	16	16	100%	6.5	4.5	0.46	24	6.63	15	21	23.4	10.88	95 UCL
PRI 9	Upland	Solids	Metals	Manganese	7439-96-5	mg/kg	16	16	100%	908	290	52	7300	1760	1500	3180	6470	2830	95 UCL
PRI 9	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	16	14	88%	3.26	1.35	0.055	15	4.23	8.65	12	14.4	11.57	95 UCL
PRI 9	Upland	Solids	Metals	Nickel	7440-02-0	mg/kg	16	16	100%	86.1	83.5	2.5	196	69.4	185	192	195	116.5	95 UCL
PRI 9	Upland	Solids	Metals	Selenium	7782-49-2	mg/kg	16	3	19%	0.316	0.132	0.065	1.8	0.498	0.875	1.42	1.72	0.583	95 UCL
PRI 9	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	16	16	100%	26.4	27	3.4	45	13.5	41.5	43.5	44.7	32.3	95 UCL
PRI 9	Upland	Solids	Metals	Zinc	7440-66-6	mg/kg	16	15	94%	43.4	22.3	3.5	180	53.7	118	165	177	86.99	95 UCL
PRI 9	Upland	Solids	SVOCs	2,4-Dinitrophenol	51-28-5	mg/kg	16	2	12%	0.176	0.16	0.13	0.34	0.0645	0.258	0.332	0.338	0.29	95 UCL
PRI 9	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	16	9	56%	0.0425	0.0175	0.00135	0.32	0.0778	0.0675	0.136	0.283	0.128	95 UCL
PRI 10	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	14	14	100%	1.59	1.29	0.435	4.73	1.25	2.89	3.63	4.51	2.762	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 10	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	14	14	100%	3.2	2.46	1.56	9.4	2.17	5.44	7.16	8.95	9.692	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 10	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	14	14	100%	19.3	14.5	12.8	78.7	17.2	17.6	39.3	70.8	78.992	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 10	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	14	14	100%	0.761	0.55	0.18	2.5	0.669	1.47	1.85	2.37	1.078	95 UCL
PRI 10	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	14	14	100%	0.000867	0.00036	0.000038	0.0031	0.00105	0.00264	0.00304	0.00309	0.00176	95 UCL
PRI 10	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	14	5	36%	0.289	0.21	0.125	0.56	0.164	0.518	0.54	0.556	0.403	95 UCL
PRI 10	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	14	14	100%	347	330	190	910	172	378	572	842	434.5	95 UCL
PRI 10	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	14	14	100%	23.7	23	17	36	5.34	28	30.8	35	26.24	95 UCL
PRI 10	Upland	Solids	Metals	Zinc	7440-66-6	mg/kg	14	14	100%	44.6	51	17	72	15.8	57.4	62.9	70.2	52.14	95 UCL
PRI 10	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	14	1	7%	0.00179	0.00135	0.00125	0.0077	0.0017	0.0014	0.0036	0.00688	0.0077	Max (too few samples or detects)
PRI 12	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	14	14	100%	45	13.2	3.2	245	68.9	122	180	232	97.95	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 12	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	14	14	100%	64.3	24.5	11.2	288	82.3	167	227	276	130.98	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 12	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	14	14	100%	257	154	23	720	244	666	694	715	461.28	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 12	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	14	14	100%	27.3	8	0.88	150	42.5	75.1	112	142	59.94	95 UCL
PRI 12	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	14	14	100%	0.0244	0.00925	0.00075	0.14	0.0372	0.0493	0.0828	0.129	0.0543	95 UCL
PRI 12	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	14	2	14%	0.801	0.148	0.105	8.7	2.28	0.639	3.59	7.68	6.007	95 UCL
PRI 12	Upland	Solids	SVOCs	2,4-Dinitrophenol	51-28-5	mg/kg	14	2	14%	0.143	0.12	0.115	0.26	0.0489	0.223	0.254	0.259	0.241	95 UCL
PRI 12	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	14	12	86%	0.0214	0.015	0.0013	0.059	0.0192	0.0522	0.0557	0.0583	0.0367	95 UCL
PRI 13	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	20	20	100%	38.6	6.44	1.07	259	65.4	95.4	150	237	77.77	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 13	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	20	20	100%	54.3	8.43	2.15	339	93.3	132	273	326	107.02	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 13	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	20	20	100%	211	32.5	13	1530	409	475	1160	1460	399.52	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 13	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	20	20	100%	21.5	3.15	0.41	150	37.6	53.8	82.6	137	45.48	95 UCL
PRI 13	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	20	20	100%	0.012	0.00195	0.00026	0.0835	0.0212	0.0304	0.0505	0.0769	0.0326	95 UCL
PRI 13	Lakebed	Solids	Metals	Zinc	7440-66-6	mg/kg	20	20	100%	31	26	6.9	80	19.2	58.1	60.1	76	40.66	95 UCL
PRI 13	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	20	7	35%	0.0175	0.00152	0.0012	0.14	0.0359	0.0377	0.0916	0.13	0.0325	95 UCL
PRI 14	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	34	34	100%	169	18.4	1.54	2470	448	445	646	1910	533.8	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 14	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	34	34	100%	541	24.6	2.8	11200	1930	929	1520	8050	2216.8	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 14	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	34	34	100%	4260	80.5	14.3	98500	16900	6020	9570	70100	19046.8	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 14	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	34	34	100%	74.5	9.15	0.71	910	173	246	298	725	204.2	95 UCL
PRI 14	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	34	34	100%	0.0942	0.0098	0.000395	0.76	0.191	0.346	0.532	0.711	0.299	95 UCL
PRI 14	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	34	31	91%	0.513	0.52	0.065	1.1	0.239	0.764	0.876	1.07	0.584	95 UCL
PRI 14	Lakebed	Solids	Metals	Manganese	7439-96-5	mg/kg	34	34	100%	269	220	21	1900	314	421	457	1430	350.9	95 UCL
PRI 14	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	34	14	41%	0.413	0.0042	0.00125	9.7	1.66	0.571	0.894	6.9	1.87	95 UCL
PRI 14	Lakebed	Solids	SVOCs	Phenol	108-95-2	mg/kg	28	3	11%	0.105	0.0625	0.047	0.55	0.111	0.208	0.309	0.497	0.114	95 UCL
PRI 14	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	24	19	79%	0.0544	0.02	0.00095	0.47	0.0996	0.138	0.158	0.399	0.121	95 UCL
PRI 14	Lakebed	Solids	Cyanide	Total cyanide	74-90-8	mg/kg	28	9	32%	0.414	0.132	0.0095	4.3	0.863	0.853	1.65	3.68	0.973	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	4	4	100%	2.76	2.95	0.74	4.4	1.7	4.25	4.32	4.38	2.879	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	4	4	100%	39.8	43	12	61	20.9	57.4	59.2	60.6	42.7	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	4	4	100%	270	305	110	360	112	351	356	359	276.7	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	4	1	25%	0.249	0.25	0.246	0.25	0.002	0.25	0.25	0.25	0.53	Max (too few samples or detects)
PRI 14	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	4	1	25%	4.45	0.6	0.6	16	7.7	11.4	13.7	15.5	9.751	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	4	2	50%	5.42	5.9	1	8.9	3.35	8.27	8.58	8.84	6.5	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	4	4	100%	11100	640	50	43000	21300	30400	36700	41700	159046	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	4	1	25%	1.8	1.8	0.6	3	1.39	3	3	3	3	Max (too few samples or detects)
PRI 14	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	4	4	100%	5810	3600	26	16000	7060	12600	14300	15700	12583	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	4	1	25%	0.298	0.25	0.05	0.64	0.247	0.523	0.581	0.628	0.64	Max (too few samples or detects)
PRI 14	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	4	3	75%	9.75	5.7	0.6	27	11.9	21.2	24.1	26.4	12.48	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	4	3	75%	6.82	3.65	1	19	8.23	14.6	16.8	18.6	12.07	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	4	2	50%	2.88	2.75	1	5	1.65	4.4	4.7	4.94	2.93	95 UCL
PRI 14	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	4	2	50%	14.5	14	4	26	10.2	24.2	25.1	25.8	25.25	95 UCL
PRI 14	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	4	4	100%	0.0000218	6.62E-06	3.84E-06	0.00007	0.0000322	5.16e-05	6.08e-05	6.82e-05	0.000072533	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
PRI 14	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	4	4	100%	0.00012	0.0000335	0.0000289	0.000385	0.000177	0.000281	0.000333	0.000375	0.000387533	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	4	4	100%	0.0011	0.000306	0.000272	0.00353	0.00162	0.00257	0.00305	0.00344	0.003537533	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	4	4	100%	0.0000057	0.0000021	5.9E-07	0.000018	0.00000827	1.35e-05	1.58e-05	1.76e-05	0.000018197	95 UCL
PRI 14	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	4	4	100%	0.00128	0.00064	0.00064	0.00322	0.00129	0.00245	0.00283	0.00314	0.00223	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	4	3	75%	2.45	2.1	0.5	5.1	2.03	4.44	4.77	5.03	2.761	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	4	4	100%	48.8	56.5	13	69	24.6	65.4	67.2	68.6	52.32	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	4	4	100%	310	335	130	440	130	410	425	437	315.7	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	4	1	25%	6.88	1.5	1.5	23	10.8	16.6	19.8	22.4	14.05	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	4	1	25%	4.36	2.88	2.5	9.2	3.24	7.42	8.31	9.02	25	Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	4	4	100%	12500	995	140	48000	23700	34100	41100	46600	28328	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	4	1	25%	2.55	2.25	1.5	4.2	1.31	3.84	4.02	4.16	4.2	Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	4	4	100%	6830	5150	36	17000	7440	14200	15600	16700	15338	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	4	3	75%	11.6	6.35	1.5	32	14	25.2	28.6	31.3	14.41	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	4	1	25%	10.9	2.5	2.5	36	16.8	26	31	35	20.88	95 UCL
PRI 14	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	4	1	25%	36.2	17.5	10	100	43.1	77.5	88.7	97.7	100	Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	4	0	0%	0.109	0.0302	0.027	0.35	0.16	0.254	0.302	0.34	0.35	Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	PAHs	Naphthalene	91-20-3	µg/L	4	1	25%	0.0234	0.0188	0.006	0.05	0.0187	0.0407	0.0453	0.0491	0.075	Max (too few samples or detects)
PRI 14	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	4	3	75%	1.31	1.3	0.25	2.4	0.882	2.1	2.25	2.37	1.363	95 UCL
PRI 14	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	4	1	25%	0.81	0.08	0.08	3	1.46	2.12	2.56	2.91	1.493	95 UCL
PRI 14	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	4	1	25%	0.845	0.06	0.06	3.2	1.57	2.26	2.73	3.11	1.413	95 UCL
PRI 14	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	4	1	25%	7.38	2.5	2.5	22	9.75	16.2	19.1	21.4	11.03	95 UCL
PRI 14	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	4	4	100%	125000000	118000000	54000000	210000000	81500000	2.01e+08	2.05e+08	2.09e+08	190900000	95 UCL
PRI 14	Lakebed	Water, Total	WQ Anions	Chlorine	7782-50-5	µg/L	4	4	100%	35	15	0	110	52	86	98	108	96.14	95 UCL
PRI 14	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	9	9	100%	18.5	17.2	4.1	38.1	9.01	27.1	32.6	37	26.87	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 14	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	9	9	100%	36.2	27.5	14.9	102	25.8	53.6	77.8	97.2	77.9	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 14	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	9	9	100%	213	136	87	741	205	372	557	704	588.2	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 14	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	9	9	100%	9.02	8.2	1.6	18	4.44	14	16	17.6	11.77	95 UCL
PRI 14	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	9	9	100%	0.00339	0.00106	0.00019	0.0131	0.00495	0.0114	0.0123	0.0129	0.0106	95 UCL
PRI 14	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	9	8	89%	0.409	0.36	0.105	1.1	0.313	0.692	0.896	1.06	0.607	95 UCL
PRI 14	Upland	Solids	Metals	Manganese	7439-96-5	mg/kg	9	9	100%	256	260	52	440	110	352	396	431	324.1	95 UCL
PRI 14	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	9	2	22%	0.0197	0.012	0.007	0.071	0.02	0.0354	0.0532	0.0674	0.0567	95 UCL
PRI 14	Upland	Solids	VOCs	Acetone	67-64-1	mg/kg	7	1	14%	0.00336	0.0009	0.00075	0.018	0.00645	0.00786	0.0129	0.017	0.018	Max (too few samples or detects)
PRI 14	Upland	Solids	Cyanide	Total cyanide	74-90-8	mg/kg	7	2	29%	0.0586	0.0475	0.011	0.115	0.0391	0.112	0.113	0.115	0.0561	95 UCL
PRI 15	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	21	21	100%	2.32	1.03	0.618	15.5	3.3	4.2	4.68	13.3	4.966	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 15	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	21	21	100%	7.19	2.09	1.7	47	13	13.2	43.8	46.4	11.815	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 15	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	21	21	100%	56	13	12.2	435	116	103	362	421	80.305	Avian TEQ = 95 UCL, HCB = 95 UCL
PRI 15	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	21	21	100%	0.982	0.54	0.16	5.5	1.2	2.1	2.5	4.9	1.407	95 UCL
PRI 15	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	21	21	100%	0.00188	0.00054	0.00032	0.024	0.0051	0.0024	0.0025	0.0197	0.00674	95 UCL
PRI 15	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	21	19	90%	0.262	0.29	0.105	0.42	0.0864	0.34	0.38	0.412	0.297	95 UCL
PRI 15	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	21	21	100%	231	250	74	420	93.6	330	360	408	266.5	95 UCL
PRI 15	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	21	4	19%	0.00542	0.0012	0.00115	0.0435	0.0115	0.01	0.035	0.0418	0.00761	95 UCL
PRI 16	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	14	14	100%	0.868	0.8	0.285	1.52	0.36	1.29	1.39	1.49	1.054	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 16	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	14	14	100%	1.94	1.93	1.32	2.6	0.372	2.34	2.44	2.57	2.269	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 16	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	14	14	100%	12.6	12.7	11.4	14.1	0.787	13.3	13.6	14	14.419	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
PRI 16	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	14	14	100%	0.408	0.33	0.1	0.8	0.211	0.697	0.735	0.787	0.508	95 UCL
PRI 16	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	14	14	100%	0.000578	0.0005	0.00013	0.0012	0.000336	0.001	0.00107	0.00117	0.00073684	95 UCL
PRI 16	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	14	12	86%	0.281	0.3	0.105	0.38	0.0853	0.358	0.374	0.379	0.322	95 UCL
PRI 16	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	14	0	0%	0.00119	0.00117	0.0011	0.00135	0.0000663	0.00125	0.00128	0.00134	0.00135	Max (too few samples or detects)
GSLIC	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	9	9	100%	413	199	17.1	1430	481	932	1180	1380	1320.88	Avian TEQ = 95 UCL, HCB = 95 UCL
GSLIC	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	9	9	100%	478	262	18.4	1450	499	1060	1250	1410	1355.8	Avian TEQ = 95 UCL, HCB = 95 UCL
GSLIC	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	9	9	100%	1140	892	31.5	3750	1280	2740	3250	3650	1705	Avian TEQ = 95 UCL, HCB = 95 UCL
GSLIC	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	9	9	100%	226	120	8.8	880	287	488	684	841	760.6	95 UCL
GSLIC	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	9	9	100%	0.14	0.052	0.000234	0.391	0.174	0.388	0.389	0.391	0.674	95 UCL
GSLIC	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	9	9	100%	0.243	0.26	0.08	0.33	0.0719	0.314	0.322	0.328	0.288	95 UCL
GSLIC	Lakebed	Solids	Metals	Arsenic	7440-38-2	mg/kg	9	9	100%	7.33	7.5	3.3	10	2.34	10	10	10	8.785	95 UCL
GSLIC	Lakebed	Solids	Metals	Cadmium	7440-43-9	mg/kg	9	9	100%	0.152	0.16	0.048	0.28	0.0802	0.264	0.272	0.278	0.202	95 UCL
GSLIC	Lakebed	Solids	Metals	Chromium	7440-47-3	mg/kg	9	9	100%	8.49	8	2.3	15	4.28	13.4	14.2	14.8	11.14	95 UCL
GSLIC	Lakebed	Solids	Metals	Iron	7439-89-6	mg/kg	9	9	100%	5430	5900	1700	9500	2690	8540	9020	9400	7099	95 UCL
GSLIC	Lakebed	Solids	Metals	Manganese	7439-96-5	mg/kg	9	9	100%	142	170	64	210	59.2	202	206	209	178.8	95 UCL
GSLIC	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	9	9	100%	4.14	3	0.75	12	3.43	7.68	9.84	11.6	6.266	95 UCL
GSLIC	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	9	9	100%	0.296	0.32	0.12	0.51	0.139	0.47	0.49	0.506	0.382	95 UCL
GSLIC	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	9	9	100%	12.3	14	5.5	19	5.03	18.2	18.6	18.9	15.42	95 UCL
GSLIC	Lakebed	Solids	Metals	Zinc	7440-66-6	mg/kg	9	9	100%	19.1	17	6.9	45	12.2	33.8	39.4	43.9	26.63	95 UCL
GSLIC	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	9	3	33%	0.073	0.016	0.00145	0.35	0.117	0.206	0.278	0.336	0.0388	95 UCL
GSLIC	Lakebed	Solids	VOCs	1,2,4-Trichlorobenzene	120-82-1	mg/kg	7	3	43%	0.00964	0.000495	0.00045	0.053	0.0194	0.0268	0.0399	0.0504	0.0259	95 UCL
GSLIC	Lakebed	Solids	VOCs	2-Butanone	78-93-3	mg/kg	7	6	86%	0.0212	0.0053	0.0018	0.12	0.0436	0.0529	0.0864	0.113	0.0941	95 UCL
GSLIC	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	7	7	100%	0.119	0.033	0.014	0.58	0.206	0.304	0.442	0.552	0.459	95 UCL
GSLIC	Lakebed	Solids	VOCs	Carbon disulfide	75-15-0	mg/kg	7	4	57%	0.00697	0.0017	0.000295	0.02	0.0088	0.0194	0.0197	0.0199	0.0139	95 UCL
SVDD	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	13	13	100%	69.5	16.1	1.74	632	170	67.4	295	564	203.78	Avian TEQ = 95 UCL, HCB = 95 UCL
SVDD	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	13	13	100%	86.1	29.5	6.59	646	174	157	365	589	213.5	Avian TEQ = 95 UCL, HCB = 95 UCL
SVDD	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	13	13	100%	252	86	32.9	1390	397	683	1030	1320	310.7	Avian TEQ = 95 UCL, HCB = 95 UCL
SVDD	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	13	13	100%	38.9	8.7	0.54	370	100	36.6	171	330	119.5	95 UCL
SVDD	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	13	13	100%	0.0213	0.006	0.0011	0.163	0.0444	0.0415	0.0934	0.149	0.0569	95 UCL
SVDD	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	13	12	92%	0.225	0.21	0.03	0.61	0.141	0.356	0.472	0.582	0.318	95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
SVDD	Lakebed	Solids	Metals	Arsenic	7440-38-2	mg/kg	13	13	100%	7.72	7.4	4.5	17	3.14	9.64	12.8	16.2	9.509	95 UCL
SVDD	Lakebed	Solids	Metals	Cadmium	7440-43-9	mg/kg	13	13	100%	0.119	0.097	0.052	0.31	0.0676	0.168	0.226	0.293	0.16	95 UCL
SVDD	Lakebed	Solids	Metals	Chromium	7440-47-3	mg/kg	13	13	100%	10.8	6.3	2.8	48	12.6	21.8	33.6	45.1	19.16	95 UCL
SVDD	Lakebed	Solids	Metals	Iron	7439-89-6	mg/kg	13	13	100%	6590	4900	2000	19000	5440	15800	18400	18900	9878	95 UCL
SVDD	Lakebed	Solids	Metals	Manganese	7439-96-5	mg/kg	13	13	100%	169	140	94	460	99.2	226	322	432	217.7	95 UCL
SVDD	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	13	13	100%	3.32	1.6	0.15	16	4.88	10.2	13.6	15.5	7.319	95 UCL
SVDD	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	13	12	92%	0.177	0.17	0.05	0.3	0.077	0.286	0.294	0.299	0.216	95 UCL
SVDD	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	13	13	100%	13.7	11	7.3	35	8.25	24.6	29.6	33.9	18.24	95 UCL
SVDD	Lakebed	Solids	Metals	Zinc	7440-66-6	mg/kg	13	13	100%	33.8	17	8.8	130	37.2	82.2	106	125	68.12	95 UCL
SVDD	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	13	3	23%	0.0185	0.008	0.0016	0.135	0.0357	0.024	0.0696	0.122	0.0108	95 UCL
SVDD	Lakebed	Solids	VOCs	1,2,4-Trichlorobenzene	120-82-1	mg/kg	9	1	11%	0.000559	0.0005	0.000255	0.0012	0.000264	0.00076	0.00098	0.00116	0.0012	Max (too few samples or detects)
SVDD	Lakebed	Solids	VOCs	2-Butanone	78-93-3	mg/kg	9	6	67%	0.0236	0.007	0.0007	0.093	0.0375	0.0874	0.0902	0.0924	0.0799	95 UCL
SVDD	Lakebed	Solids	VOCs	Acetone	67-64-1	mg/kg	9	7	78%	0.111	0.023	0.000475	0.44	0.187	0.44	0.44	0.44	0.388	95 UCL
SVDD	Lakebed	Solids	VOCs	Carbon disulfide	75-15-0	mg/kg	9	6	67%	0.00264	0.0016	0.000165	0.0088	0.00303	0.00704	0.00792	0.00862	0.00457	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Aluminum	7429-90-5	µg/L	2	1	50%	16800	16800	650	33000	22900	-	-	-	33000	Max (too few samples or detects)
SVDD	Lakebed	Water, Dissolved	Metals	Antimony	7440-36-0	µg/L	2	2	100%	3.4	3.4	1.4	5.4	2.83	-	-	-	3.293	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Arsenic	7440-38-2	µg/L	2	2	100%	180	180	110	250	99	-	-	-	129.7	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Barium	7440-39-3	µg/L	2	2	100%	3050	3050	3000	3100	70.7	-	-	-	2941	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Beryllium	7440-41-7	µg/L	2	1	50%	1.56	1.56	0.61	2.5	1.34	-	-	-	2.5	Max (too few samples or detects)
SVDD	Lakebed	Water, Dissolved	Metals	Cadmium	7440-43-9	µg/L	2	2	100%	4.05	4.05	2.9	5.2	1.63	-	-	-	3.672	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Chromium	7440-47-3	µg/L	2	1	50%	108	108	25	190	117	-	-	-	219.4	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Chromium (VI)	18540-29-9	µg/L	2	1	50%	0.849	0.849	0.178	1.52	0.949	-	-	-	1.52	Max (too few samples or detects)
SVDD	Lakebed	Water, Dissolved	Metals	Cobalt	7440-48-4	µg/L	2	2	100%	78.5	78.5	70	87	12	-	-	-	63.96	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Copper	7440-50-8	µg/L	2	2	100%	52.6	52.6	7.3	98	64.1	-	-	-	49.64	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Iron	7439-89-6	µg/L	2	2	100%	185000	185000	880	370000	261000	-	-	-	721936	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Lead	7439-92-1	µg/L	2	2	100%	51	51	3	99	67.9	-	-	-	54.24	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Manganese	7439-96-5	µg/L	2	2	100%	27500	27500	16000	39000	16300	-	-	-	26019	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Mercury	7439-97-6	µg/L	2	2	100%	0.675	0.675	0.25	1.1	0.601	-	-	-	0.624	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Molybdenum	7439-98-7	µg/L	2	2	100%	70	70	30	110	56.6	-	-	-	95.49	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Nickel	7440-02-0	µg/L	2	2	100%	147	147	74	220	103	-	-	-	159.5	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Selenium	7782-49-2	µg/L	2	2	100%	10.9	10.9	6.8	15	5.8	-	-	-	13.73	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Silver	7440-22-4	µg/L	2	2	100%	2.3	2.3	2.1	2.5	0.283	-	-	-	2.198	95 UCL
SVDD	Lakebed	Water, Dissolved	Metals	Thallium	7440-28-0	µg/L	2	1	50%	7.25	7.25	2.5	12	6.72	-	-	-	12.5	Max (too few samples or detects)
SVDD	Lakebed	Water, Dissolved	Metals	Vanadium	7440-62-2	µg/L	2	1	50%	238	238	75	400	230	-	-	-	400	Max (too few samples or detects)
SVDD	Lakebed	Water, Dissolved	Metals	Zinc	7440-66-6	µg/L	2	2	100%	338	338	86	590	356	-	-	-	362.4	95 UCL
SVDD	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	µg/L	2	2	100%	0.000102	0.000102	0.0001	0.000103	0.00000212	-	-	-	0.000111678	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	µg/L	2	2	100%	0.000529	0.000529	0.000418	0.00064	0.000157	-	-	-	0.000651678	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	µg/L	2	2	100%	0.0048	0.0048	0.00357	0.00604	0.00175	-	-	-	0.006051678	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	µg/L	2	2	100%	0.0000285	0.0000285	0.000022	0.000035	0.00000919	-	-	-	0.000027402	95 UCL
SVDD	Lakebed	Water, Total	PCBs	Total PCBs	1336-36-3	µg/L	2	2	100%	0.0476	0.0476	0.0107	0.0845	0.0522	-	-	-	0.0377	95 UCL
SVDD	Lakebed	Water, Total	Metals	Aluminum	7429-90-5	µg/L	2	1	50%	16300	16300	650	32000	22200	-	-	-	32000	Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Metals	Antimony	7440-36-0	µg/L	2	2	100%	3.45	3.45	2.6	4.3	1.2	-	-	-	3.403	95 UCL
SVDD	Lakebed	Water, Total	Metals	Arsenic	7440-38-2	µg/L	2	2	100%	160	160	110	210	70.7	-	-	-	144.9	95 UCL
SVDD	Lakebed	Water, Total	Metals	Barium	7440-39-3	µg/L	2	2	100%	3150	3150	3100	3200	70.7	-	-	-	5793	95 UCL
SVDD	Lakebed	Water, Total	Metals	Beryllium	7440-41-7	µg/L	2	1	50%	2.4	2.4	2.3	2.5	0.141	-	-	-	3.328	95 UCL
SVDD	Lakebed	Water, Total	Metals	Cadmium	7440-43-9	µg/L	2	1	50%	3.38	3.38	1.25	5.5	3.01	-	-	-	5.5	Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Metals	Chromium	7440-47-3	µg/L	2	1	50%	102	102	25	180	110	-	-	-	268.5	95 UCL
SVDD	Lakebed	Water, Total	Metals	Cobalt	7440-48-4	µg/L	2	2	100%	77	77	67	87	14.1	-	-	-	69.14	95 UCL
SVDD	Lakebed	Water, Total	Metals	Copper	7440-50-8	µg/L	2	1	50%	60.5	60.5	25	96	50.2	-	-	-	63.1	95 UCL
SVDD	Lakebed	Water, Total	Metals	Iron	7439-89-6	µg/L	2	2	100%	186000	186000	2100	370000	260000	-	-	-	672218	95 UCL
SVDD	Lakebed	Water, Total	Metals	Lead	7439-92-1	µg/L	2	1	50%	49.8	49.8	1.5	98	68.2	-	-	-	1858	95 UCL
SVDD	Lakebed	Water, Total	Metals	Manganese	7439-96-5	µg/L	2	2	100%	27500	27500	16000	39000	16300	-	-	-	24816	95 UCL
SVDD	Lakebed	Water, Total	Metals	Mercury	7439-97-6	µg/L	2	2	100%	0.465	0.465	0.26	0.67	0.29	-	-	-	0.46	95 UCL
SVDD	Lakebed	Water, Total	Metals	Molybdenum	7439-98-7	µg/L	2	2	100%	32	32	31	33	1.41	-	-	-	29.28	95 UCL
SVDD	Lakebed	Water, Total	Metals	Nickel	7440-02-0	µg/L	2	2	100%	144	144	68	220	107	-	-	-	177	95 UCL
SVDD	Lakebed	Water, Total	Metals	Selenium	7782-49-2	µg/L	2	2	100%	7	7	5.7	8.3	1.84	-	-	-	7.069	95 UCL
SVDD	Lakebed	Water, Total	Metals	Silver	7440-22-4	µg/L	2	2	100%	2	2	1.5	2.5	0.707	-	-	-	2.1	95 UCL
SVDD	Lakebed	Water, Total	Metals	Thallium	7440-28-0	µg/L	2	1	50%	6.12	6.12	1.25	11	6.89	-	-	-	11	Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Metals	Vanadium	7440-62-2	µg/L	2	1	50%	232	232	75	390	223	-	-	-	390	Max (too few samples or detects)
SVDD	Lakebed	Water, Total	Metals	Zinc	7440-66-6	µg/L	2	2	100%	308	308	26	590	399	-	-	-	462	95 UCL
SVDD	Lakebed	Water, Total	SVOCs	Hexachlorobenzene	118-74-1	µg/L	2	0	0%	0.475	0.475	0.35	0.6	0.177	-	-	-	0.6	Max (too few samples or detects)
SVDD	Lakebed	Water, Total	SVOCs	Pentachlorophenol	87-86-5	µg/L	2	1	50%	22.2	22.2	17.5	27	6.72	-	-	-	27	Max (too few samples or detects)
SVDD	Lakebed	Water, Total	VOCs	Bromoform	75-25-2	µg/L	2	1	50%	13	13	0.1	26	18.3	-	-	-	14.77	95 UCL
SVDD	Lakebed	Water, Total	VOCs	Carbon disulfide	75-15-0	µg/L	2	2	100%	2.3	2.3	1.4	3.2	1.27	-	-	-	1.94	95 UCL
SVDD	Lakebed	Water, Total	VOCs	Chloroform	67-66-3	µg/L	2	1	50%	2.31	2.31	0.12	4.5	3.1	-	-	-	2.3	95 UCL
SVDD	Lakebed	Water, Total	Cyanide	Total cyanide	74-90-8	µg/L	2	2	100%	14.5	14.5	11	18	4.95	-	-	-	12.87	95 UCL
SVDD	Lakebed	Water, Total	WQ Anions	Chloride	16887-00-6	µg/L	2	2	100%	225000000	225000000	170000000	280000000	77800000	-	-	-	187600000	95 UCL
SVDD	Lakebed	Water, Total	WQ Anions	Nitrate (NO3)	14797-55-8	µg/L	2	1	50%	3150	3150	1300	5000	2620	-	-	-	1286	95 UCL
Background	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	17	17	100%	1.89	1.74	0.46	5.25	1.44	3.88	4.77	5.15	2.792	Avian TEQ = 95 UCL, HCB = 95 UCL
Background	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	17	17	100%	3.59	3	1.5	11.2	2.48	6.21	7.52	10.5	7.274	Avian TEQ = 95 UCL, HCB = 95 UCL
Background	Lakebed	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	17	17	100%	20.6	15.6	11.8	89.5	18.4	25.5	44.8	80.6	52.094	Avian TEQ = 95 UCL, HCB = 95 UCL
Background	Lakebed	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	17	17	100%	0.751	0.52	0.12	2.9	0.768	1.58	2.42	2.8	1.076	95 UCL
Background	Lakebed	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	17	17	100%	0.000626	0.00037	0.00011	0.0024	0.000653	0.00142	0.002	0.00232	0.00101	95 UCL
Background	Lakebed	Solids	Metals	Aluminum	7429-90-5	mg/kg	29	29	100%	7750	5000	860	17000	6330	17000	17000	17000	12873	95 UCL

Table 2-7
Summary Statistics of Solid and Water COPECs
US Magnesium LLC
Tooele County, Utah

Exposure Area	Habitat	Media	COPEC Group	COPEC	CAS #	Units	Number of Samples	Number of Detects	Frequency of Detection	Mean	Median	Min	Max	Standard Deviation	90th Percentile	95th Percentile	99th Percentile	95 UCL	95 UCL Description
Background	Lakebed	Solids	Metals	Antimony	7440-36-0	mg/kg	29	29	100%	0.382	0.37	0.085	0.85	0.22	0.658	0.78	0.847	0.451	95 UCL
Background	Lakebed	Solids	Metals	Arsenic	7440-38-2	mg/kg	29	29	100%	10.3	9.1	4.9	23	4.07	15.2	16.6	21.3	11.57	95 UCL
Background	Lakebed	Solids	Metals	Barium	7440-39-3	mg/kg	29	29	100%	239	210	130	480	89.7	340	352	446	266.9	95 UCL
Background	Lakebed	Solids	Metals	Beryllium	7440-41-7	mg/kg	29	29	100%	0.375	0.24	0.04	0.87	0.303	0.786	0.828	0.862	0.62	95 UCL
Background	Lakebed	Solids	Metals	Cadmium	7440-43-9	mg/kg	29	21	72%	0.157	0.17	0.0165	0.35	0.117	0.324	0.346	0.35	0.196	95 UCL
Background	Lakebed	Solids	Metals	Chromium	7440-47-3	mg/kg	29	29	100%	9.52	6.3	1.2	20	7.44	19.2	20	20	15.54	95 UCL
Background	Lakebed	Solids	Metals	Cobalt	7440-48-4	mg/kg	29	29	100%	3.13	2.6	0.54	6.4	2.24	6.22	6.36	6.4	4.945	95 UCL
Background	Lakebed	Solids	Metals	Copper	7440-50-8	mg/kg	29	29	100%	10.2	11	2.4	22	6.37	19	19	21.2	12.2	95 UCL
Background	Lakebed	Solids	Metals	Iron	7439-89-6	mg/kg	29	29	100%	7520	5100	740	17000	6290	17000	17000	17000	12611	95 UCL
Background	Lakebed	Solids	Metals	Manganese	7439-96-5	mg/kg	29	29	100%	179	150	22	360	128	342	350	357	283.1	95 UCL
Background	Lakebed	Solids	Metals	Mercury	7439-97-6	mg/kg	29	28	97%	0.0368	0.025	0.0046	0.16	0.0329	0.069	0.089	0.142	0.051	95 UCL
Background	Lakebed	Solids	Metals	Molybdenum	7439-98-7	mg/kg	27	27	100%	1.9	0.84	0.051	13	2.7	3.9	5.13	11	3.155	95 UCL
Background	Lakebed	Solids	Metals	Nickel	7440-02-0	mg/kg	29	29	100%	8.1	6.1	1.1	17	6.09	16	16.6	17	13.03	95 UCL
Background	Lakebed	Solids	Metals	Selenium	7782-49-2	mg/kg	29	25	86%	0.384	0.35	0.049	1.1	0.289	0.75	0.792	1.02	0.48	95 UCL
Background	Lakebed	Solids	Metals	Silver	7440-22-4	mg/kg	29	19	66%	0.0425	0.04	0.0095	0.094	0.0275	0.0802	0.0858	0.0926	0.0531	95 UCL
Background	Lakebed	Solids	Metals	Vanadium	7440-62-2	mg/kg	29	29	100%	18.9	12	4.5	41	13.7	37.8	41	41	27.89	95 UCL
Background	Lakebed	Solids	Metals	Zinc	7440-66-6	mg/kg	29	29	100%	28.5	25	6.5	81	19	49.2	51.8	73.2	36.4	95 UCL
Background	Lakebed	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	17	2	12%	0.00189	0.0014	0.00115	0.0087	0.00181	0.00224	0.0043	0.00782	0.00498	95 UCL
Background	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 1	avteq-nd2-cat1	pg/g	18	18	100%	0.663	0.64	0.345	1.32	0.228	0.887	0.975	1.25	0.757	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
Background	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 2	avteq-nd2-cat2	pg/g	18	18	100%	1.7	1.68	1.38	2.35	0.228	1.92	2.01	2.28	1.792	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
Background	Upland	Solids	Dioxins/Furans	Calculated TEQ (ND=1/2 DL), Avian Category 3	avteq-nd2-cat3	pg/g	18	18	100%	12	12	11.7	12.7	0.228	12.3	12.4	12.6	12.142	Avian TEQ = 95 UCL, HCB = Max (too few samples or detects)
Background	Upland	Solids	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	pg/g	18	18	100%	0.278	0.26	0.14	0.71	0.128	0.358	0.446	0.657	0.335	95 UCL
Background	Upland	Solids	PCBs	Total PCBs	1336-36-3	mg/kg	18	18	100%	0.000284	0.000255	0.00016	0.00066	0.000123	0.000394	0.000481	0.000624	0.00033506	95 UCL
Background	Upland	Solids	Metals	Aluminum	7429-90-5	mg/kg	30	30	100%	10800	10000	7600	15000	2120	14000	14500	15000	11411	95 UCL
Background	Upland	Solids	Metals	Antimony	7440-36-0	mg/kg	30	30	100%	0.236	0.24	0.1	0.37	0.0819	0.34	0.351	0.367	0.261	95 UCL
Background	Upland	Solids	Metals	Arsenic	7440-38-2	mg/kg	30	30	100%	5.95	5.55	4.1	10	1.55	8	8.38	9.62	6.441	95 UCL
Background	Upland	Solids	Metals	Barium	7440-39-3	mg/kg	30	30	100%	213	220	120	280	44.3	270	270	277	227.1	95 UCL
Background	Upland	Solids	Metals	Beryllium	7440-41-7	mg/kg	30	30	100%	0.497	0.475	0.35	0.75	0.104	0.632	0.688	0.741	0.53	95 UCL
Background	Upland	Solids	Metals	Cadmium	7440-43-9	mg/kg	30	30	100%	0.429	0.42	0.29	0.65	0.0798	0.523	0.556	0.624	0.454	95 UCL
Background	Upland	Solids	Metals	Chromium	7440-47-3	mg/kg	30	30	100%	11.1	11	7.7	15	1.84	14	14	14.7	11.66	95 UCL
Background	Upland	Solids	Metals	Cobalt	7440-48-4	mg/kg	30	30	100%	3.82	3.65	2.6	5.8	0.785	4.91	5.16	5.66	4.067	95 UCL
Background	Upland	Solids	Metals	Copper	7440-50-8	mg/kg	30	30	100%	14.6	14	9.4	23	3.68	20	21.1	22.7	15.77	95 UCL
Background	Upland	Solids	Metals	Iron	7439-89-6	mg/kg	30	30	100%	12100	11000	8400	19000	3020	17000	17500	18700	13060	95 UCL
Background	Upland	Solids	Metals	Manganese	7439-96-5	mg/kg	30	30	100%	428	415	270	630	84.1	544	580	616	453.8	95 UCL
Background	Upland	Solids	Metals	Mercury	7439-97-6	mg/kg	30	30	100%	0.0336	0.032	0.019	0.071	0.0103	0.0451	0.0482	0.0649	0.0369	95 UCL
Background	Upland	Solids	Metals	Molybdenum	7439-98-7	mg/kg	29	29	100%	0.765	0.74	0.42	1.3	0.183	0.972	1.05	1.24	0.823	95 UCL
Background	Upland	Solids	Metals	Nickel	7440-02-0	mg/kg	30	30	100%	8.86	8.75	5.9	12	1.62	11	11.5	12	9.361	95 UCL
Background	Upland	Solids	Metals	Selenium	7782-49-2	mg/kg	30	30	100%	0.256	0.25	0.18	0.32	0.0375	0.31	0.31	0.317	0.268	95 UCL
Background	Upland	Solids	Metals	Silver	7440-22-4	mg/kg	30	30	100%	0.0704	0.068	0.039	0.12	0.0192	0.0906	0.104	0.117	0.0764	95 UCL
Background	Upland	Solids	Metals	Vanadium	7440-62-2	mg/kg	30	30	100%	17.7	17.5	12	24	2.95	22	22.5	23.7	18.65	95 UCL
Background	Upland	Solids	Metals	Zinc	7440-66-6	mg/kg	30	30	100%	40.8	38	26	73	11.2	52	61.3	71.8	44.31	95 UCL
Background	Upland	Solids	SVOCs	Hexachlorobenzene	118-74-1	mg/kg	18	0	0%	0.00115	0.00115	0.00115	0.00115	0	0.00115	0.00115	0.00115	0.00115	Max (too few samples or detects)

Notes:
Concentrations for Avian TEQ are reported after the addition of hexachlorobenzene, with the appropriate toxicity equivalence factor applied for the respective TEQ category. However, in the risk estimates, avian TEQ without hexachlorobenzene and hexachlorobenzene are both entered separately, then combined into the dose after application of the appropriate bioaccumulation factors for each constituent.
- = Statistic could not be calculated due to low sample size
µg/L = Micrograms per liter
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Inlet Canal
HCB = Hexachlorobenzene
HPAH = High molecular weight polycyclic aromatic hydrocarbons
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
NB = No benchmark
ND = Not detected
ND=0 = Non-detected values substituted with 0
ND=1/2DL = Non-detected values substituted with half the detection limit
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
pg/g = Picograms per gram
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley Diversion Ditch
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
UCL = Upper confidence limit on the mean
VOC = Volatile organic compound
WQ = Water quality

Table 2-8a
Threatened and Endangered Species
US Magnesium LLC
Tooele County, Utah

Listing Status	Common Name	Genus Species	Occurrence in Investigation Area[5]	Source
Amphibians				
Federal Threatened Species	None	None	NA	NA
Federally Endangered Species	None	None	NA	NA
Reptiles				
Federal Threatened Species	Desert Tortoise	*Gopherus agassizii*	No	BIOTICS[1,2]
Federally Endangered Species	None	None	NA	NA
Birds				
Federal Threatened Species	Mexican Spotted Owl	*Strix occidentalis lucida*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Gunnison Sage-grouse	*Centrocercus minimus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Yellow-billed Cuckoo	*Coccyzus americanus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
Federally Endangered Species	California Condor	*Gymnogyps californianus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Whooping Crane	*Grus americana*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Southwestern Willow Flycatcher	*Empidonax traillii extimus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
Mammals				
Federal Threatened Species	Utah Prairie-dog	*Cynomys parvidens*	No	BIOTICS[1,2]
	Brown/Grizzly Bear	*Ursus arctos*	No	BIOTICS[1,2]
	Canada Lynx	*Lynx canadensis*	No	BIOTICS[1,2]
Federally Endangered Species	Black-footed Ferret	*Mustela nigripes*	No	BIOTICS[1,2]
	Gray Wolf	*Canis lupus*	No	BIOTICS[1,2]
Mollusks				
Federal Threatened Species	None	None	NA	NA
Federally Endangered Species	Kanab Ambersnail	*Oxyloma kanabense*	No	BIOTICS[1,2]
Plants				
Federal Threatened Species	Jones Cycladenia	*Cycladenia humilis var. jonesii*	No	IPAC
Federal Threatened Species	Ute Ladies'-tresses	*Spiranthes diluvialis*	No	IPAC

Notes:
[1] Utah Division of Wildlife Resources. Sensitive Species by County. https://dwrcdc.nr.utah.gov/ucdc/viewreports/sscounty.pdf
[2] Utah Division of Wildlife Resources. Utah's Federally Listed Species by County. https://dwrcdc.nr.utah.gov/ucdc/ViewReports/te_cnty.pdf
[3] https://www.fws.gov/nevada/protected_species/amphibians/images/csf_dist_new.gif
[4] http://ebird.org/content/ebird/
[5] The category of 'yes' or 'no' is based on a general expectation from the sources identified in the table.
BIOTICS = Utah Natural Heritage Program's Biodiversity Tracking and Conservation System
NA = Not applicable

Table 2-8b
Species of Concern
US Magnesium LLC
Tooele County, Utah

Listing Status	Common Name	Genus Species	Occurrence in Investigation Area[5]	Source
Amphibians				
Federal Candidate Species	Relict Leopard Frog	*Rana onca*	No	BIOTICS[1,2]
Conservation Agreement Species	Columbia Spotted Frog	*Rana luteiventris*	No	BIOTICS[1]; USFWS[3]
Birds				
Conservation Agreement Species	Northern Goshawk	*Accipiter gentiles*	No	BIOTICS[1]; Cornell Lab of Ornithology eBird Map[4]
Bald and Golden Eagle Protection Act	Bald Eagle	*Haliaeetus leucocephalus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
Bird of Conservation Concern, Bald and Golden Eagle Protection Act	Golden Eagle	*Aquila chrysaetos*	Yes	Cornell Lab of Ornithology eBird Map[4]
Bird of Conservation Concern	Brewer's Sparrow	*Spizella breweri*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Clark's Grebe	*Aechmophorus clarkii*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Green-tailed Towhee	*Pipilo chlorurus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Lesser Yellowlegs	*Tringa flavipes*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Lewis's Woodpecker	*Melanerpes lewis*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Long-billed Curlew	*Numenius americanus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Marbled Godwit	*Limosa fedoa*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Olive-sided Flycatcher	*Contopus cooperi*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Pinyon Jay	*Gymnorhinus cyanocephalus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Sage Thrasher	*Oreoscoptes montanus*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Sagebrush Sparrow	*Artemisiospiza nevadensis*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Willet	*Tringa semipalmata*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
	Willow Flycatcher	*Empidonaz trailii*	No	BIOTICS[1,2]; Cornell Lab of Ornithology eBird Map[4]
Utah Species of Greatest Conservation Need	Snowy Plover	*Charadrius nivosus*	Yes	Cornell Lab of Ornithology eBird Map[4]

Notes:
[1] Utah Division of Wildlife Resources. Sensitive Species by County. https://dwrcdc.nr.utah.gov/ucdc/viewreports/sscounty.pdf
[2] Utah Division of Wildlife Resources. Utah's Federally Listed Species by County. https://dwrcdc.nr.utah.gov/ucdc/ViewReports/te_cnty.pdf
[3] https://www.fws.gov/nevada/protected_species/amphibians/images/csf_dist_new.gif
[4] http://ebird.org/content/ebird/
[5] The category of 'yes' or 'no' is based on a general expectation from the sources identified in the table.
BIOTICS = Utah Natural Heritage Program's Biodiversity Tracking and Conservation System
NA = Not applicable

Table 2-9
Land Use Scenarios
US Magnesium LLC
Tooele County, Utah

PRI	Land Use Scenarios	Habitat Type	Description	Assumed Environmental Conditions & Exposure
PRI 1 Former Ditches	Current	Lakebed	The Western Ditch received non-contact cooling water and water from the cast house that is not acidic — however, there was some backflow of acidic water that flows into the Western Ditch from the Main Ditch. The other wastewater Ditches (Central Ditch, Chlorine Ditch, and Main [combined flow] Ditch) received highly acidic waste water. The ditches have been closed and capped as per the Resource Conservation and Recover Act (RCRA) Administrative Settlement Agreement and Order on Consent (AOC) except for the eastern portion of the main ditch (2016).	Given capping and closure, this Preliminary Remediation Investigation (PRI) does not need to be evaluated under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Four sample locations in the eastern portion of the Main Ditch have been evaluated in other exposure units as follows: PRI1-11 and PRI1-12 were evaluated as PRI 5 lakebed, PRI1-13 was evaluated as PRI 5 upland, and PRI1-14 was evaluated as PRI 2 upland.
	Future	NA	The ditches have been closed and capped as per the RCRA AOC (2016).	Given capping and closure, this PRI was not needed to be evaluated under CERCLA.
PRI 2 Landfill	Current	Upland	The landfill is operated under a Tooele County permit and reportedly receives solids wastes including cell rebuild debris (refractory, salts, graphite, magnesium, castable ceramics); packaging; metal parts; and solid waste (rubbish) from plant operations. No hazardous or special wastes have reportedly been disposed at the landfill, although the landfill reportedly historically received asbestos waste. Waste is placed on native ground surface (no excavation or liner). There is daily use of dense debris to cover materials on exposed working faces that are subject to wind dispersal or avian scavengers; and twice monthly, a 6-inch gypsum cover is applied to the exposed working face. The Landfill disposal area extends from the area immediately east of the Chlorine Ditch, and is encroaching into PRI 5.	The BERA dataset was used to characterize current environmental conditions. Acute exposures are realistic given the lack of habitat and continuous physical disturbance associated with ongoing O&M activities at the landfill.
	Future	Upland	There is no plan to move or close the landfill. This scenario assumes it will remain an active landfill in the future and will be permitted by Utah Department of Environmental Quality (UDEQ) as a Class IIIb non-hazardous industrial landfill. Future land use is assumed to be similar to the current industrial land use. There is no expectation that operations will be modified in such a way that the landfill would not be used and would become fallow.	The Current condition was used as a surrogate to characterize conditions under the future scenario. Use of the current condition is considered to be conservative given updated landfill operation and maintenance (O&M) protocols intended to reduce exposures (e.g., a 6-inch of clean gypsum cover will be applied to the exposed working face). Given continued operations at the landfill, this PRI is not anticipated to become fallow.
PRI 3 Sanitary Lagoon	Current	Upland	The Sanitary Lagoon received sanitary wastewater from plant operations following treatment by a bacteriological process. Dredged spoils from ditch maintenance have washed into the sanitary lagoon. It has steep sidewalls and a flat bottom. PRI 3 has been refurbished per the RCRA AOC (2016).	Given removal of contaminated soils and refurbishment as per the RCRA AOC (2016), this PRI was not evaluated under CERCLA.
	Future	NA	PRI 3 has been refurbished per the RCRA AOC (2016).	Given removal of contaminated soils and refurbishment as per the RCRA AOC (2016), this PRI was not evaluated under CERCLA.
PRI 4 Gypsum Pile	Current	Upland	The gypsum pile consists of (1) calcium sulfate (gypsum) removed from the concentrated brine and derived from the desulfation process, where sulfate is removed as gypsum solids (CaSO4) from the concentrated brine via addition of calcium chloride solution; (2) the unreacted calcium carbonate and other solids from calcium chloride production; and (3) raw plant water. The pile expands by approximately 6 to 10 acres per year. The current footprint of the gypsum pile has expanded to within the footprint of the Northwest Ponded Waste Lagoon (PRI Area 6). The boundary between PRI Areas 4 and 6 varies over time due to fluctuating water levels in the pond and the increasing size of the gypsum pile.	The BERA dataset was used to characterize current environmental conditions. Acute exposures are realistic given the lack of habitat present at the gypsum pile. The hypothetical future scenario assuming chronic exposure is evaluated in Appendix C.
	Future	Upland	Clean gypsum will continue to be added to the pile daily. Thus, future land use is expected to be similar to the current industrial land use conditions. However, in the absence of data on the potential for establishment of plants on the gypsum pile, it is assumed that plants may be able to grow in the future if the PRI is allowed to go fallow. Vegetation is not expected to become established; but if observed, would be removed to prevent habitat establishment. The future hypothetical scenario assuming the land is allowed to go fallow is evaluated in Appendix C.	The current condition was used as a surrogate to characterize conditions under the future scenario. Use of the current condition is considered to be conservative given that as part of future O&M protocols, clean gypsum will be added to the pile, covering the presently exposed material. The BERA dataset was also used to evaluate chronic exposure to birds and mammals, in the event that vegetation is able to grow in the future. This is considered highly conservative given the unlikely establishment of vegetated habitat.
PRI 5 SE Ponded Waste Lagoon	Current	Upland and Lakebed	PRI 5 (also referred to as the Current Waste Pond [CWP]) is an active wastewater impoundment that receives acidic process wastewater via the Main Ditch and has a surface connection to PRI 6. The CWP was constructed in 1986 by enhancing an existing mudflat area to the west of the Old Waste Pond (OWP)/PRI 7. The continuously ponded area within PRI 5 (and PRI 6) and wastewater depths within PRI 5 (and PRI 6) have increased in recent years, seemingly due to increased wastewater discharges resulting from increased magnesium production and a reduction in overall wastewater pond capacity due to gypsum in-filling of the PRI Area 6 lagoon. These changes have been accompanied by acid dissolution of the oolitic sand substrate within the waste lagoons. Wastewater from the PRI 5 lagoon has intermittently discharged to the OWP (PRI Area 7) through the formation of sinkholes and preferential flow paths through the berm separating PRIs 5 and 7. An overflow pipe with an invert elevation of 4,214 ft AMS has been installed to facilitate controlled discharges of wastewater from CWP to the OWP. The CWP is highly acidic and thus, does not provide viable lakebed habitat, although acute exposures are possible. Only the upland portions of the CWP present potentially viable habitat. The Skull Valley Diversion Ditch (SVDD) runs along the southern edge of the PRI. USM permanently ceased use of the section of the SVDD adjacent to the CWP, thus SVDD is evaluated independently from the PRIs.	The BERA dataset was used to characterize current environmental conditions in upland portions of the site only. Given that the CWP is highly acidic, lakebed habitat is not viable. However, acute exposures to lakebed habitat are possible. Chronic exposures to upland habitat are assumed.
	Future	Upland and Lakebed	Consistent with the Proposed Pond Upgrade Plan a Groundwater Discharge Permit has been obtained to create a barrier wall that will enable operating PRIs 5,6 and 7 as a single Retrofitted Waste Pond (RWP). Upon filling, the water within the RWP will be highly acidic and thus, is expected to eliminate viable lakebed habitat, although it is uncertain whether exposure will be completely eliminated. Only the upland portions of the RWP are expected to provide potentially viable habitat. All areas of PRI 5 will be located within the RWP, thus will not become fallow in the future. Hypothetical future scenarios are evaluated in Appendix C.	In the future, PRI 5 will predominantly be inundated by industrial acidic wastewater that precludes habitat establishment except for upland portions of the RWP. In Appendix C, the BERA dataset was used as a surrogate to characterize future environmental conditions in upland portions of PRI 5 that are within the RWP. Given that the RWP is highly acidic, lakebed habitat is not viable. However, hypothetical future conditions where the RWP was allowed to go fallow are evaluated in Appendix C. Additionally, given the plan to combine PRIs 5, 6 and 7 into a single industrial surface impoundment waste pond, these PRIs were also evaluated as a single decision unit under the future scenario (see Appendix C).
PRI 6 NW Ponded Waste Lagoon	Current	Upland and Lakebed	PRI 6 (also referred to as the CWP) is an active wastewater impoundment receives acidic process wastewater via the Main Ditch and circum-neutral wastewater from gypsum slurry runoff from the gypsum pile (PRI 4) and has a surface connection to PRI 5. As described above for PRI Area 5, the continuously ponded area and wastewater depths within PRI Area 6 have also been apparently increasing in recent years. Wastewater from the PRI Area 6 lagoon has intermittently discharged to Northwest Lagoon Overflow Area (PRI Area 8) through the formation of sinkholes and preferential flow paths through the berm separating PRI Areas 6 and 8. Surface water in the CWP is highly acidic, and thus does not provide viable lakebed habitat, although acute exposure is possible. Only the upland portions of the CWP present potentially viable habitat.	The BERA dataset was used to characterize current environmental conditions in lakebed and upland portions of the site only. Given that the CWP is highly acidic, lakebed habitat is not viable, but acute exposures are possible. Chronic exposures to upland habitat are assumed.
	Future	Upland and Lakebed	Consistent with the Proposed Pond Upgrade Plan a Groundwater Discharge Permit has been obtained to create a barrier wall that will enable operating PRIs 5, 6 and 7 as a single RWP. Upon filling, the water within the RWP will be highly acidic and thus, will not provide viable lakebed habitat, although it is uncertain whether exposure will be completely eliminated. Only the upland portions of the RWP are expected to provide potentially viable habitat. All areas of PRI 6 will be located within the RWP, thus will not become fallow in the future. Hypothetical future scenarios are evaluated in Appendix C.	In the future, PRI 6 will predominantly be inundated by industrial acidic wastewater that precludes habitat establishment except for upland portions of the RWP. In Appendix C, the BERA dataset was used as a surrogate to characterize future environmental conditions in upland portions of PRI 5 that are within the RWP. Given that the RWP is highly acidic, lakebed habitat is not viable. However, hypothetical future conditions where the RWP was allowed to go fallow are evaluated in Appendix C. Additionally, given the plan to combine PRIs 5, 6 and 7 into a single industrial surface impoundment waste pond, these PRIs were also evaluated as a single decision unit under the future scenario (see Appendix C).
PRI 7 NE Ponded Waste Lagoon	Current	Lakebed	PRI Area 7 is the former wastewater disposal pond, also referred to as the OWP. It is approximately 800 acres in size and was constructed shortly after the initial construction of the plant in the early 1970s. In 1984, it was flooded by the Great Salt Lake (GSL) and closed to discharges. Currently, the OWP seasonally has standing water during winter and springtime due to accumulated precipitation and groundwater discharge. Groundwater seepage into the pond occurs at multiple locations along the southeastern edge of the pond adjacent to the berm separating the CWP and OWP. The OWP is seasonally flooded by acidic wastewater from the CWP due to the installation of an overflow pipe through the berm separating the OWP and CWP that occurred in November 2017.	The BERA dataset were used to characterize current environmental conditions. Given that PRI-7 lies entirely in the playa, the habitat is considered lakebed. Because it currently receives overflow discharges of acidic wastewater from the CWP, exposure under the current condition is considered acute. However, the pH of the wastewater is neutral sometimes, which could result in potential chronic exposures to lakebed receptors.
	Future	Lakebed	Consistent with the Proposed Pond Upgrade Plan, a Groundwater Discharge Permit has been obtained to create a barrier wall that will enable operating PRIs 5, 6 and 7 as a single RWP. Upon filling, the water within the RWP will be highly acidic and thus, will not provide viable lakebed habitat, although it is uncertain whether exposure will be completely eliminated. All areas of PRI 7 will be located within the RWP, thus will not become fallow in the future. Hypothetical future scenarios are evaluated in Appendix C.	In the future, PRI 7 will predominantly be inundated by industrial acidic wastewater that precludes habitat establishment except for upland portions of the RWP. In Appendix C, the BERA dataset was used as a surrogate to characterize future environmental conditions in upland portions of PRI 5 that are within the RWP. Given that the RWP is highly acidic, lakebed habitat is not viable. However, hypothetical future conditions where the RWP was allowed to go fallow are evaluated in Appendix C. Additionally, given the plan to combine PRIs 5, 6 and 7 into a single industrial surface impoundment waste pond, these PRIs were also evaluated as a single decision unit under the future scenario (see Appendix C).

Table 2-9
Land Use Scenarios
US Magnesium LLC
Tooele County, Utah

PRI	Land Use Scenarios	Habitat Type	Description	Assumed Environmental Conditions & Exposure
PRI 8 NW Lagoon Overflow	Current	Upland and Lakebed	Acidic wastewater (pH< 1 based on Phase 1A data and subsequent observations) from PRI 6 formerly flowed into PRI 8 on limited occasions, prior to the installation of the overflow pipe from the CWP. The surface water feature in a former barrow area north of the new berm (referred to as the "angel wing") is assumed to experience similar conditions as water features south of the berm since the angel wing area has been occasionally flooded by acidic wastewater which migrates beneath the new northwest berm. This migrations no longer occurs due to installation of the overflow pipe.	The BERA dataset was used to characterize current environmental conditions. Given fluctuating water levels, samples in and around the former barrow area (angel wing) are expected to be frequently inundated. Hence, these samples were used to characterize lakebed conditions in PRI 8.
	Future	NA	This area is not anticipated to be used for industrial activities. PRI 8 will be allowed to become fallow since it no longer receives acidic wastewater discharges due to the installation of the overflow pipe connecting the CWP and OWP.	The current condition was used as a surrogate to characterize conditions in the future. Use of the Current condition is considered to be conservative given the construction of the overflow pipe prevents future discharges from the CWP into PRI 8.
PRI 9 Smut Area	Current	Upland	Smut Piles are where the "smut" (magnesium oxide and other salts) that settles to the bottoms of the melt and electrolytic cell is disposed of. The southern portion of the smut area is an "older" disposal area where waste is more weathered.	The BERA dataset was used to characterize current environmental conditions. Acute exposures are realistic given the lack of habitat present in PRI 9.
	Future	Upland	Future industrial land use is assumed to be similar to current land use except a new lithium production process plant will be reprocessing smut to recover lithium carbonate. This PRI is not expected to become fallow.	The current condition was used as a surrogate to characterize conditions in the future. Although a new plant will recover lithium, use of the current condition is considered to be comparable to conditions in the future. Given continued industrial operation, this PRI is not expected to become fallow.
PRI 10 Barium Sulfate Disposal Area	Current	Upland	Waste disposed of at the Barium Sulfate Area is cast-house residue from historical use of a barium-containing flux during casting. The Barium Sulfate area is a permitted, closed repository where process material containing barium was treated and disposed of during the early 1990s. Engineered earthen disposal cells were constructed to contain waste material containing barium. The waste was flooded with brine (which contains high concentrations of sulfate) to immobilize any barium present by conversion to insoluble barium sulfate. After treatment, the cells were capped with 3 feet of soil.	The BERA dataset was used to characterize current environmental conditions assuming chronic exposure. Chronic exposures are assumed, but likely conservative given the limited attractive habitat in the barium sulfate area.
	Future	NA	This area is not anticipated to be used for industrial activities. The future land use is expected to be similar to the current land use.	Given the area will no longer support industrial operations, future industrial land use was not evaluated. The current condition was used as a surrogate to characterize future conditions in which the land is allowed to become fallow. Use of the current condition is considered to be conservative given ongoing weathering and there are no plans for future use as a disposal area.
PRI 11 ATI Titanium & USM Parking	Current	None	This PRI includes the ATI Titanium Plant and USM parking lot. It contains an industrial facility and associated infrastructure.	Given continued use as a facility or parking, environmental conditions under the current scenario were not evaluated.
	Future	None	Industrial land use in the future is assumed to be similar to current land use. There is no expectation that the facility or parking lot will be demolished and the land will be allowed to become fallow.	Given continued use as a facility or parking, environmental conditions for the future land use scenario were not evaluated.
PRI 12 Ancillary Worker Exposure Area	Current	Upland	This PRI includes the Hill Brother Chemicals industrial facility immediately south-southeast of the USM Plant. The southern strip of the PRI consists of ruderal habitat.	The BERA dataset was used to characterize current environmental conditions. Chronic exposures are assumed in PRI 12.
	Future	Upland	Future industrial land use is assumed to similar to current industrial land use. There is no expectation that the Hill Brothers facility will be demolished and the land will be allowed to go fallow.	The current condition was used as a surrogate to characterize conditions in the future assuming continued industrial land use. Use of the current condition is considered to be appropriate given that future operations are anticipated to be similar to current operations.
PRI 13 NE Buffer Area	Current	Lakebed	This PRI is situated in the bed of the GSL to the north and east of the OWP and to the north of the north dike of the USM solar evaporation ponds. The GSL Intake Canal, which supplies brine from GSL to the USM solar evaporation ponds, and the SVDD run through PRI 13, but these ditches are considered separate exposure units. From about 2007 to 2016 there was an input of non-contact cooling water to the SVDD near the northeastern boundary of PRI 7 that was discharged from the ATI facility under Utah Pollutant Discharge Elimination System (UPDES), Major Industrial Permit No. UT0025755. However, the freshwater input from the Former ATI Discharge has been discontinued which has eliminated the source of fresh water.	The BERA dataset was used to characterize current environmental conditions. Chronic exposures are assumed in PRI 13.
	Future	NA	This area is not anticipated to be used for industrial activities. The land is assumed to remain fallow in the future.	The area will not be used for industrial activities. Given anticipated similar conditions, the current condition was used as a surrogate to characterize conditions in the future assuming the land is fallow and exposures are chronic.
PRI 14 SE Buffer Area	Current	Upland and Lakebed	This PRI is situated in the bed of the GSL and associated shore and berm areas to the south of the CWP and OWP and south of the north dike of the USM solar evaporation pond 1 North. PRI 14 includes a portion of Solar Evaporation Pond 1 North and a former solar evaporation pond (sometimes referred as "Pond 1 West") which received wastewater discharges between 1984 and 1985. A groundwater seepage area is present at the north edge of Pond 1 West. A portion of the SVDD traverses PRI 14.	The BERA dataset was used to characterize current environmental conditions. Chronic exposures are assumed in PRI 14.
	Future	NA	The current activities (solar evaporation ponds, pumps, canals) are not expected to change and the land is expected to remain fallow.	The area will not be used for industrial activities. Given anticipated similar conditions, the current condition was used as a surrogate to characterize conditions in the future assuming the land is fallow and exposures are chronic.
PRI 15 Alluvial Upland Buffer Area (Lakeside Valley)	Current	Upland	This PRI includes the alluvial upland or grassland from the bed of the GSL to the Tooele County Road along the foot of the Lakeside Mountains west of the site. A portion of the SVDD traverses the southern half of PRI 15.	The BERA dataset was used to characterize current environmental conditions. Chronic exposures are assumed in PRI 15.
	Future	NA	This area is not anticipated to be used for industrial activities. The land is assumed to remain fallow in the future.	The area will not be used for industrial activities. Given anticipated similar conditions, the current condition was used as a surrogate to characterize conditions in the future assuming the land is fallow and exposures are chronic.
PRI 16 Lakeside Mountains	Current	Upland	PRI 16 includes the foothills and the Lakeside Mountains west of the Tooele County Road.	The BERA dataset was used to characterize current environmental conditions. Chronic exposures are assumed in PRI 16.
	Future	NA	This area is not anticipated to be used for industrial activities. The land is assumed to remain fallow in the future.	The area will not be used for industrial activities. Given anticipated similar conditions, the current condition was used as a surrogate to characterize conditions in the future assuming the land is fallow and exposures are chronic.
Skull Valley Diversion Ditch (SVDD)	Current	Lakebed	The SVDD does not directly receive wastewater; however, during late winter to early summer when the wastewater level in the CWP is at its peak, wastewater may seep through the berm separating the SVDD and the CWP. Earthen berms have been placed in the SVDD to contain potential wastewater seepage. USM permanently ceased use of the section of the SVDD adjacent to the CWP and an alternative alignment for the SVDD has being developed that routed Skull Valley discharge farther away from the CWP. This alternative alignment follows the P-11 canal through PRI 13 to the south of the CWP. Additionally, the entire length of the SVDD within PRI 5 is within the RWP and the portion of the SVDD adjacent to PRI 7 has been filled and covered by an earthen dike as part of the RWP construction.	The BERA dataset was used to characterize current environmental conditions in SVDD. Chronic exposures are assumed in the SVDD.
	Future	NA	Not a reasonable scenario since the realignment and RWP construction will eliminate the current ditch.	Given the ditch will cease to exist after the realignment and RWP construction, the future scenario is not applicable.
Great Salt Lake Intake Canal (GSLIC)	Current	Lakebed	The GSL Intake Canal, which supplies brine from GSL to the USM solar evaporation ponds, runs through PRI 13.	The BERA dataset was used to characterize current environmental conditions in GSLIC. Chronic exposures are assumed in the GSLIC.
	Future	Lakebed	The current activities are not expected to change and the land is expected to remain fallow.	The area will not be used for industrial activities. Given anticipated similar conditions, the current condition was used as a surrogate to characterize conditions in the future assuming the land is fallow and exposures are chronic.

Notes:
NA - not applicable
USM = US Magnesium LLC

Table 2-10
Summary of Solid Media COPECs
US Magnesium LLC
Tooele County, Utah

Analyte	Cas #	PRI 1*	PRI 2	PRI 3*	PRI 4	PRI 5[b]	PRI 6[b]	PRI 7	PRI 8[b]	PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14[b]	PRI 15	PRI 16	SVDD	GSLIC
Calculated TEQ (ND=0), Mammalian	CALC_DX_0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Calculated TEQ (ND=1/2 DL), Mammalian	CALC_DX_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Calculated TEQ (ND=0), Avian	CALC_DX_0_AV	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Calculated TEQ (ND=1/2 DL), Avian	CALC_DX_2_Av	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Total PCBs	1336-36-3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Total Aluminum	7429-90-5			X					X										
Total Antimony	7440-36-0	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Total Arsenic	7440-38-2	X		X	X	X		X										X	X
Total Barium	7440-39-3	X		X		X	X		X		X					X			
Total Beryllium	7440-41-7									X									
Total Cadmium	7440-43-9			X				X										X	X
Total Calcium	7440-70-2																		
Total Chromium	7440-47-3	X	X	X		X		X		X								X	X
Total Cobalt	7440-48-4									X									
Total Copper	7440-50-8		X	X															
Total Iron	7439-89-6	X		X				X										X	X
Total Lead	7439-92-1																		
Total Magnesium	7439-95-4																		
Total Manganese	7439-96-5							X		X					X			X	X
Total Mercury	7439-97-6	X		X	X		X												
Total Molybdenum	7439-98-7	X	X	X	X	X	X	X		X								X	X
Total Nickel	7440-02-0	X	X	X						X									
Total Potassium	7440-09-7																		
Total Selenium	7782-49-2	X		X		X	X	X		X								X	X
Total Silver	7440-22-4			X															
Total Sodium	7440-23-5																		
Total Thallium	7440-28-0																		
Total Vanadium	7440-62-2	X	X	X	X	X		X	X	X	X							X	X
Total Zinc	7440-66-6		X	X						X	X			X				X	X
Hexachlorobenzene	118-74-1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
1,1'-Biphenyl	92-52-4																		
1,2,4,5-Tetrachlorobenzene	95-94-3	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]
2,3,4,6-Tetrachlorophenol	58-90-2																		
2,4,5-Trichlorophenol	95-95-4																		
2,4,6-Trichlorophenol	88-06-2	X																	
2,2-Oxybis(1-chloropropane)	108-60-1																		
2,4-Dichlorophenol	120-83-2																		
2,4-Dimethylphenol	105-67-9																		
2,4-Dinitrophenol	51-28-5								X	X		X	X						
2,4-Dinitrotoluene	121-14-2																		
2,6-Dinitrotoluene	606-20-2																		
2-Chloronaphthalene	91-58-7																		
2-Chlorophenol	95-57-8																		
2-Methylphenol	95-48-7																		
2-Nitroaniline	88-74-4																		
2-Nitrophenol	88-75-5																		
3,3'-Dichlorobenzidine	91-94-1																		
3-Nitroaniline	99-09-2																		
4,6-Dinitro-2-methylphenol	534-52-1					X			X										
4-Bromophenyl-phenylether	101-55-3																		

Table 2-10
Summary of Solid Media COPECs
US Magnesium LLC
Tooele County, Utah

Analyte	Cas #	PRI 1*	PRI 2	PRI 3*	PRI 4	PRI 5[b]	PRI 6[b]	PRI 7	PRI 8[b]	PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14[b]	PRI 15	PRI 16	SVDD	GSLIC
4-Chloro-3-methylphenol	59-50-7																		
4-Chloroaniline	106-47-8																		
4-Chlorophenyl-phenylether	7005-72-3																		
3 & 4 Methylphenol	15831-10-4	X																	
4-Nitroaniline	100-01-6																		
4-Nitrophenol	100-02-7																		
Acetophenone	98-86-2																		
Benzaldehyde	100-52-7																		
Benzylbutylphthalate	85-68-7		X									X							
Bis(2-chloroethoxy)methane	111-91-1																		
bis(2-Chloroethyl) ether	111-44-4																		
Bis(2-ethylhexyl)phthalate	117-81-7		X	X															
Carbazole	86-74-8																		
Dibenzofuran	132-64-9																		
Diethyl phthalate	84-66-2																		
Dimethylphthalate	131-11-3																		
Di-n-butylphthalate	84-74-2		X																
Di-n-octylphthalate	117-84-0																		
Hexachlorobutadiene	87-68-3	X	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]
Hexachlorocyclopentadiene	77-47-4	X																	
Hexachloroethane	67-72-1																		
Isophorone	78-59-1																		
Nitrobenzene	98-95-3																		
N-Nitrosodimethylamine	62-75-9																		
N-Nitroso-di-n-propylamine	621-64-7																		
N-Nitrosodiphenylamine	86-30-6																		
Pentachlorobenzene	608-93-5	X		X	X	X	X	X										X	X
Pentachlorophenol	87-86-5	X							X										
Phenol	108-95-2					X	X								X				
Low Molecular Weight PAH (ND=0)	LPAH-0																		
Low Molecular Weight PAH (ND=1/2DL)	LPAH-5																		
High Molecular Weight PAH (ND=0)	HPAH-0		X																
High Molecular Weight PAH (ND=1/2DL)	HPAH-5		X																
1,4-Dioxane	123-91-1																		
1,1-Dichloroethane	75-34-3	X				X	X	X										X	X
1,1-Dichloroethene	75-35-4																		
1,2-Dibromo-3-chloropropane	96-12-8																		
1,2-Dibromoethane	106-93-4																		
1,2-Dichlorobenzene	95-50-1																		
1,2-Dichloroethane	107-06-2																		
cis-1,2-Dichloroethene	156-59-2																		
trans-1,2-Dichloroethene	156-60-5																		
1,2-Dichloropropane	78-87-5																		
1,3-Dichlorobenzene	541-73-1																		
cis-1,3-Dichloropropene	10061-01-5																		
trans-1,3-Dichloropropene	10061-02-6																		
1,4-Dichlorobenzene	106-46-7	X																	
1,1,1-Trichloroethane	71-55-6																		
1,1,2-Trichloroethane	79-00-5																		
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1																		

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Summary of Solid Media COPECs
US Magnesium LLC
Tooele County, Utah

Analyte	Cas #	PRI 1*	PRI 2	PRI 3*	PRI 4	PRI 5[b]	PRI 6[b]	PRI 7	PRI 8[b]	PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14[b]	PRI 15	PRI 16	SVDD	GSLIC
1,2,3-Trichlorobenzene	87-61-6																		
1,2,4-Trichlorobenzene	120-82-1	X		X		X		X										X	X
1,1,2,2-Tetrachloroethane	79-34-5																		
2-Butanone	78-93-3	X				X		X										X	X
2-Hexanone	591-78-6																		
4-Methyl-2-pentanone	108-10-1	X																	
Acetone	67-64-1	X				X	X	X	X						X			X	X
Benzene	71-43-2																		
Bromochloromethane	74-97-5																		
Bromodichloromethane	75-27-4	X				X													
Bromoform	75-25-2	X				X													
Bromomethane	74-83-9	X				X													
Carbon disulfide	75-15-0	X				X		X										X	X
Carbon tetrachloride	56-23-5	X																	
Chlorobenzene	108-90-7																		
Cyclohexane	110-82-7																		
Dibromochloromethane	124-48-1	X				X													
Chloroethane	75-00-3																		
Chloroform	67-66-3	X				X			X										
Chloromethane	74-87-3																		
Dichlorodifluoromethane (Freon-12)	75-71-8																		
Ethyl benzene	100-41-4	X																	
Isopropylbenzene	98-82-8																		
Methyl tert-butyl ether (MTBE)	1634-04-4																		
Dichloromethane (Methylene chloride)	75-09-2																		
Styrene	100-42-5																		
Tetrachloroethene	127-18-4	X				X													
Toluene	108-88-3																		
Trichloroethene	79-01-6																		
Trichlorofluoromethane (Freon-11)	75-69-4																		
Vinyl chloride	75-01-4																		
o-Xylene	95-47-6																		
m,p-Xylenes	179601-23-1																		
Perchlorate	14797-73-0																		
Cyanide, Total	74-90-8	X		X		X									X				

Notes:
[a] = Not detected but retained as a COPEC in the SLERA since the constituent is a bioaccumulative. Non-detected constituents were not retained in the BERA.
b = COPEC lists for lakebed and upland habitats do not match in these PRIs because for specific analytes in one of the habitats, all samples were nondetects and not included as a COPEC.
** Since PRI 1 and PRI 3 have been remediated under RCRA, COPECs only found in these PRIs have not been retained further in the BERA.*
BERA = Baseline ecological risk assessment
COPEC = Constituent of Potential Ecological Concern
GSLIC = Great Salt Lake Inlet Canal
ND=0 = Non-detected values substituted with 0
ND=1/2DL = Non-detected values substituted with half the detection limit
PAH = Polycyclic aromatic hydrocarbon
PRI = Preliminary Remediation Investigation
SLERA = Screening-level ecological risk assessment
SVDD = Skull Valley Diversion Ditch
TEQ = Dioxin/furan toxicity equivalence factor
X = COPEC

Table 2-11
Summary of Water COPECs
US Magnesium LLC
Tooele County, Utah

Analyte	Cas #	Surface Water (COPEC)
Calculated TEQ (ND=0), Mammalian	CALC_DX_0	X
Calculated TEQ (ND=1/2 DL), Mammalian	CALC_DX_2	X
Calculated TEQ (ND=0), Avian	CALC_DX_0_AV	X
Calculated TEQ (ND=1/2 DL), Avian	CALC_DX_2_Av	X
Total PCBs	1336-36-3	X
Aluminum	7429-90-5	X
Antimony	7440-36-0	X
Arsenic	7440-38-2	X
Barium	7440-39-3	X
Beryllium	7440-41-7	X
Cadmium	7440-43-9	X
Calcium	7440-70-2	
Chromium	7440-47-3	X
Chromium, Hexavalent	18540-29-9	X
Cobalt	7440-48-4	X
Copper	7440-50-8	X
Iron	7439-89-6	X
Lead	7439-92-1	X
Magnesium	7439-95-4	
Manganese	7439-96-5	X
Mercury	7439-97-6	X
Molybdenum	7439-98-7	X
Nickel	7440-02-0	X
Potassium	7440-09-7	
Selenium	7782-49-2	X
Silver	7440-22-4	X
Sodium	7440-23-5	
Thallium	7440-28-0	X
Vanadium	7440-62-2	X
Zinc	7440-66-6	X
1,1'-Biphenyl	92-52-4	
1,2,4,5-Tetrachlorobenzene	95-94-3	X
2,3,4,6-Tetrachlorophenol	58-90-2	
2,4,5-Trichlorophenol	95-95-4	
2,4,6-Trichlorophenol	88-06-2	
2,2-Oxybis(1-chloropropane)	108-60-1	
2,4-Dichlorophenol	120-83-2	
2,4-Dimethylphenol	105-67-9	
2,4-Dinitrophenol	51-28-5	
2,4-Dinitrotoluene	121-14-2	
2,6-Dinitrotoluene	606-20-2	
2-Chloronaphthalene	91-58-7	
2-Chlorophenol	95-57-8	
2-Methylphenol	95-48-7	
2-Nitroaniline	88-74-4	
2-Nitrophenol	88-75-5	
3,3'-Dichlorobenzidine	91-94-1	
3-Nitroaniline	99-09-2	
4,6-Dinitro-2-methylphenol	534-52-1	
4-Bromophenyl-phenylether	101-55-3	
4-Chloro-3-methylphenol	59-50-7	
4-Chloroaniline	106-47-8	
4-Chlorophenyl-phenylether	7005-72-3	
3 & 4 Methylphenol	15831-10-4	
4-Nitroaniline	100-01-6	
4-Nitrophenol	100-02-7	X
Acetophenone	98-86-2	
Benzaldehyde	100-52-7	
Benzylbutylphthalate	85-68-7	
Bis(2-chloroethoxy)methane	111-91-1	
bis(2-Chloroethyl) ether	111-44-4	

Table 2-11
Summary of Water COPECs
US Magnesium LLC
Tooele County, Utah

Analyte	Cas #	Surface Water (COPEC)
Bis(2-ethylhexyl)phthalate	117-81-7	X
Carbazole	86-74-8	
Dibenzofuran	132-64-9	
Diethyl phthalate	84-66-2	
Dimethylphthalate	131-11-3	
Di-n-butylphthalate	84-74-2	
Di-n-octylphthalate	117-84-0	
Hexachlorobenzene	118-74-1	X
Hexachlorobutadiene	87-68-3	X
Hexachlorocyclopentadiene	77-47-4	
Hexachloroethane	67-72-1	
Isophorone	78-59-1	
Nitrobenzene	98-95-3	
N-Nitrosodimethylamine	62-75-9	
N-Nitroso-di-n-propylamine	621-64-7	
N-Nitrosodiphenylamine	86-30-6	
Pentachlorobenzene	608-93-5	X
Pentachlorophenol	87-86-5	X
Phenol	108-95-2	
2-Methylnaphthalene	91-57-6	
Acenaphthene	83-32-9	
Acenaphthylene	208-96-8	
Anthracene	120-12-7	
Benzo(a)anthracene	56-55-3	
Benzo(a)pyrene	50-32-8	
Benzo(b)fluoranthene	205-99-2	
Benzo(g,h,i)perylene	191-24-2	
Benzo(k)fluoranthene	207-08-9	
Chrysene	218-01-9	
Dibenzo(a,h)anthracene	53-70-3	
Fluoranthene	206-44-0	
Fluorene	86-73-7	
Indeno(1,2,3-cd)pyrene	193-39-5	
Naphthalene	91-20-3	X
Phenanthrene	85-01-8	
Pyrene	129-00-0	
Low Molecular Weight PAH (ND=0)	LPAH-0	
Low Molecular Weight PAH (ND=1/2DL)	LPAH-5	
High Molecular Weight PAH (ND=0)	HPAH-0	
High Molecular Weight PAH (ND=1/2DL)	HPAH-5	
1,4-Dioxane	123-91-1	
1,1-Dichloroethane	75-34-3	
1,1-Dichloroethene	75-35-4	
1,2-Dibromo-3-chloropropane	96-12-8	
1,2-Dibromoethane	106-93-4	
1,2-Dichlorobenzene	95-50-1	
1,2-Dichloroethane	107-06-2	
cis-1,2-Dichloroethene	156-59-2	
trans-1,2-Dichloroethene	156-60-5	
1,2-Dichloropropane	78-87-5	
1,3-Dichlorobenzene	541-73-1	
cis-1,3-Dichloropropene	10061-01-5	
trans-1,3-Dichloropropene	10061-02-6	
1,4-Dichlorobenzene	106-46-7	
1,1,1-Trichloroethane	71-55-6	
1,1,2-Trichloroethane	79-00-5	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	
1,2,3-Trichlorobenzene	87-61-6	
1,2,4-Trichlorobenzene	120-82-1	
1,1,2,2-Tetrachloroethane	79-34-5	
2-Butanone	78-93-3	

Table 2-11
Summary of Water COPECs
US Magnesium LLC
Tooele County, Utah

Analyte	Cas #	Surface Water (COPEC)
2-Hexanone	591-78-6	
4-Methyl-2-pentanone	108-10-1	
Acetone	67-64-1	
Benzene	71-43-2	
Bromochloromethane	74-97-5	
Bromodichloromethane	75-27-4	
Bromoform	75-25-2	X
Bromomethane	74-83-9	X
Carbon disulfide	75-15-0	X
Carbon tetrachloride	56-23-5	X
Chlorobenzene	108-90-7	
Cyclohexane	110-82-7	
Dibromochloromethane	124-48-1	
Chloroethane	75-00-3	
Chloroform	67-66-3	X
Chloromethane	74-87-3	
Dichlorodifluoromethane (Freon-12)	75-71-8	
Ethyl benzene	100-41-4	X
Isopropylbenzene	98-82-8	
Methyl tert-butyl ether (MTBE)	1634-04-4	
Dichloromethane (Methylene chloride)	75-09-2	
Styrene	100-42-5	
Tetrachloroethene	127-18-4	
Toluene	108-88-3	X
Trichloroethene	79-01-6	
Trichlorofluoromethane (Freon-11)	75-69-4	
Vinyl chloride	75-01-4	
o-Xylene	95-47-6	
m,p Xylenes	179601-23-1	X
Total Dissolved Solids	TDS	
Bromide	24959-67-9	
Chloride	16887-00-6	X
Chlorine, Field	7782-50-5	X
Total Cyanide - Filtered	74-90-8	X
Total Cyanide - Unfiltered	74-90-8	X
Fluoride	16984-48-8	
Nitrate as N	14797-55-8	X
Nitrite as N	14797-65-0	
Sulfate	14808-79-8	
Perchlorate	14797-73-0	
Monochloroacetic Acid	79-11-8	
Monobromoacetic acid	79-08-3	
Dichloroacetic Acid	79-43-6	
Dibromoacetic acid	631-64-1	
Trichloroacetic acid	76-03-9	
Total Alkalinity	ALK	
Orthophosphate as P	PHOSPHATE AS P	
Hydrogen Chloride as acidic wastewater	7647-01-0	X[1]

Notes:
[1] Hydrogen Chloride, as acidic wastewater, was not identified as a surface water COPEC in the SLERA.
It has been added to the surface water COPEC list for the BERA at the request of the BTAG.
BERA = Baseline ecological risk assessment
BTAG = Biological Technical Assistance Group
COPEC = Constituent of potential ecological concern
ND=0 = Non-detected values substituted with 0
ND=1/2DL = Non-detected values substituted with half the detection limit
PAH = Polycyclic aromatic hydrocarbon
SLERA = Screening-level ecological risk assessment
TEQ = Dioxin/furan toxicity equivalence factor
X = COPEC

Table 2-12
Assessment and Measurement Endpoints per PRI
US Magnesium LLC
Tooele County, Utah

PRI	PRI Description	Land Use Scenario	Habitat	Assessment Endpoint	Measurement Endpoint/Line of Evidence[1]
PRI 1	Former Ditches	Current and Future	NA	NA	NA
PRI 2	Landfill	Current and Future	Upland	Protection of Survival of Upland Gleaning Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Aerial Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Herbivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Carnivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Invertivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Herbivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Carnivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
PRI 3	Sanitary Lagoon	Current and Future	Upland	NA	NA
PRI 4	Gypsum Pile	Current[2]	Upland	Protection of Survival of Upland Gleaning Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Aerial Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Herbivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Carnivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Invertivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Herbivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Carnivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
PRI 5	SE Ponded Waste Lagoon	Current[2]	Upland and Lakebed[3]	Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland Gleaning Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Measured Bird Egg Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Survival of Lakebed Probing Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival HQs: Measured Bird Egg Concentration Compared to Critical Tissue Concentration Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Aerial Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Herbivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Carnivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Invertivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Survival of Lakebed Herbivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Survival of Lakebed Carnivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival

Table 2-12
Assessment and Measurement Endpoints per PRI
US Magnesium LLC
Tooele County, Utah

PRI	PRI Description	Land Use Scenario	Habitat	Assessment Endpoint	Measurement Endpoint/Line of Evidence[1]
PRI 6	NW Ponded Waste Lagoon	Current[2]	Upland and Lakebed[3]	Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland Gleaning Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Survival of Lakebed Probing Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Aerial Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Herbivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Carnivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater
				Protection of Survival of Lakebed Invertivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Survival of Lakebed Herbivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Survival of Lakebed Carnivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
PRI 7	Northeast Ponded Waste Lagoon	Current[2]	Lakebed[3,4]	Protection of Survival of Lakebed Probing Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival HQs: Measured Bird Egg Concentration Compared to Critical Tissue Concentration Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Survival of Lakebed Aerial Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Survival of Lakebed Herbivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Survival of Lakebed Carnivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Survival of Lakebed Invertivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Survival of Lakebed Herbivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Survival of Lakebed Carnivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
				Protection of Aquatic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Surface Water Concentration Compared to Benchmark HQs: Modeled Aquatic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Benthic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Sediment Concentration Compared to Sediment Quality Benchmark HQs: Modeled Benthic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Lakebed Probing Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival HQs: Measured Bird Egg Concentration Compared to Critical Tissue Concentration Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success

Table 2-12
Assessment and Measurement Endpoints per PRI
US Magnesium LLC
Tooele County, Utah

PRI	PRI Description	Land Use Scenario	Habitat	Assessment Endpoint	Measurement Endpoint/Line of Evidence[1]
PRI 7 (cont'd)	Northeast Ponded Waste Lagoon	Current[2]	Lakebed[3,4]	Protection of Growth, Reproduction, and Survival of Lakebed Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival Site-Specific Toxicity Studies: Palatability and Acute Toxicity of Acidic Wastewater Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Acute TRV for Survival
PRI 8	NW Lagoon Overflow	Current and Future	Upland and Lakebed	Protection of Aquatic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Surface Water Concentration Compared to Benchmark HQs: Modeled Aquatic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Benthic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Sediment Concentration Compared to Sediment Quality Benchmark HQs: Modeled Benthic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Gleaning/Probing Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Carnivorous Mammals due to Chronic Exposure	Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
PRI 9	Smut Area	Current and Future	Upland	Protection of Survival of Upland Gleaning Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Aerial Invertivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Herbivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Carnivorous Birds due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Invertivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Herbivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
				Protection of Survival of Upland Carnivorous Mammals due to Acute Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Acute TRV for Survival
PRI 10	Barium Sulfate Area	Current and Future	Upland	Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland Gleaning Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival

Table 2-12
Assessment and Measurement Endpoints per PRI
US Magnesium LLC
Tooele County, Utah

PRI	PRI Description	Land Use Scenario	Habitat	Assessment Endpoint	Measurement Endpoint/Line of Evidence[1]
PRI 11	ATI Titanium & USM Parking	Current and Future	None	N/A	N/A
PRI 12	Ancillary Worker Exposure Area	Current and Future	Upland	Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland Gleaning Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
PRI 13	NE Buffer Area	Current and Future	Lakebed	Protection of Aquatic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Surface Water Concentration Compared to Benchmark HQs: Modeled Aquatic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Benthic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Sediment Concentration Compared to Sediment Quality Benchmark HQs: Modeled Benthic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Lakebed Probing Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Measured Bird Egg Concentration Compared to Critical Tissue Concentration Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Lakebed Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
PRI 14	SE Buffer Area	Current and Future	Upland and Lakebed	Protection of Aquatic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Surface Water Concentration Compared to Benchmark HQs: Modeled Aquatic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Benthic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Sediment Concentration Compared to Sediment Quality Benchmark HQs: Modeled Benthic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Gleaning/Probing Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Measured Bird Egg Concentration Compared to Critical Tissue Concentration Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival Ecological Field Surveys: Avian Reproductive Success
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland and Lakebed Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration

Table 2-12
Assessment and Measurement Endpoints per PRI
US Magnesium LLC
Tooele County, Utah

PRI	PRI Description	Land Use Scenario	Habitat	Assessment Endpoint	Measurement Endpoint/Line of Evidence[1]
PRI 14 (cont'd)	SE Buffer Area	Current and Future	Upland and Lakebed	Protection of Growth, Reproduction, and Survival of Upland and Lakebed Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Large Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
PRI 15	Alluvial Upland Buffer Area	Current and Future	Upland	Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland Gleaning Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Large Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
PRI 16	Lakeside Mountains	Current and Future	Upland	Protection of Terrestrial Plant Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Terrestrial Plants HQs: Modeled Terrestrial Plant Concentration Compared to Critical Tissue Benchmark
				Protection of Soil Invertebrate Community Structure and Function due to Chronic Exposure	HQs: Measured Upland Soil Concentration Compared to Benchmark for Soil Invertebrates HQs: Modeled Soil Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Upland Gleaning Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Upland Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Upland Large Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Upland Soil) Compared to Chronic TRV for Growth, Reproduction, or Survival
SVDD	Skull Valley Diversion Ditch	Current	Lakebed	Protection of Aquatic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Surface Water Concentration Compared to Benchmark HQs: Modeled Aquatic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Benthic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Sediment Concentration Compared to Sediment Quality Benchmark HQs: Modeled Benthic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Lakebed Probing Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
		Future	NA	NA	NA

Table 2-12
Assessment and Measurement Endpoints per PRI
US Magnesium LLC
Tooele County, Utah

PRI	PRI Description	Land Use Scenario	Habitat	Assessment Endpoint	Measurement Endpoint/Line of Evidence[1]
GSLIC	Great Salt Lake Inlet Canal	Current and Future	Lakebed	Protection of Aquatic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Surface Water Concentration Compared to Benchmark HQs: Modeled Aquatic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Benthic Biota Community Structure and Function due to Chronic Exposure	HQs: Measured Lakebed Sediment Concentration Compared to Sediment Quality Benchmark HQs: Modeled Benthic Invertebrate Concentration Compared to Critical Tissue Benchmark
				Protection of Growth, Reproduction, and Survival of Lakebed Probing Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Aerial Invertivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Birds due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival
				Protection of Growth, Reproduction, and Survival of Lakebed Invertivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Herbivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival HQs: Modeled Small Mammal Concentration Compared to Critical Tissue Concentration
				Protection of Growth, Reproduction, and Survival of Lakebed Carnivorous Mammals due to Chronic Exposure	HQs: Modeled Dose (using Lakebed Sediment) Compared to Chronic TRV for Growth, Reproduction, or Survival

Notes:
[1] Bird eggs were only evaluated in exposure units where they were collected.
[2] Future hypothetical scenarios for PRIs in the RCRA Carve-Out were evaluated separately in Appendix C.
[3] It is assumed there is no exposure to aquatic biota, benthic biota, birds, and mammals in and around the Waste Pond lagoons due to high acidity. However, acute exposure to birds and mammals was evaluated as a conservative assumption.
[4] Upland areas in PRI 7 are limited to small developed areas in which no soil samples were collected. Therefore, upland receptors were not evaluated for PRI 7.
GSLIC = Great Salt Lake Inlet Canal
HQ = Hazard quotient
NA = not applicable (risk calculations not performed)
PRI = Preliminary Remediation Investigation
RCRA = Resource Conservation and Recovery Act
SVDD = Skull Valley Diversion Ditch
TRV = Toxicity reference value
USM = US Magnesium LLC

Table 2-13
Representative Wildlife Receptors of Concern
US Magnesium LLC
Tooele County, Utah

Receptor Groups	Habitat Type	Representative Species[1]
Gleaning Invertivorous Bird	Upland	Horned lark
Probing Invertivorous Bird	Lakebed	American avocet, snowy plover
Aerial Invertivorous Bird	Upland and Lakebed	Tree swallow
Carnivorous Bird	Upland and Lakebed	American kestrel
Herbivorous Bird	Upland and Lakebed	Mourning dove
Invertivorous Mammal	Upland and Lakebed	Grasshopper mouse
Herbivorous Mammal	Upland and Lakebed	Ord's kangaroo rat
Carnivorous Mammal	Upland and Lakebed	Badger
Large Herbivorous Mammal	Upland	Pronghorn antelope

Notes:
[1] Representative species are used to infer the potential for adverse impacts to taxonomically and functionally related receptors of interest.

Table 2-14
Comparisons Among Herbivore, Invertivore, and Omnivore – Example Calculation for Copper
US Magnesium LLC
Tooele County, Utah

Representative Spp	Body Weight (g)	Food Ingestion Rate (g/day)	Soil Ingestion Rate (g/day)	Home Range (ha)	Soil EPC (mg/kg)	Food EPC (mg/kg)	Dose (mg/kg-d)	TRV (mg/kg-d)	HQ
Kangaroo rat (h)	38	5.4	0.17	1.4	250	18	0.61	9.34	0.07
Grasshopper mouse (i)	65	5.5	0.11	2.3	250	129	3.43	9.34	0.4
Deer mouse (o)	63	7.1	0.14	1.4	250	18 (plant) 129 (invert)	1.37	9.34	0.2
Badger (c)	7000	246	23	220	250	17	0.0026	9.34	0.0003

Notes:
Assumes an exposure area of 0.405 ha (1 acre)
Exposure factors for all Representative Wildlife Receptors are presented in Table 2-8
h = Representative herbivore
i = Representative invertivore
o = Omnivore (diet of 50% plant and 50% invertebrates)
c = Representative carnivore (included for completeness)
EPC = Exposure point concentration
g = Grams
ha = Hectare
HQ = Hazard quotient
mg/kg = Milligrams per kilogram
mg/kg-d = Milligrams per kilogram per day
TRV = Toxicity reference value

Table 2-15
Exposure Point Concentration Types For Direct Contact Exposures
US Magnesium LLC
Tooele County, Utah

			EPC Types for Upland Receptors		EPC Types for Lakebed Receptors	
Exposure Unit	**Habitat within Exposure Unit**	**Assumed Exposures**	**Terrestrial Invertebrates**	**Terrestrial Plants**	**Aquatic Biota**	**Benthic Invertebrates**
PRI 1	-	No exposure due to remediation[a]	-	-	-	-
PRI 2	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	-	-	-	-
PRI 3	-	No exposure due to remediation[a]	-	-	-	-
PRI 4	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	-	-	-	-
PRI 5	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Acute exposure for birds and mammals in lakebed habitat, no exposure for plants and invertebrates in lakebed habitat (3) ILT exposure for probing birds in lakebed habitat	Pt-by-Pt	Pt-by-Pt	-	-
PRI 6	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Acute exposure for birds and mammals in lakebed habitat, no exposure for plants and invertebrates in lakebed habitat (3) ILT exposure for probing birds in lakebed habitat	Pt-by-Pt	Pt-by-Pt	-	-
PRI 7	lakebed	(1) Acute exposure for birds and mammals, no exposure for aquatic biota and benthic invertebrates (2) ILT exposure for probing birds (3) Chronic exposure for all receptors	-	-	Pt-by-Pt	Pt-by-Pt
PRI 8	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Chronic exposure for all receptors in lakebed habitat	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 9	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	-	-	-	-
PRI 10	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	-	-
PRI 11	-	No exposure due to no habitat	-	-	-	-
PRI 12	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	-	-
PRI 13	lakebed	(1) Chronic exposure for all receptors	-	-	Pt-by-Pt	Pt-by-Pt
PRI 14	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Chronic exposure for all receptors in lakebed habitat	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 15	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	-	-
PRI 16	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	-	-
SVDD	lakebed	(1) Chronic exposure for all receptors	-	-	Pt-by-Pt	Pt-by-Pt
GSLIC	lakebed	(1) Chronic exposure for all receptors	-	-	Pt-by-Pt	Pt-by-Pt

Notes:
[a] PRI 1 and PRI 3 are not evaluated because these exposure units have been remediated per the RCRA Carve-out Cleanup Project.
- = Not applicable because habitat is not found in the exposure unit or because habitat does not support the receptor.
Pt-by-Pt EPCs used for direct contact exposures in exposure units with chronic exposure.
EPC = Exposure point concentration
GSLIC = Great Salt Lake Inlet Canal
ILT = Infectious Laryngotracheitis
PRI = Preliminary Remediation Investigation
RCRA = Resource Conservation and Recovery Act
SVDD = Skull Valley Diversion Ditch

Table 2-16
Exposure Point Concentration Types For Daily Dose Exposures
US Magnesium LLC
Tooele County, Utah

			EPC Types for Upland Receptors								EPC Types for Lakebed Receptors							
Exposure Unit	Habitat within Exposure Unit	Assumed Exposures	horned lark	tree swallow	mourning dove	American kestrel	grasshopper mouse	Ord's kangaroo rat	badger	pronghorn antelope[a]	snowy plover	American avocet	tree swallow	mourning dove	American kestrel	grasshopper mouse	Ord's kangaroo rat	badger
PRI 1	-	No exposure due to remediation[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PRI 2	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-	-	-	-	-	-
PRI 3	-	No exposure due to remediation[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PRI 4	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-	-	-	-	-	-
PRI 5	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Acute exposure for birds and mammals in lakebed habitat, no exposure for plants and invertebrates in lakebed habitat (3) ILT exposure for probing birds in lakebed habitat	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	-	Pt-by-Pt, SWAC	Pt-by-Pt, SWAC	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 6	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Acute exposure for birds and mammals in lakebed habitat, no exposure for plants and invertebrates in lakebed habitat (3) ILT exposure for probing birds in lakebed habitat	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	-	Pt-by-Pt, SWAC	Pt-by-Pt, SWAC	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 7	lakebed	(1) Acute exposure for birds and mammals, no exposure for aquatic biota and benthic invertebrates (2) ILT exposure for probing birds (3) Chronic exposure for all receptors	-	-	-	-	-	-	-	-	Pt-by-Pt, 95UCL, SWAC	Pt-by-Pt, 95UCL, SWAC	Pt-by-Pt, 95UCL	Pt-by-Pt, 95UCL	Pt-by-Pt, 95UCL	Pt-by-Pt, 95UCL	Pt-by-Pt, 95UCL	Pt-by-Pt, 95UCL
PRI 8	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Chronic exposure for all receptors in lakebed habitat	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	-	95UCL	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL
PRI 9	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-	-	-	-	-	-
PRI 10	upland	(1) Chronic exposure for all receptors	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	-	-	-	-	-	-	-	-	-
PRI 11	-	No exposure due to no habitat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PRI 12	upland	(1) Chronic exposure for all receptors	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	-	-	-	-	-	-	-	-	-
PRI 13	lakebed	(1) Chronic exposure for all receptors	-	-	-	-	-	-	-	-	95UCL	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL
PRI 14	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Chronic exposure for all receptors in lakebed habitat	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	95UCL	95UCL	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL
PRI 15	upland	(1) Chronic exposure for all receptors	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	95UCL	-	-	-	-	-	-	-	-
PRI 16	upland	(1) Chronic exposure for all receptors	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL	95UCL	-	-	-	-	-	-	-	-
SVDD	lakebed	(1) Chronic exposure for all receptors	-	-	-	-	-	-	-	-	95UCL	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL
GSLIC	lakebed	(1) Chronic exposure for all receptors	-	-	-	-	-	-	-	-	95UCL	95UCL	95UCL	95UCL	95UCL	Pt-by-Pt	Pt-by-Pt	95UCL

Notes:
[a] Pronghorn antelope is only evaluated in outer PRIs (PRI 13, PRI 14, PRI 15, PRI 16)
[b] PRI 1 and PRI 3 are not evaluated because these exposure units have been remediated per the RCRA Carve-out Cleanup Project
- = Not applicable because habitat is not found in the exposure unit or because habitat does not support the receptor
Pt-by-Pt EPCs used for (1) acute and chronic exposure of small home range receptors and (2) acute exposure of all birds and mammals
95UCL used for chronic exposure of large home range birds and mammals
SWAC used for intermittent longer-term exposure of snowy plover and American avocet in the exposure units with acidic waste ponds
95UCL = 95 percent Uppoer Confidence Limit
ILT = Infectious Laryngotracheitis
GSLIC = Great Salt Lake Inlet Canal
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley Diversion Ditch
SWAC = Surface-weighted average concentration

Table 2-17
SWAC EPCs for Intermittent Longer-term Exposures
US Magnesium LLC
Tooele County, Utah

Land Use Scenario	Exposure Area	Habitat	Analyte	SWAC	Units
Current	CWP	Lakebed	1,1-Dichloroethane	0.00058	mg/kg
Current	CWP	Lakebed	1,2,4-Trichlorobenzene	0.00086	mg/kg
Current	CWP	Lakebed	2-Butanone	0.017	mg/kg
Current	CWP	Lakebed	Acetone	0.07	mg/kg
Current	CWP	Lakebed	Antimony	1.6	mg/kg
Current	CWP	Lakebed	Arsenic	12	mg/kg
Current	CWP	Lakebed	Avian TEQ Category 1 ND = 0	0.036	mg/kg
Current	CWP	Lakebed	Avian TEQ Category 1 ND = 1/2DL	0.036	mg/kg
Current	CWP	Lakebed	Avian TEQ Category 2 ND = 0	0.19	mg/kg
Current	CWP	Lakebed	Avian TEQ Category 2 ND = 1/2DL	0.19	mg/kg
Current	CWP	Lakebed	Avian TEQ Category 3 ND = 0	1.77	mg/kg
Current	CWP	Lakebed	Avian TEQ Category 3 ND = 1/2DL	1.77	mg/kg
Current	CWP	Lakebed	Barium	629	mg/kg
Current	CWP	Lakebed	Bromodichloromethane	0.1	mg/kg
Current	CWP	Lakebed	Bromoform	0.4	mg/kg
Current	CWP	Lakebed	Carbon disulfide	0.049	mg/kg
Current	CWP	Lakebed	Chloroform	0.03	mg/kg
Current	CWP	Lakebed	Chromium	11	mg/kg
Current	CWP	Lakebed	Dibromochloromethane	0.2	mg/kg
Current	CWP	Lakebed	Hexachlorobenzene	175	mg/kg
Current	CWP	Lakebed	Hexachlorobutadiene	5.77	mg/kg
Current	CWP	Lakebed	Mercury	0.03	mg/kg
Current	CWP	Lakebed	Molybdenum	12	mg/kg
Current	CWP	Lakebed	PCBs, Total	8.08	mg/kg
Current	CWP	Lakebed	Pentachlorobenzene	5.7	mg/kg
Current	CWP	Lakebed	Phenol	42	mg/kg
Current	CWP	Lakebed	Selenium	0.23	mg/kg
Current	CWP	Lakebed	Tetrachloroethene	0.01	mg/kg
Current	CWP	Lakebed	Total cyanide	0.2	mg/kg
Current	CWP	Lakebed	Vanadium	26	mg/kg
Current	PRI 7	Lakebed	1,1-Dichloroethane	0.00027	mg/kg
Current	PRI 7	Lakebed	1,2,4-Trichlorobenzene	0.017	mg/kg
Current	PRI 7	Lakebed	2-Butanone	0.031	mg/kg
Current	PRI 7	Lakebed	Acetone	0.12	mg/kg
Current	PRI 7	Lakebed	Antimony	0.5	mg/kg
Current	PRI 7	Lakebed	Arsenic	16.53	mg/kg
Current	PRI 7	Lakebed	Avian TEQ Category 1 ND = 0	0.0025	mg/kg
Current	PRI 7	Lakebed	Avian TEQ Category 1 ND = 1/2DL	0.0025	mg/kg
Current	PRI 7	Lakebed	Avian TEQ Category 2 ND = 0	0.0066	mg/kg
Current	PRI 7	Lakebed	Avian TEQ Category 2 ND = 1/2DL	0.0066	mg/kg
Current	PRI 7	Lakebed	Avian TEQ Category 3 ND = 0	0.048	mg/kg
Current	PRI 7	Lakebed	Avian TEQ Category 3 ND = 1/2DL	0.048	mg/kg
Current	PRI 7	Lakebed	Cadmium	0.16	mg/kg
Current	PRI 7	Lakebed	Carbon disulfide	0.027	mg/kg
Current	PRI 7	Lakebed	Chromium	23.4	mg/kg
Current	PRI 7	Lakebed	Hexachlorobenzene	4.58	mg/kg
Current	PRI 7	Lakebed	Iron	15974	mg/kg
Current	PRI 7	Lakebed	Manganese	203	mg/kg
Current	PRI 7	Lakebed	Molybdenum	7.05	mg/kg
Current	PRI 7	Lakebed	PCBs, Total	0.3	mg/kg
Current	PRI 7	Lakebed	Pentachlorobenzene	0.32	mg/kg
Current	PRI 7	Lakebed	Selenium	0.35	mg/kg
Current	PRI 7	Lakebed	Vanadium	23.16	mg/kg

Notes:

Concentrations for Avian TEQ are reported after the addition of hexachlorobenzene, with the appropriate toxicity equivalence factor applied for the respective TEQ category. However, in the risk estimates, avian TEQ without hexachlorobenzene and hexachlorobenzene are both entered separately, then combined into the dose after application of the appropriate bioaccumulation factors for each constituent.

CWP = Current Waste Pond
EPC = Exposure point concentration
mg/kg = Milligram(s) per kilogram
ND=0 = Non-detected values substituted with 0
ND=1/2DL = Non-detected values substituted with half the detection limit
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SWAC = Surface-weighted average concentration
TEQ = Toxic equivalency quotient

Table 2-18
Wildlife Exposure Factors
US Magnesium LLC
Tooele County, Utah

Receptor	Dietary Proportions [a]	Body Weight (kg)		Food Ingestion Rate [d] (g/day, dw)	Soil Ingestion Proportion		Soil Ingestion Rate (g/day, dw)	Water Ingestion Rate [b] (L/day)	Home Range (ha)	
Birds										
Snowy plover	100% invertebrates	0.046	[c]	9.92	0.180	[e]	1.78	0.007	0.827	[f]
Avocet	100% invertebrates	0.316	[g]	43.6	0.30	[h]	13.1	0.027	132.70	[i]
Tree swallow	100% invertebrates	0.0201	[g]	11.6	0.022	[j]	0.26	0.004	4.9	[k]
Mourning dove	100% vegetation	0.101	[l]	14.7	0.139	[m]	2.05	0.013	6,362	[n]
Horned lark	100% invertebrates	0.038	[c]	7.02	0.100	[o]	0.70	0.007	2.0	[p]
American kestrel	100% small mammals	0.121	[q]	20.4	0.057	[r]	1.16	0.014	38	[s]
Mammals										
Grasshopper mouse	100% invertebrates	0.038	[t]	5.54	0.02	[u]	0.11	0.005	2.3	[v]
Ord's Kangaroo Rat	100% vegetation	0.065	[w]	5.37	0.03	[x]	0.17	0.008	1.4	[y]
Badger	100% small mammals	7.0	[w]	246	0.094	[bb]	23.2	0.570	220	[cc]
Pronghorn	100% vegetation	40	[w]	667	0.02	[z]	13.3	2.738	64	[aa]

Notes:
g/day dw - grams per day dry weight
ha - hectares
kg - kilograms
L/day - liters per day
[a] Food proportions are conservatively estimated as 100% of food items in a representative feeding guild.
[b] Allometric equation from United States Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187. Office of Research and Development, USEPA, Washington, D.C.
[c] Cornell Birds of North America, online. For snowy plover, body weight average of range of 34-58 grams. For Horned lark, body weight average of range of 24-48 grams.
[d] Nagy, K.A. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B 71, 21R·31R.
Allometric equations from Nagy, 2001 were used to calculate food ingestion rate. The receptors are listed with their associated allometric group below:
For the snowy plover and avocet, the shorebird allometric group is used. For the tree swallow, the species specific/insectivorous bird is used.
For the morning dove, the horned lark, and the kestrel, the allometric groups used are the passerine bird, insectivorous bird, and carnivorous bird, respectively.
For the mammals grasshopper mouse, ord's kangaroo rat, pronghorn, and badger, the allometric groups used are the rodentia, desert rodentia, herbivore, and carnivore, respectively.

Table 2-18
Wildlife Exposure Factors
US Magnesium LLC
Tooele County, Utah

[e] Beyer, et al. 1994. Estimates of Soil Ingestion by Wildlife. The Journal of Wildlife Management 58:375-382. Value for western sandpiper.
[f] Cavitt, 2010. Average home range reported for all snowy plovers at the Site.
[g] Dunning, 1993.
[h] Beyer, et al. 1994. Value for semipalmated sandpiper.
[i] Cornell Birds of North America, online. Home range varies with breeding stage. In Utah, broods were recaptured 300-100 m from their nest. Median converted to ha.
[j] Blancher & McNicol 1991. Tree swallow diet in relation to wetland acidity. Can J Zool. 69:2629-2637.
[k] McCarty, J. P. and D. W. Winkler. 1999a. Foraging ecology and diet selectivity of tree swallows feeding nestlings. Condor no. 101 (2):246-254. When breeding/rearing, 100-150 m from nest. Median converted to ha.
[l] Dunning, 2016 online update
[m] USEPA EcoSSL 2005. Table 3 EcoSSL Attachment 4-1. 90th percentile result. Value for "dove".
[n] Cornell Birds of North America, online. Median of 1-8 km. (Converted to ha.)
[o] Rotenberry, J. T. 1980. Dietary relationships among shrubsteppe passerine birds: competition or opportunism in a variable environment. Ecol. Monogr. no. 50:93-110.
[p] Cornell Birds of North America, online. Median of territory size between 1.3 and 2.7 ha.
[q] USEPA 1993
[r] USEPA EcoSSL 2005. Table 3 EcoSSL Attachment 4-1. 90th percentile result. Value for "hawk".
[s] USFWS 1997. Foraging area for males (telemetry) during nesting (males performed most of foraging)
[t] Silva & Downing, 1994. Average body weight.
[u] Beyer, et al. 1994. Value for white-footed mouse.
[v] McCarty 1978, CAWHR https://www.wildlife.ca.gov/Data/CWHR
[w] Mammals of Texas - Online. (http://www.nsrl.ttu.edu/tmot1/). For Ord's Kangaroo Rat average of 60-70 grams.
[x] USEPA EcoSSL 2005. Table 3 EcoSSL Attachment 4-1. 90th percentile result. Value for "vole".
[y] CAWHR Database https://www.wildlife.ca.gov/Data/CWHR Reference from CA Wildlife Habitat Relationships Database:
Blair, W. F. 1943. Populations of the deer mouse and associated small mammals in the mesquite associations of southern New Mexico. Contrib. Lab. Vertebr. Biol. Univ. Mich. No. 21. 40pp
[z] Beyer, et al. 1994. Value for deer.
[aa] CAWHR Database https://www.wildlife.ca.gov/Data/CWHR. Median of range during spring and summer (0.45 km converted to ha). (Yoakum, 1978)
[bb] Beyer, et al. 1994. Value for raccoon.
[cc] Lindzey, F.G. 1978. Movement patterns of badgers in northwestern Utah. J Wildlife Mgmt 42 (2): 418–422. Average of female home ranges in Utah (137-304 ha).

Table 2-19
Site Use Factors
US Magnesium LLC
Tooele County, Utah

Habitat	Upland											Lakebed										
Representative receptor (Home Range)	*Upland Exposure Unit Area (ha)*	Horned Lark (2.0 ha)	Tree Swallow (4.9 ha)	Mourning Dove (6362 ha)	American Kestrel (38 ha)	Grasshopper Mouse (2.3 ha)	Ord's Kangaroo Rat (1.4 ha)	Badger (220 ha)	Pronghorn antelope (64 ha)	Soil Invertebrates	Terrestrial Plants	*Lakebed Exposure Unit Area (ha)*	Snowy Plover (0.827 ha)	Avocet (132.7 ha)	Tree Swallow (4.9 ha)	Mourning Dove (6362 ha)	American Kestrel (38 ha)	Grasshopper Mouse (2.3 ha)	Ord's Kangaroo Rat (1.4 ha)	Badger (220 ha)	Benthic Invertebrates	Aquatic Biota
PRI 1[a]	-	-	-	-	-	-	-	-	-	-	-	*13.35*	-	-	-	-	-	-	-	-	-	-
PRI 2	*14.47*	1.00	1.00	0.0023	0.38	1.00	1.00	0.07	0.23	1.00	1.00											
PRI 3[a]	*0.74*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PRI 4	*74.64*	1.00	1.00	0.012	1.00	1.00	1.00	0.34	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
PRI 5	*67.87*	1.00	1.00	0.011	1.00	1.00	1.00	0.31	1.00	1.00	1.00	*68.18*	1.00	0.51	1.00	0.011	1.00	1.00	1.00	0.31	1.00	1.00
PRI 6	*28.43*	1.00	1.00	0.004	0.75	1.00	1.00	0.13	0.44	1.00	1.00	*42.61*	1.00	0.32	1.00	0.007	1.00	1.00	1.00	0.19	1.00	1.00
PRI 7	-	-	-	-	-	-	-	-	-	-	-	*338.57*	1.00	1.00	1.00	0.05	1.00	1.00	1.00	1.00	1.00	1.00
PRI 8	*67*	1.00	1.00	0.011	1.00	1.00	1.00	0.30	1.00	1.00	1.00	*4.62*	1.00	0.03	1.00	0.0007	0.12	1.00	1.00	0.02	1.00	1.00
PRI 9	*45.69*	1.00	1.00	0.007	1.00	1.00	1.00	0.21	0.71	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
PRI 10	*11.78*	1.00	1.00	0.002	0.31	1.00	1.00	0.05	0.18	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
PRI 12	*29.02*	1.00	1.00	0.005	0.76	1.00	1.00	0.13	0.45	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
PRI 13	-	-	-	-	-	-	-	-	-	-	-	*5458.17*	1.00	1.00	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00
PRI 14	*453.66*	1.00	1.00	0.07	1.00	1.00	1.00	1.00	1.00	1.00	1.00	*2996.47*	1.00	1.00	1.00	0.47	1.00	1.00	1.00	1.00	1.00	1.00
PRI 15	*6062.33*	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
PRI 16	*4386.28*	1.00	1.00	0.69	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
GSLIC	-	-	-	-	-	-	-	-	-	-	-	*7.09*	1.00	0.05	1.00	0.0011	0.19	1.00	1.00	0.03	1.00	1.00
SVDD	-	-	-	-	-	-	-	-	-	-	-	*12.45*	1.00	0.09	1.00	0.002	0.33	1.00	1.00	0.06	1.00	1.00
RWP	*102.88*	1.00	1.00	0.02	1.00	1.00	1.00	0.47	1.00	1.00	1.00	*430.20*	1.00	1.00	1.00	0.07	1.00	1.00	1.00	1.00	1.00	1.00
CWP	*57.79*	1.00	1.00	0.01	1.00	1.00	1.00	0.26	0.90	1.00	1.00	*57.79*	1.00	0.44	1.00	0.009	1.00	1.00	1.00	0.26	1.00	1.00
RWP All Upland	*533.09*	1.00	1.00	0.08	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-
RWP All Lakebed	-	-	-	-	-	-	-	-	-	-	-	*533.09*	1.00	1.00	1.00	0.08	1.00	1.00	1.00	1.00	1.00	1.00

Notes:
- = NA because receptor is not present in habitat.
[a] PRI 1 and PRI 3 are not evaluated because these exposure units have been remediated per the RCRA Carve-out Cleanup Project.
CWP = Current Waste Pond
GSLIC = Great Salt Lake Inlet Canal
ha = Hectare
PRI = Preliminary Remediation Investigation
RCRA = Resource Conservation and Recovery Act
RWP = Retrofitted Waste Pond
SVDD = Skull Valley Diversion Ditch

Table 2-20
Uptake Model Parameters for Modeled Prey Item Tissue
US Magnesium LLC
Tooele County, Utah

Analyte	Tissue Type	Model Type [1]	Model Parameters						Additional Model Inputs [2]	
			Intercept	a	b	c	d	Additive Constant	Log(K_{ow})	Percent Solids
Site-specific models (using Phase 2A Site sample chemistry data, see ERM 2018a)										
TEQ-Avian (pg/g)	Soil Invertebrate	Linear	3.39	0.401	--	--	--	--	--	--
	Plants	Plateau	--	1.58	0.931	0.746	--	1.66	--	--
	Mammal	Linear	2.39	0.623	--	--	--	--	--	--
	Brine Fly	Constant[3]	3.96	--	--	--	--	--	--	--
TEQ-Mammalian (pg/g)	Soil Invertebrate	Linear	3.04	0.373	--	--	--	--	--	--
	Plants	Plateau	--	1.35	0.703	0.629	--	2.31	--	--
	Mammal	Linear	2.34	0.603	--	--	--	--	--	--
	Brine Fly	Constant[3]	3.26	--	--	--	--	--	--	--
Total PCBs (mg/kg)	Soil Invertebrate	Linear	0.0308	0.689	--	--	--	--	--	--
	Plants	Sigmoid	--	-11.5	-5.38	-7.44	1.85	--	--	--
	Mammal	Plateau	--	-6.64	7.24	0.271	--	9.12	--	--
	Brine Fly	Linear	-3.06	0.243	--	--	--	--	--	--
Total Mercury (mg/kg)	Soil Invertebrate	Constant[3]	-2.81	--	--	--	--	--	--	--
	Plants	Constant[3]	-5.77	--	--	--	--	--	--	--
	Mammal	Constant[3]	-3.74	--	--	--	--	--	--	--
	Brine Fly	Constant[3]	-0.573	--	--	--	--	--	--	--
Hexachlorobenzene (mg/kg)	Soil Invertebrate	Linear	0.385	0.818	--	--	--	--	--	--
	Plants	Plateau	--	-7.86	3.88	0.696	--	6.73	--	--
	Mammal	Plateau	--	-5.17	5.76	0.522	--	6.73	--	--
	Brine Fly	Linear	-1.35	0.501	--	--	--	--	--	--
Literature-based models (see Table 12 of ERM 2018a)										
Hexachlorobutadiene (mg/kg)	Soil Invertebrate	BAF	--	1967	--	--	--	--	4.78 (PubChem)	31
	Plants	BAF	--	0.0651	--	--	--	--		--
	Mammal	BTF	--	0.0048	--	--	--	--		33
	Brine Fly	BAF	--	0.44	--	--	--	--		31
Pentachlorobenzene (mg/kg)	Soil Invertebrate	BAF	--	4183	--	--	--	--	5.18 (PubChem)	31
	Plants	BAF	--	0.0382	--	--	--	--		--
	Mammal	BTF	--	0.0121	--	--	--	--		33
	Brine Fly	BAF	--	0.32	--	--	--	--		31

Notes

[1] Model equations are reported in Section 2.3.2.5 of the BERA text.

[2] Literature-based models were based on analyte-specific log(K_{OW}), adjusted from wet weight to dry weight using the mean percent solids in prey-specific tissue samples collected for Phase 2A (see ERM 2018b).

[3] The constant values reported are based on natural log transformed values. The constant values are back-transformed before use in dose calculations.

[4] BTFs are calculated using a food-to-muscle transfer coefficient and the food ingestion rate of the prey item, along with other parameters (as shown in Equation 6 in Section 2.3.2.5 of the BERA text).

BAF = Bioaccumulation factor

K_{ow} = octanol-water partition coefficient

mg/kg = Milligrams per kilogram

PCB = Polychlorinated biphenyl

pg/g = Picograms per gram

TEQ = Dioxin/furan toxicity equivalence factor

Citations

ERM 2018a. US Magnesium Phase 2A Investigation: Evaluation and Selection of Bioaccumulation Models for Persistent, Bioaccumulative, and Toxic Constituents. November 2018. Prepared for US Magnesium by ERM, Scottsdale, Arizona.

ERM 2018b. US Magnesium Phase 2A Investigation Data Report. December 2018. Prepared for US Magnesium LLC and USEPA Region 8 by ERM, Scottsdale, Arizona.

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Table 2-21
Uptake Models and Abiotic Media Used in Dose Models
US Magnesium LLC
Tooele County, Utah

Habitat	Receptor	Representative Species	Assumed Diet	Dietary EPC Calculation		Incidental Ingestion
				Abiotic Media	Site-specific Uptake Model	
Upland	Gleaning Invertebrate-Consuming Bird	horn lark	crawling insects	Soil	terrestrial invertebrate uptake model	Soil
Upland	Aerial Invertebrate-Consuming Bird	tree swallow	flying insects	Soil	terrestrial invertebrate uptake model	Soil
Upland	Carnivorous Bird	American kestrel	small mammals	Soil	small mammal uptake model	Soil
Upland	Herbivorous Bird	mourning dove	seeds	Soil	terrestrial plant uptake model	Soil
Upland	Invertebrate-Consuming Mammal	grasshopper mouse	crawling insects	Soil	terrestrial invertebrate uptake model	Soil
Upland	Herbivorous Mammal	Ord's kangaroo rat	seeds and forbs	Soil	terrestrial plant uptake model	Soil
Upland	Carnivorous Mammal	badger	small mammals	Soil	small mammal uptake model	Soil
Upland	Large Herbivorous Mammal	pronghorn antelope	terrestrial plants	Soil	terrestrial plant-to-soil uptake model	Soil
Lakebed	Probing Invertebrate-Consuming Bird	snowy plover American avocet	brine flies and brine shrimp	Sediment	brine fly uptake model[a]	Sediment
Lakebed	Aerial Invertebrate-Consuming Bird	tree swallow	flying insects	Sediment	brine fly uptake model	Sediment
Lakebed	Carnivorous Bird	American kestrel	small mammals	Sediment	small mammal uptake model	Sediment
Lakebed	Herbivorous Bird	mourning dove	seeds	Sediment	terrestrial plant uptake model	Sediment
Lakebed	Invertebrate-Consuming Mammal	grasshopper mouse	crawling insects	Sediment	brine fly uptake model	Sediment
Lakebed	Herbivorous Mammal	Ord's kangaroo rat	seeds and forbs	Sediment	terrestrial plant uptake model	Sediment
Lakebed	Carnivorous Mammal	badger	small mammals	Sediment	small mammal uptake model	Sediment

Notes:
EPC = Exposure point concentration
[a] *Brine shrimp uptake model was not developed due to data insufficiencies. Brine fly uptake model will be used as a surrogate for brine shrimp.*

Table 2-22
Exposure Point Concentration Types For Tissue Body Burden
US Magnesium LLC
Tooele County, Utah

			EPC Types for Upland Receptors				EPC Types for Lakebed Receptors		
			Modeled Tissue			Measured Tissue	Modeled Tissue		Measured Tissue
Exposure Unit	Habitat within Exposure Unit	Assumed Exposures	small mammals	terrestrial plants	terrestrial invertebrates	egg tissue	small mammals	aquatic invertebrates	egg tissue
PRI 1	-	No exposure due to remediation[a]	-	-	-	-	-	-	-
PRI 2	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	-	-	-	-	-	-	-
PRI 3	-	No exposure due to remediation[a]	-	-	-	-	-	-	-
PRI 4	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	-	-	-	-	-	-	-
PRI 5	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Acute exposure for birds and mammals in lakebed habitat, no exposure for plants and invertebrates in lakebed habitat (3) ILT exposure for probing birds in lakebed habitat	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-
PRI 6	upland and lakebed	(1) chronic exposure for all receptors in upland habitat, (2) acute exposure for birds and mammals in lakebed habitat, no exposure for plants and invertebrates in lakebed habitat, (3) ILT exposure for probing birds in lakebed habitat	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-
PRI 7	lakebed	(1) Acute exposure for birds and mammals no exposure for aquatic biota and benthic invertebrates (2) ILT exposure for probing birds (3) Chronic exposure for all receptors	-	-	-	-	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 8	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Chronic exposure for all receptors in lakebed habitat	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	Pt-by-Pt	Pt-by-Pt	-
PRI 9	upland	(1) Acute exposure for birds and mammals, no exposure for plants and invertebrates	-	-	-	-	-	-	-
PRI 10	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-
PRI 11	-	No exposure due to no habitat	-	-	-	-	-	-	-
PRI 12	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-
PRI 13	lakebed	(1) Chronic exposure for all receptors	-	-	-	-	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 14	upland and lakebed	(1) Chronic exposure for all receptors in upland habitat (2) Chronic exposure for all receptors in lakebed habitat	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt
PRI 15	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-
PRI 16	upland	(1) Chronic exposure for all receptors	Pt-by-Pt	Pt-by-Pt	Pt-by-Pt	-	-	-	-
SVDD	lakebed	(1) Chronic exposure for all receptors	-	-	-	-	Pt-by-Pt	Pt-by-Pt	-
GSLIC	lakebed	(1) Chronic exposure for all receptors	-	-	-	-	Pt-by-Pt	Pt-by-Pt	-

Notes:
- = Not applicable because habitat is not found in the exposure unit or because habitat does not support the Assessment Endpoint.
Tissue burden Pt-by-Pt EPCs used for (1) exposure units with chronic exposure of all receptors, and/or (2) exposure units where eggs were collected
[a] PRI 1 and PRI 3 are not evaluated because these exposure units have been remediated per the RCRA Carve-out Cleanup Project
EPC = Exposure point concentration
GSLIC = Great Salt Lake Inlet Canal
ILT = Infectious Laryngotracheitis
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley Diversion Ditch

Table 2-23
Direct Contact Benchmarks for Aquatic Biota
US Magnesium LLC
Tooele County, Utah

Analyte	CAS Number or Database ID[a]	Final Chronic Benchmark[b] (µg/L)	NOAEL Benchmark Source	Selected LOAEL Benchmark (µg/L)	LOAEL Benchmark Source
Dissolved Aluminum	7429-90-5	87	Utah Numeric Criteria for Aquatic Life		No Available Benchmark
Dissolved Antimony	7440-36-0	30	USEPA Tier II Secondary Chronic Values	180	USEPA Tier II Secondary Acute Values
Dissolved Arsenic	7440-38-2	8000	Great Salt Lake Brine Shrimp NOEC	15000	Great Salt Lake Brine Shrimp LOEC
Dissolved Barium	7440-39-3	4000	Brine Shrimp NOEC	4762000	Brine Shrimp LC50
Dissolved Beryllium	7440-41-7	0.66	USEPA Tier II Secondary Chronic Values	35	USEPA Tier II Secondary Acute Values
Bis(2-ethylhexyl)phthalate	117-81-7	1.7	USEPA Region 6 Saltwater TRVs	27	USEPA Tier II Secondary Acute Values
Bromoform	75-25-2	320	USEPA Tier II Secondary Chronic Values	-	No Available Benchmark
Bromomethane	74-83-9	16	USEPA Region 5 ESL for Water	-	No Available Benchmark
Dissolved Cadmium	7440-43-9	0.72	Utah Numeric Criteria for Aquatic Life	33	NAWQC Salt Water Acute Criteria
Carbon Disulfide	75-15-0	0.92	USEPA Tier II Secondary Chronic Values	17	USEPA Tier II Secondary Acute Values
Carbon Tetrachloride	56-23-5	9.8	USEPA Tier II Secondary Chronic Values	180	USEPA Tier II Secondary Acute Values
Chloride	16887-00-6	230000	NAWQC Fresh Water Chronic Criteria	860000	NAWQC Freshwater Acute Criteria
Chlorine	7782-50-5	7.5	NAWQC Salt Water Chronic Criteria	13	NAWQC Salt Water Acute Criteria
Chloroform	67-66-3	28	USEPA Tier II Secondary Chronic Values	490	USEPA Tier II Secondary Acute Values
Dissolved Chromium	7440-47-3	74	Utah Numeric Criteria for Aquatic Life	570	NAWQC Freshwater Acute Criteria
Chromium, Hexavalent	18540-29-9	11	Utah Numeric Criteria for Aquatic Life	16	NAWQC Freshwater Acute Criteria
Dissolved Cobalt	7440-48-4	23	USEPA Tier II Secondary Chronic Values	1500	USEPA Tier II Secondary Acute Values
Dissolved Copper	7440-50-8	3.1	NAWQC Salt Water Chronic Criteria	68	Great Salt Lake Brine Shrimp EC50
Total Cyanide - Unfiltered	74-90-8	1	NAWQC Salt Water Chronic Criteria	17000	Brine Shrimp LC50
Ethylbenzene	100-41-4	7.3	USEPA Tier II Secondary Chronic Values	130	USEPA Tier II Secondary Acute Values
Hexachlorobenzene	118-74-1	10	USEPA Region 6 Saltwater TRVs	-	No Available Benchmark
Hexachlorobutadiene	87-68-3	0.32	USEPA Region 6 Saltwater TRVs	-	No Available Benchmark
Dissolved Iron	7439-89-6	1000	NAWQC Fresh Water Chronic Criteria	-	No Available Benchmark
Dissolved Lead	7439-92-1	2.5	Utah Numeric Criteria for Aquatic Life	477	NAWQC adjusted for hardness
Dissolved Manganese	7439-96-5	120	USEPA Tier II Secondary Chronic Values	51800	Brine shrimp LC50
Dissolved Mercury	7439-97-6	0.012	Utah Numeric Criteria for Aquatic Life	1.4	NAWQC Freshwater Acute Criteria
Dissolved Molybdenum	7439-98-7	370	USEPA Tier II Secondary Chronic Values	16000	USEPA Tier II Secondary Acute Values
Naphthalene	91-20-3	12	USEPA Tier II Secondary Chronic Values	190	USEPA Tier II Secondary Acute Values
Dissolved Nickel	7440-02-0	8.2	NAWQC Salt Water Chronic Criteria	1516	NAWQC adjusted for hardness
Nitrate as N	14797-55-8	-	No Available Benchmark	-	No Available Benchmark
Nitrophenol, 4-	100-02-7	300	USEPA Tier II Secondary Chronic Values	1200	USEPA Tier II Secondary Acute Values
Total PCBs	1336-36-3	0.014	Utah Numeric Criteria for Aquatic Life	-	No Available Benchmark
Pentachlorobenzene	608-93-5	0.47	USEPA Tier II Secondary Chronic Values	8.4	USEPA Tier II Secondary Acute Values
Pentachlorophenol	87-86-5	7.9	NAWQC Salt Water Chronic Criteria	300	Brine shrimp LC50
Dissolved Selenium	7782-49-2	4.6	Utah Numeric Criteria for Aquatic Life	290	NAWQC Salt Water Acute Criteria
Dissolved Silver	7440-22-4	1.6	Utah Numeric Criteria for Aquatic Life	1.9	NAWQC Salt Water Acute Criteria

Table 2-23
Direct Contact Benchmarks for Aquatic Biota
US Magnesium LLC
Tooele County, Utah

Analyte	CAS Number or Database ID[a]	Final Chronic Benchmark[b] (µg/L)	NOAEL Benchmark Source	Selected LOAEL Benchmark (µg/L)	LOAEL Benchmark Source
Tetrachlorobenzene, 1,2,4,5-	95-94-3	**3**	**USEPA Region 5 ESL for Water**	**-**	**No Available Benchmark**
Dissolved Thallium	7440-28-0	**12**	**USEPA Tier II Secondary Chronic Values**	**100**	**USEPA Tier II Secondary Acute Values**
Toluene	108-88-3	**9.8**	**USEPA Tier II Secondary Chronic Values**	**120**	**USEPA Tier II Secondary Acute Values**
Dissolved Vanadium	7440-62-2	**20**	**USEPA Tier II Secondary Chronic Values**	**280**	**USEPA Tier II Secondary Acute Values**
m,p Xylenes	179601-23-1	**13**	**USEPA Tier II Secondary Chronic Values**	**230**	**USEPA Tier II Secondary Acute Values**
Dissolved Zinc	7440-66-6	**81**	**NAWQC Salt Water Chronic Criteria**	**388**	**NAWQC adjusted for hardness**
Hydrogen Chloride as acidic wastewater	7647-01-0	**-**	**No Available Benchmark[c]**	**-**	**No Available Benchmark**

Notes:
[a] Database ID is used as a substitute for compounds without a CAS number
[b] The selected saltwater and freshwater benchmark was chosen from the sources in the table with priority from left to right. The lower of these two benchmarks were chosen as the Final Chronic Benchmark.
[c] Hydrogen chloride, as acidic wastewater will be evaluated qualitatively.
All concentrations are in µg/L
LC50 = Lethal concentration for 50%
LOAEL = Lowest observed adverse effect level
LOEC = Lowest observed effect concentration
NOAEL = No observed adverse effect level
NOEC = No observed effect concentration
NAWQC = National Ambient Water Quality Criteria
ORNL = Oak Ridge National Lab
SCV = Secondary Chronic Value
TRV = Toxicity reference value
UF = Uncertainty factor
µg/L = Micrograms per liter
USEPA = United States Environmental Protection Agency
USEPA 2009. National Recommended Water Quality Criteria. Office of Water. Office of Science and Technology. 4304T. Available at:http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
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USEPA. 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA530-D-99-001A. Office of Solid Waste and Emergency Response. Washington, D.C.
Utah Numeric Quality for Aquatic Life: https://www.epa.gov/wqs-tech/water-quality-standards-regulations-utah

Table 2-24
Direct Contact Benchmarks for Saltwater Benthic Invertebrates
US Magnesium LLC
Tooele County, Utah

Analyte[a]	CAS Number or Database Id[a]	Final Chronic NOAEL Benchmark (µg/kg)	Benchmark Source	Final Chronic LOAEL Benchmark (µg/kg)	Benchmark Source
Acetone	67-64-1	**799[e]**	USEPA Region 6 TRVs	**-**	No Available Benchmark
Aluminum	7429-90-5	**14,000,000**	USEPA Region 6 Freshwater TRVs	**-**	No Available Benchmark
Antimony (metallic)	7440-36-0	**2,000**	USEPA Region 6 Saltwater TRVs	**2,400**	T50 from Buchman 2008
Arsenic	7440-38-2	**8,200**	Saltwater ERL	**33,000**	Freshwater PEC
Barium	7440-39-3	**20,000**	USEPA Region 6 Freshwater TRVs	**-**	No Available Benchmark
Beryllium and compounds	7440-41-7	**-**	NA	**-**	NA
Bis(2-ethylhexyl)phthalate	117-81-7	**182**	Saltwater TEL	**2,647**	Saltwater PEL
Bromodichloromethane	75-27-4	**-**	No Available Benchmark	**-**	No Available Benchmark
Bromoform	75-25-2	**492**	USEPA Region 5 Sediment ESLs	**-**	No Available Benchmark
Bromomethane	74-83-9	**1**	USEPA Region 5 Sediment ESLs	**-**	No Available Benchmark
Butyl Benzyl Phthalate	85-68-7	**-**	NA	**-**	NA
Cadmium	7440-43-9	**990**	Freshwater TEC	**4,980**	Freshwater PEC
Carbon Disulfide	75-15-0	**24**	USEPA Region 5 Sediment ESLs	**-**	No Available Benchmark
Chloroform	67-66-3	**121**	USEPA Region 6 Freshwater TRVs	**-**	No Available Benchmark
Chromium, Metal (III)	7440-47-3	**43,400**	Freshwater TEC	**111,000**	Freshwater PEC
Cobalt	7440-48-4	**-**	NA	**-**	NA
Copper	7440-50-8	**31,600**	Freshwater TEC	**149,000**	Freshwater PEC
Cyanide, Total	74-90-8	**-[e]**	No Available Benchmark	**-**	No Available Benchmark
Dibromochloromethane	124-48-1	**-**	No Available Benchmark	**-**	No Available Benchmark
Dibutyl Phthalate	84-74-2	**-**	NA	**-**	NA
Dichloroethane, 1,1-	75-34-3	**0.575**	USEPA Region 5 Sediment ESLs	**200**	LANL LOAEL
Dinitro-o-cresol, 4,6-	534-52-1	**104**	USEPA Region 5 Sediment ESLs	**-**	No Available Benchmark
Dinitrophenol, 2,4-	51-28-5	**6**	USEPA Region 5 Sediment ESLs	**-**	No Available Benchmark
Hexachlorobenzene	118-74-1	**42000[e]**	Barber et al. 1997[b]	**-[e]**	No Available Benchmark
Hexachlorobutadiene	87-68-3	**27[e]**	USEPA Region 5 Sediment ESLs	**630[e]**	Fuchsman et al. 2000[d]
Iron	7439-89-6	**20,000,000**	Freshwater LEL	**40,000,000**	Freshwater SEL
Manganese (Non-diet)	7439-96-5	**46,000**	Freshwater LEL	**1,100,000[e]**	Freshwater SEL
Mercury (elemental)	7439-97-6	**150**	Saltwater ERL	**710**	Saltwater ERM
Methyl Ethyl Ketone	78-93-3	**42**	USEPA Region 5 Sediment ESLs	**35,000**	Dutch Value in Buchman 2008
Molybdenum	7439-98-7	**-**	No Available Benchmark	**-**	No Available Benchmark
Nickel Soluble Salts	7440-02-0	**20,900**	Saltwater ERL	**48,600**	Freshwater PEC
Total Polychlorinated Biphenyls	1336-36-3	**23**	Saltwater ERL	**180**	Saltwater ERM
Pentachlorobenzene	608-93-5	**604[e]**	USEPA Region 6 Freshwater TRVs	**-**	No Available Benchmark
Pentachlorophenol	87-86-5	**23,000[e]**	USEPA Region 5 Sediment ESLs	**-[e]**	No Available Benchmark
Phenol	108-95-2	**49**	USEPA Region 5 Sediment ESLs	**-[e]**	No Available Benchmark
Polycyclic aromatic hydrocarbons, Total (high molecular weight)	0-03-4	**-**	NA	**-**	NA
Selenium	7782-49-2	**2000[e]**	USEPA Region 3 Sediment Screening Benchmark	**-[e]**	No Available Benchmark
Silver	7440-22-4	**500**	Freshwater LEL	**3,700**	Saltwater ERM
Tetrachlorobenzene, 1,2,4,5-	95-94-3	**10**	Dutch value in Buchman 2008	**1,000**	Dutch value in Buchman 2008
Tetrachloroethylene	127-18-4	**2**	Dutch value in Buchman 2008	**20**	Dutch value in Buchman 2008
Trichlorobenzene, 1,2,4-	120-82-1	**11**	LANL NOAEL	**110**	LANL LOAEL
Vanadium, Metallic	7440-62-2	**-[e]**	No Available Benchmark	**-[e]**	No Available Benchmark
Zinc (Metallic)	7440-66-6	**121,000**	Freshwater TEC	**410,000**	Saltwater ERM

Table 2-24
Direct Contact Benchmarks for Saltwater Benthic Invertebrates
US Magnesium LLC
Tooele County, Utah

Notes:
All concentrations in micrograms per kilogram (µg/kg).
[a] Database ID is used as a substitute for compounds without a CAS number
[b] The benchmark for HCB was selected from Barber et al. 1997 because it was based on a robust and reliable spiked sediment study, rather than the LEL, SEL, and AET, which are based on co-occurrence data. The benchmark from Barber et al 1997 is based on
[c] Saltwater AETs from Buchman et al 2008 are not included due to low reliability and transparency. This is an update from ERM 2020.
[d] The LOAEL benchmark from Fuchsman et al 2000 was selected because it was based on a robust and reliable spiked sediment study, rather than the AET, which is based on co-occurrence data. The benchmark from Fuchsman et al 2000 is based on Leptocheirus plumulosis with 1% TOC in sediment, and is also protective of Hyalella azteca.
[e] Benchmark is different from value presented in ERM 2020
AET = Adverse Effect Threshold
ERM = Effects Range Median
ERL = Effects Range Low
EqP = Sediment Equilibrium Partitioning Value
LANL = Los Alamos National Laboratory
LEL = Low Effect Level
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
PEC = Probable Effects Concentration
PEL = Probable Effects Level
SEL = Severe Effect Level
T50 = Toxic effect for 50%
TEC = Threshold Effect Concentration
TEL = Threshold Effects Level
TRV = Toxicity reference value
USEPA = United States Environmental Protection Agency

Barber, T., P. Fuchsman, D. Chappie, J. Sferra, F. Newton, and P. Sheehan. 1997. Toxicity of hexachlorobenzene to Hyalella azteca and Chironomus tentans in spiked sediment bioassays. ET&C 16(8):1716-1720.
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Table 2-25
Direct Contact Benchmarks for Terrestrial Plants
US Magnesium LLC
Tooele County, Utah

		NOAEL Benchmarks		LOAEL Benchmarks	
Analyte[a]	CAS Number or Database ID[a]	Selected NOAEL Benchmark (mg/kg)	Benchmark Reference	Selected LOAEL Benchmark (mg/kg)	Benchmark Reference
Acetone	67-64-1	-	No Available Benchmark	**50000**	Wan and Rahe 1998 (ECOTOX)
Aluminum	7429-90-5	-	No Available Benchmark	**50**	ORNL
Antimony (metallic)	7440-36-0	-	No Available Benchmark	**5**	ORNL
Arsenic	7440-38-2	**18**	EcoSSL	-	No Available Benchmark
Barium	7440-39-3	-	No Available Benchmark	**500**	ORNL
Beryllium and compounds	7440-41-7	**NA**	NA	**NA**	NA
Bis(2-ethylhexyl)phthalate	117-81-7	-	No Available Benchmark	**1000**	Hulzebos et al. 1993 (ECOTOX)
Bromodichloromethane	75-27-4	-	No Available Benchmark	-	No Available Benchmark
Bromoform	75-25-2	-	No Available Benchmark	-	No Available Benchmark
Bromomethane	74-83-9	-	No Available Benchmark	-	No Available Benchmark
Butyl Benzyl Phthlate	85-68-7	**NA**	NA	**NA**	NA
Cadmium	7440-43-9	**32**	EcoSSL	-	No Available Benchmark
Carbon Disulfide	75-15-0	-	No Available Benchmark	-	No Available Benchmark
Chloroform	67-66-3	-	No Available Benchmark	-	No Available Benchmark
Chromium, Metal (III)	7440-47-3	-	No Available Benchmark	**1**	ORNL
Cobalt	7440-48-4	**NA**	NA	**NA**	NA
Copper	7440-50-8	**70**	EcoSSL	**100**	ORNL
Cyanide, Total	74-90-8	-	No Available Benchmark	-	No Available Benchmark
Dibromochloromethane	124-48-1	-	No Available Benchmark	-	No Available Benchmark
Dibutyl Phthalate	84-74-2	**NA**	NA	**NA**	NA
Dichloroethane, 1,1-	75-34-3	-	No Available Benchmark	-	No Available Benchmark
Dinitro-o-cresol, 4,6-	534-52-1	-	No Available Benchmark	**10**	Garten and Frank 1984 (ECOTOX)
Dinitrophenol, 2,4-	51-28-5	-	No Available Benchmark	**20**	ORNL
Hexachlorobenzene	118-74-1	-	No Available Benchmark	**100**	LANL LOAEL
Hexachlorobutadiene	87-68-3	-	No Available Benchmark	-	No Available Benchmark
Iron	7439-89-6	-	No Available Benchmark	-	No Available Benchmark
Manganese (Non-diet)	7439-96-5	**220**	EcoSSL	**500**	ORNL
Mercury (elemental)	7439-97-6	-	No Available Benchmark	**0.3**	ORNL
Methyl Ethyl Ketone	78-93-3	-	No Available Benchmark	-	No Available Benchmark
Molybdenum	7439-98-7	**20**	ARCHE 2020	**51**	ARCHE 2020
Nickel Soluble Salts	7440-02-0	**38**	EcoSSL	-	No Available Benchmark
Total Polychlorinated Biphenyls	1336-36-3	-	No Available Benchmark	**40**	ORNL
Pentachlorobenzene	608-93-5	-	No Available Benchmark	**56**	Hulzebos et al. 1993 (ECOTOX)
Pentachlorophenol	87-86-5	**5**	EcoSSL	**17.3**	USEPA Region 6 TRV
Phenol	108-95-2	-	No Available Benchmark	**70**	ORNL
Polycyclic aromatic hydrocarbons, Total (high molecular weight)	0-03-4	**NA**	NA	**NA**	NA
Selenium	7782-49-2	**0.52**	EcoSSL	**1**	ORNL
Silver	7440-22-4	**560**	EcoSSL	-	No Available Benchmark
Tetrachlorobenzene, 1,2,4,5-	95-94-3	-	No Available Benchmark	**1.3**	Hulzebos et al. 1993 (ECOTOX)
Tetrachloroethylene	127-18-4	-	No Available Benchmark	**1000**	Hulzebos et al. 1993 (ECOTOX)
Trichlorobenzene, 1,2,4-	120-82-1	-	No Available Benchmark	**48**	Hulzebos et al. 1993 (ECOTOX)
Vanadium, Metallic	7440-62-2	**11**[b]	Larsson 2013	**100**	Kaplan et al. 1990
Zinc (Metallic)	7440-66-6	**160**	EcoSSL	-	No Available Benchmark

Table 2-25
Direct Contact Benchmarks for Terrestrial Plants
US Magnesium LLC
Tooele County, Utah

Notes:
All concentrations are in mg/kg
[a] Database ID is used as a substitute for compounds without a CAS number.
[b] Benchmark is different from value presented in ERM 2020
EC50 = effect concentration for 50%
EcoSSL = Ecological Soil Screening Values
LANL = Los Alamos National Laboratory
LOAEL = Lowest observed adverse effect level
mg/kg = Milligrams per kilogram
NA = Not applicable because analyte is only a COPEC in PRIs with no exposure to terrestrial plants
NOAEL = No observed adverse effect level
ORNL = Oak Ridge National Laboratory
TRV = Toxicity reference value
USEPA = United States Environmental Protection Agency

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Table 2-26
Direct Contact Benchmarks for Soil Invertebrates
US Magnesium LLC
Tooele County, Utah

		NOAEL Benchmark		LOAEL Benchmark	
Analyte	**CAS Number or Database ID[a]**	**Selected NOAEL Benchmark (mg/kg)**	**Benchmark Source**	**Selected LOAEL Benchmark (mg/kg)**	**Benchmark Source**
Acetone	67-64-1	-	No Available Benchmark	-	No Available Benchmark
Aluminum	7429-90-5	-	No Available Benchmark	-	No Available Benchmark
Antimony (metallic)	7440-36-0	**78**	EcoSSL	-	No Available Benchmark
Arsenic	7440-38-2	-	No Available Benchmark	**60**	ORNL
Barium	7440-39-3	**330**	EcoSSL	-	No Available Benchmark
Beryllium and compounds	7440-41-7	**NA**	NA	**NA**	NA
Bis(2-ethylhexyl)phthalate	117-81-7	**5000**	Jensen et al. 2001 (ECOTOX)	-	No Available Benchmark
Bromodichloromethane	75-27-4	-	No Available Benchmark	-	No Available Benchmark
Bromoform	75-25-2	-	No Available Benchmark	-	No Available Benchmark
Bromomethane	74-83-9	-	No Available Benchmark	-	No Available Benchmark
Butyl Benzyl Phthlate	85-68-7	**NA**	NA	**NA**	NA
Cadmium	7440-43-9	**140**	EcoSSL	-	No Available Benchmark
Carbon Disulfide	75-15-0	-	No Available Benchmark	-	No Available Benchmark
Chloroform	67-66-3	-	No Available Benchmark	-	No Available Benchmark
Chromium, Metal (III)	7440-47-3	-	No Available Benchmark	**0.4**	ORNL
Cobalt	7440-48-4	**NA**	NA	**NA**	NA
Copper	7440-50-8	**80**	EcoSSL	-	No Available Benchmark
Cyanide, Total	74-90-8	-	No Available Benchmark	-	No Available Benchmark
Dibromochloromethane	124-48-1	-	No Available Benchmark	-	No Available Benchmark
Dibutyl Phthalate	84-74-2	**NA**	NA	**NA**	NA
Dichloroethane, 1,1-	75-34-3	-	No Available Benchmark	-	No Available Benchmark
Dinitro-o-cresol, 4,6-	534-52-1	-	No Available Benchmark	**21**	Heimbach 1984 (ECOTOX)
Dinitrophenol, 2,4-	51-28-5	-	No Available Benchmark	-	No Available Benchmark
Hexachlorobenzene	118-74-1	-	No Available Benchmark	**100**	LANL LOAEL
Hexachlorobutadiene	87-68-3	-	No Available Benchmark	-	No Available Benchmark
Iron	7439-89-6	-	No Available Benchmark	-	No Available Benchmark
Manganese (Non-diet)	7439-96-5	**450**	EcoSSL	-	No Available Benchmark
Mercury (elemental)	7439-97-6	-	No Available Benchmark	**0.1**	ORNL
Methyl Ethyl Ketone	78-93-3	-	No Available Benchmark	-	No Available Benchmark
Molybdenum	7439-98-7	-	No Available Benchmark	-	No Available Benchmark
Nickel Soluble Salts	7440-02-0	**280**	EcoSSL	-	No Available Benchmark
Total Polychlorinated Biphenyls	1336-36-3	-	No Available Benchmark	**251**	USEPA Region 6 TRV
Pentachlorobenzene	608-93-5	-	No Available Benchmark	**20**	ORNL
Pentachlorophenol	87-86-5	**31**	EcoSSL	-	No Available Benchmark
Phenol	108-95-2	-	No Available Benchmark	**30**	ORNL
Polycyclic aromatic hydrocarbons, Total (high molecular weight)	0-03-4	**NA**	NA	**NA**	NA
Selenium	7782-49-2	**4.1**	EcoSSL	**70**	ORNL
Silver	7440-22-4	-	No Available Benchmark	-	No Available Benchmark
Tetrachlorobenzene, 1,2,4,5-	95-94-3	-	No Available Benchmark	-	No Available Benchmark
Tetrachloroethylene	127-18-4	-	No Available Benchmark	-	No Available Benchmark
Trichlorobenzene, 1,2,4-	120-82-1	-	No Available Benchmark	**20**	ORNL
Vanadium, Metallic	7440-62-2	-	No Available Benchmark	-	No Available Benchmark
Zinc (Metallic)	7440-66-6	**120**	EcoSSL	**200**	ORNL

Table 2-26
Direct Contact Benchmarks for Soil Invertebrates
US Magnesium LLC
Tooele County, Utah

Notes:
All concentrations are in milligrams per kilogram (mg/kg).
[a] Database ID is used as a substitute for compounds without a CAS number.
[b] Literature-based benchmark is based on a NOEC-equivalent concentration and will be treated as a low benchmark.
EcoSSL - Ecological Soil Screening Values
LANL - Los Alamos National Laboratory
LC10 - lethal concentration for 10%
LC50 - lethal concentration for 50%
LOAEL - Lowest observed adverse effect level
mg/kg - milligrams per kilogram
NA - not applicable because analyte is only a COPEC in PRIs without no exposure to terrestrial plants
NOAEL - No observed adverse effect level
TRV - toxicity reference value
UF - uncertainty factor
USEPA - United States Environmental Protection Agency

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Table 2-27
Avian Toxicity Reference Values
US Magnesium LLC
Tooele County, Utah

		Acute TRV			Chronic TRV			Longer-term TRV		
COPEC	Cas #	Acute NOAEL TRV (mg/kg-bw-day)	Acute LOAEL TRV (mg/kg-bw/day)	TRV Source (Secondary Source)	Chronic NOAEL TRV (mg/kg-bw-day)	Chronic LOAEL TRV (mg/kg-bw/day)	TRV Source (Secondary Source)	Longer-term NOAEL TRV (mg/kg-bw-day)	Longer-term LOAEL TRV (mg/kg-bw/day)	TRV Source (Secondary Source)
Avian TEQ - AHR Category 1	CALC_DX_0_AV	0.00019	0.0019	[d]	0.0000021	0.000021	[d]	0.0000021	0.000021	[d]
Avian TEQ - AHR Category 2	CALC_DX_0_AV	0.0013	0.013	Nosek et al. 1992 (Parametrix 2004)	0.000014	0.00014	Nosek et al. 1992 (ORNL)	0.000014	0.00014	Nosek et al. 1992 (ORNL)
Avian TEQ - AHR Category 3	CALC_DX_0_AV	0.0078	0.078	[d]	0.000087	0.00087	[d]	0.000087	0.00087	[d]
Total Polychlorinated Biphenyls	1336-36-3	11.042	110.42	Stickel et al. 1984 (Parametrix 2004)	0.112	1.12	Tori and Peterle (1983)	0.112	1.12	Tori and Peterle (1983)
Total Aluminum	7429-90-5	*NA*	*NA*	*NA*	109.7	1,097	Carriere et al. 1986 (ORNL)	109.7	1,097	Carriere et al. 1986 (ORNL)
Total Antimony	7440-36-0	-	-	None	-	-	None	-	-	None
Total Arsenic	7440-38-2	16.15	161.5	NAS 1977 (ORNL 1996; Parametrix 2004)	2.24	4.5	Multiple studies (Eco-SSL)	2.24	4.5	Multiple studies (Eco-SSL)
Total Barium	7440-39-3	-	-	None	20.8	41.7	Johnson et al. 1960 (ORNL)	208	417	Johnson et al. 1960 (ORNL)
Total Beryllium	7440-41-7	-	-	None	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Total Cadmium	7440-43-9	*NA*	*NA*	*NA*	1.47	6.35	Multiple studies (Eco-SSL)	1.47	6.35	Multiple studies (Eco-SSL)
Total Chromium	7440-47-3	-	-	None	2.66	15.6	Multiple studies (Eco-SSL)	2.66	15.6	Multiple studies (Eco-SSL)
Chromium, Hexavalent	18540-29-9	-	-	None	0.24	4.02	Jensen and Maurice 1980; Asmatullah et al. 1999 (Eco-SSL)	0.24	4.02	Jensen and Maurice 1980; Asmatullah et al. 1999 (Eco-SSL)
Total Cobalt	7440-48-4	*NA*	*NA*	*NA*	7.61	18.3	Multiple studies (Eco-SSL)	7.61	18.3	Multiple studies (Eco-SSL)
Total Copper	7440-50-8	18.3	183	Ward et al. 1995 (Eco-SSL)	4.05	12.1	Ankari et al. 1998 (Eco-SSL)	4.05	12.1	Ankari et al. 1998 (Eco-SSL)
Total Iron	7439-89-6	-	-	None	100	1000	Jensen and Maurice 1978 (ECOTOX)	100	1000	Jenson and Maurice 1978 (ECOTOX)
Total Lead	7439-92-1	65.6	656	Hill et al. 1975 (Parametrix 2004)	1.63	3.26	Edens and Garlich 1983 (Eco-SSL)	1.63	3.26	Edens and Garlich 1983 (Eco-SSL)
Total Manganese	7439-96-5	-	-	None	179	377	Multiple studies (Eco-SSL)	179	377	Multiple studies (Eco-SSL)
Total Mercury	7439-97-6	2.55	25.5	Hill et al. 1975	0.45	0.9	Hill and Schaffner 1976 (ORNL)	2.25	4.5	Hill and Schaffner 1976 (ORNL)
Total Molybdenum	7439-98-7	-	-	None	3.5	35	Lepore and Miller 1965 (R9 BTAG, ORNL)	3.5	35	Lepore and Miller 1965 (R9 BTAG, ORNL)
Total Nickel	7440-02-0	23	39	Ling and Leach 1979 (Eco-SSL)	6.71	18.6	Multiple studies (Eco-SSL)	6.71	18.6	Multiple studies (Eco-SSL)
Total Selenium	7782-49-2	0.528	5.28	Heinz et al. 1989 (Parametrix 2004)	0.29	0.579	El-Begearmi and Combs 1982 (Eco-SSL)	0.29	0.579	El-Begearmi and Combs 1982 (Eco-SSL)
Total Silver	7440-22-4	*NA*	*NA*	*NA*	2.02	60.5	Multiple studies (Eco-SSL)	2.02	60.5	Multiple studies (Eco-SSL)
Total Thallium	7440-28-0	1.75	17.5	Schafer 1972	0.035	0.35	Schafer 1972 (LANL)	0.035	0.35	Schafer 1972 (LANL)
Total Vanadium	7440-62-2	27[f]	266.6[f]	Hill 1986	0.344	0.688	Hill 1979 (Eco-SSL)	0.344	0.688	Hill 1979 (Eco-SSL)
Total Zinc	7440-66-6	109	219	Blalock and Hill 1988 (Eco-SSL)	66.1	171	Multiple studies (Eco-SSL)	66.1	171	Multiple studies (Eco-SSL)
Hexachlorobenzene	118-74-1	2.818	28.18	Shirazi et al. 1994 (Parametrix 2004)	0.56	2.25	Vos et al. 1971 (ORNL)	0.56	2.25	Vos et al. 1971 (ORNL)
1,2,4,5-Tetrachlorobenzene	95-94-3	-	-	None	-	-	None	-	-	None
2,4-Dinitrophenol	51-28-5	33.6	50.61	Dominguez et al. 1993 (ATSDR)	0.336	0.561	Dominguez et al. 1993 (ATSDR)	0.336	0.561	Dominguez et al. 1993 (ATSDR)
4,6-Dinitro-2-methylphenol	534-52-1	*NA*	*NA*	*NA*	0.0495	0.495	Buschke 1947 (ATSDR)	0.0495	0.495	Buschke 1947 (ATSDR)
4-Nitrophenol	100-02-7	-	-	None	-	-	None	-	-	None
Benzylbutylphthalate	85-68-7	-	-	None	-	-	None	-	-	None
Bis(2-ethylhexyl)phthalate	117-81-7	14	140	Hill et al. 1975	1.1	11	Peakall 1974 (ORNL)	1.1	11	Peakall 1974 (ORNL)
Di-n-butylphthalate	84-74-2	-	-	None	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Hexachlorobutadiene	87-68-3	-	-	None	3.5	35	Schwetz et al. 1974 (EPA R8 RCRA)	3.5	35	Schwetz et al. 1974 (EPA R8 RCRA)
Pentachlorobenzene	608-93-5	-	-	None	-	-	None	-	-	None
Pentachlorophenol	87-86-5	19	190	Hudson et al. 1984	6.73	67.3	Stedman et al. 1980 (Eco-SSL)	6.73	67.3	Stedman et al. 1980 (Eco-SSL)
Phenol	108-95-2	*NA*	*NA*	*NA*	0.113	1.13	Schafer 1983	0.113	1.13	Schafer 1983
Naphthalene	91-20-3	-	-	None	1653	16530	Landis Assoc. Inc. 1985 (Eco-SSL)	1653	16530	Landis Assoc. Inc. 1985 (Eco-SSL)
Polycyclic aromatic hydrocarbons, Total (high molecular weight)	HPAH-0	2	20	Trust et al. 1994 (Eco-SSL)	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
1,1-Dichloroethane	75-34-3	-	-	None	-	-	None	-	-	None
1,2,4-Trichlorobenzene	120-82-1	-	-	None	-	-	None	-	-	None
2-Butanone (MEK)	78-93-3	-	-	None	-	-	None	-	-	None
Acetone	67-64-1	20100	201000	Hill and Camardese 1986	201	2010	Hill and Camardese 1986 (LANL)	201	2010	Hill and Camardese 1986 (LANL)
Bromodichloromethane	75-27-4	-	-	None	-	-	None	-	-	None
Bromoform	75-25-2	-	-	None	-	-	None	-	-	None
Bromomethane	74-83-9	31.3	36.5	ECHA Registration Dossier	0.313	0.73	ECHA Registration Dossier	0.313	0.73	ECHA Registration Dossier

Table 2-27
Avian Toxicity Reference Values
US Magnesium LLC
Tooele County, Utah

		Acute TRV			Chronic TRV			Longer-term TRV		
COPEC	Cas #	Acute NOAEL TRV (mg/kg-bw-day)	Acute LOAEL TRV (mg/kg-bw/day)	TRV Source (Secondary Source)	Chronic NOAEL TRV (mg/kg-bw-day)	Chronic LOAEL TRV (mg/kg-bw/day)	TRV Source (Secondary Source)	Longer-term NOAEL TRV (mg/kg-bw-day)	Longer-term LOAEL TRV (mg/kg-bw/day)	TRV Source (Secondary Source)
Carbon disulfide	75-15-0	-	-	None	-	-	None	-	-	None
Dibromochloromethane	124-48-1	-	-	None	-	-	None	-	-	None
Chloroform	67-66-3	-	-	None	-	-	None	-	-	None
Tetrachloroethene	127-18-4	-	-	None	-	-	None	-	-	None
Toluene	108-88-3	-	-	None	-	-	None	-	-	None
m,p Xylenes	179601-23-1	10667	106670	Hill and Camardese 1986 (LANL)	106.7	1070	Hill and Camardese 1986 (LANL)	106.7	1070	Hill and Camardese 1986 (LANL)
Chlorine	7782-50-5	-	-	None	21[f]	206[f]	Hamdullah et al. 2010	0.002	0.02	Hamdullah et al. 2010
Cyanide, Total	74-90-8	0.2	2	Wiemeyer et al. 1986	0.004	0.04	Wiemeyer et al. 1986 (LANL)	0.004	0.04	Wiemeyer et al. 1986 (LANL)
Hydrogen Chloride, as acidic wastewater	7647-01-0	-	-	None	-	-	None	-	-	None

Notes:
[a] LD50 is reported as >5000 mg/kg org. This was converted to mg/kg body weight using a body weight of 1.1 kg and an ingestion rate of 0.0916 kg/day.
[b] A TRV could not be derived by Eco-SSL as there were not enough study results to meet the minimum data requirements.
[c] LOAEL reported as 200 mg/L in drinking water. Hen body weight from study is 0.188 kg. Applied drinking water ingestion equation from Exposure Factors Handbook to derive TRV.
[d] Category 1 and 3 TRVs for TCDD TEQ were extrapolated from the Category 2 TRV using ratios provided in Table 3-9.
[e] Hydrogen chloride, as acidic wastewater, will be evaluated qualitatively.
[f] TRV is different from value presented in ERM 2020
All concentrations are in mg/kg-bw/day
AHR = aryl hydrocarbon receptor
ECHA = European Chemical Agency
EcoSSL = Ecological Soil Screening Values
LANL = Los Alamos National Laboratory
LD50 = Lethal dose for 50%
LOAEL = Lowest observed adverse effect level
mg/kg=bw/day = milligram per kilogram of body weight per day
NOAEL = No observed adverse effect level
ORNL = Oak Ridge National Laboratory
R9 BTAG = USEPA Region 9 Biological Technical Assistance Group, values found in DON 1998
TRV = toxicity reference value
UF = uncertainty factor
USEPA = United States Environmental Protection Agency
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Table 2-28
Mammalian Toxicity Reference Values
US Magnesium LLC
Tooele County, Utah

		Acute TRV			Chronic TRV		
COPEC	Cas #	Acute NOAEL TRV (mg/kg-bw-day)	Acute LOAEL TRV (mg/kg-bw/day	TRV Source (Secondary Source)	Chronic NOAEL TRV (mg/kg-bw-day)	Chronic LOAEL TRV (mg/kg-bw/day	TRV Source (Secondary Source)
Calculated TEQ, Mammalian	CALC_DX_0	0.00021	0.0021	Hochstein et al. 1988 (Parametrix 2004)	0.000001	0.00001	Murray et al. 1979 (ORNL)
Total Polychlorinated Biphenyls	1336-36-3	*25*	250	Eisler 1986 (Parametrix 2004)	0.093	0.93	McCoy et al. 1995
Total Aluminum	7429-90-5	*NA*	*NA*	*NA*	1.93	19.3	Ondreicka et al. 1966 (ORNL)
Total Antimony	7440-36-0	2440	24400	Ainsworth et al. 1997 (Eco-SSL)	0.059	0.59	Rossi et al. 1987 (Eco-SSL)
Total Arsenic	7440-38-2	1.3	13	Kaise et al. 1985 (Parametrix 2004)	1.04	1.66	Neiger and Osweiler 1989 (Eco-SSL)
Total Barium	7440-39-3	137	197	Borzelleca et al. 1988 (Eco-SSL)	51.8	82.7	Multiple studies (Eco-SSL)
Total Beryllium	7440-41-7	6	60	Lanchow University 1978 (ATSDR)	*NA*	*NA*	*NA*
Total Cadmium	7440-43-9	*NA*	*NA*	*NA*	0.77	7.7	Yuhas et al. 1979 (Eco-SSL)
Total Chromium	7440-47-3	9.15	91.5	Vernot et al. 1977 (ATSDR)	2.4	58.2	Multiple studies (Eco-SSL)
Chromium, Hexavalent	18540-29-9	131	1310	Junaid et al. 1996 (Eco-SSL)	9.24	38.4	Multiple studies (Eco-SSL)
Total Cobalt	7440-48-4	*NA*	*NA*	*NA*	7.33	18.9	Multiple studies (Eco-SSL)
Total Copper	7440-50-8	23.3	35	Boyden 1938 (Eco-SSL)	5.6	9.34	Allcroft et al. 1961 (Eco-SSL)
Total Iron	7439-89-6	4930	49300	Boyd and Shanas 1963 (ECHA)	98.6	986	Boyd and Shanas 1963 (ECHA)
Total Lead	7439-92-1	97.4	974	Holbrook et al. 1975 (Parametrix 2004)	4.7	8.9	Kimmel et al. 1980 (Eco-SSL)
Total Manganese	7439-96-5	16.6	166	Kostial et al. 1989 (ATSDR)	51.5	146	Multiple studies (Eco-SSL)
Total Mercury	7439-97-6	1.48	14.8	Dieter et al. 1992 (ATSDR)	0.025	0.25	Khan et al. 2004
Total Molybdenum	7439-98-7	5.9	59	Multiple sources (ATSDR)	0.26	2.6	Schroeder and Mitchner 1971 (ORNL)
Total Nickel	7440-02-0	1.95	19.5	Mastromatteo 1986 (ATSDR)	1.7	3.4	Pandey and Srivastava 2000 (Eco-SSL)
Total Selenium	7782-49-2	0.35	3.5	Cummins and Kimura 1971 (Parametrix 2004)	0.143	0.215	Mahan and Moxon 1984 (Eco-SSL)
Total Silver	7440-22-4	*NA*	*NA*	*NA*	6.02	119	Multiple studies (Eco-SSL)
Total Thallium	7440-28-0	0.5	5	Downs et al. 1960 (ATSDR)	0.0074	0.074	Formigli et al. 1986 (ORNL)
Total Vanadium	7440-62-2	1.55	15.5	Llobet and Domingo 1984 (ATSDR)	4.16	8.31	Sanchez et al. 1991 (Eco-SSL)
Total Zinc	7440-66-6	-	-	None	75.4	298	Multiple studies (Eco-SSL)
Hexachlorobenzene	118-74-1	35.5	355	Schafer and Bowles 1985 (Parametrix 2004)	0.57	2.8	Arnold et al. 1985
1,2,4,5-Tetrachlorobenzene	95-94-3	25	250	NIOSH 2003	2.61	5	Fisher et al. 1990; Neeper-Bradley et al. 1990 (R8 RCRA)
2,4-Dinitrophenol	51-28-5	20	30	Spencer et al. 1948 (ATSDR)	10	20	Takahasi et al. 2009 (ATSDR)
4,6-Dinitro-2-methylphenol	534-52-1	*NA*	*NA*	*NA*	5	10	Vashakidze 1967 (ATSDR)
4-Nitrophenol	100-02-7	-	-	None	40	400	Plasterer et al. 1985 (ATSDR)
Benzylbutylphthalate	85-68-7	116.5	1165	ECHA	*NA*	*NA*	*NA*
Bis(2-ethylhexyl)phthalate	117-81-7	50	500	Dostal et al. 1987 (ATSDR)	18.3	183	Lamb et al. 1987 (ORNL)
Di-n-butylphthalate	84-74-2	250	2500	Hardin et al. 1987 (ATSDR)	*NA*	*NA*	*NA*
Hexachlorobutadiene	87-68-3	10	100	Kociba et al. 1977 (ATSDR)	2.47	4.98	Multiple sources (R8 RCRA)
Pentachlorobenzene	608-93-5	200	2000	Kavlock et al. 1987 (ECOTOX)	8.5	22	Multiple sources (R8 RCRA)
Pentachlorophenol	87-86-5	2.5	25	St. Omer and Gadusek 1987 (ATSDR)	8.42	22.7	Multiple studies (Eco-SSL)
Polycyclic aromatic hydrocarbons, Total (high molecular weight)	HPAH-0	27.3	273	Rigdon and Neal 1965 (Eco-SSL)	*NA*	*NA*	*NA*
Phenol	108-95-2	*NA*	*NA*	*NA*	60	600	NTP 1989 (LANL)
Naphthalene	91-20-3	250	500	Booth et al. 1983 (Eco-SSL)	65.6	328	Verschuuren et al. 1976 (Eco-SSL)
1,1-Dichloroethane	75-34-3	-	-	None	382	3820	NCI 1977 (LANL)
1,2,4-Trichlorobenzene	120-82-1	130	465	Gray and Kavlock 1984 (ECOTOX); ECHA	19.4	26.3	Moore 1994a, 1994b (R8 RCRA)
2-Butanone	78-93-3	-	-	None	1771	4571	Cox et al. 1975 (ORNL)
Acetone	67-64-1	184.4	1844	Striegel and Carpenter 1961 (ATSDR)	10	50	EPA 1986 (ORNL)
Bromodichloromethane	75-27-4	21.5	215	Aida et al. 1987 (ATSDR)	0.5	50	Ruddick et al. 1983 (ATSDR)
Bromoform	75-25-2	35.4	354	NTP 1989 (ATSDR)	100	200	NTP 1989 (ATSDR)
Bromomethane	74-83-9	-	-	None	10	50	Danse et al. 1984 (IRIS)
Carbon disulfide	75-15-0	632	1510	Gibson and Roberts (1972); Hoffmann and Klapperstuck 1990 (ATSDR)	0.25	2.5	Jones-Price et al. 1984 (LANL)
Dibromochloromethane	124-48-1	25	250	NTP 1985 (ATSDR)	20	85	Tobe et al. 1982 (ATSDR)
Chloroform	67-66-3	10	100	Thompson et al. 1974 (ATSDR)	15	41	Palmer et al. 1979 (ORNL)
Tetrachloroethene	127-18-4	150.2	1502	Hayes et al. 1986 (ATSDR)	2	10	Buben and O'Flaherty 1985 (LANL)
Toluene	108-88-3	2350	2610	NIOSH 1983; Kimura et al. 1971 (ATSDR)	26	260	Nawrot and Staples 1979 (ORNL)

Table 2-28
Mammalian Toxicity Reference Values
US Magnesium LLC
Tooele County, Utah

		Acute TRV			Chronic TRV		
COPEC	Cas #	Acute NOAEL TRV (mg/kg-bw-day)	Acute LOAEL TRV (mg/kg-bw/day	TRV Source (Secondary Source)	Chronic NOAEL TRV (mg/kg-bw-day)	Chronic LOAEL TRV (mg/kg-bw/day	TRV Source (Secondary Source)
m,p Xylenes	179601-23-1	200	2000	NTP 1986 (ATSDR)	2.1	2.6	Marks et al. 1982 (ORNL)
Chlorine	7782-50-5	290	2900	BG-Chemie 1991 (ATSDR)	6.7	67	Hasegawa et al. 1986 (ATSDR)
Cyanide, Total	74-90-8	-	-	None	1	10	ECHA
Hydrogen Chloride, as acidic wastewater	7647-01-0	-	-	None	-	-	None

Notes:
[a] Hydrogen chloride, as acidic wastewater, will be evaluated qualitatively.
All concentrations are in mg/kg-bw/day
ATSDR = Agency for Toxic Substances and Disease Registry
ATSDR Available at: https://www.atsdr.cdc.gov/toxprofiles/index.asp#P
Booz, Allen, Hamilton. 2012. Derivation of Mammalian and Avian Dose-Based Toxicity Reference Values and Soil Screening Levels for Selected Agency Region 8. Resource Conservation and Recovery Program.
ECHA = European Chemical Agency
ECHA. Available at: https://echa.europa.eu/information-on-chemicals
Ecological Soil Screening Values. Available at:http://www.epa.gov/ecotox/ecossl/
EcoSSL = Ecological Soil Screening Values
ECOTOX. Available at:https://cfpub.epa.gov/ecotox/
LANL = Los Alamos National Laboratory
LANL (Los Alamos National Laboratory), October 2015. "ECORISK Database (Release 3.3)," LA-UR-15-27397, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2015, 600921).
LD50 = lethal dose for 50%
LOAEL = Lowest observed adverse effect level
mg/kg-bw/day = Milligram per kilogram of body weight per day
NOAEL = No observed adverse effect level
ORNL = Oak Ridge National Laboratory
Parametrix 2004. Focused Ecological Risk Assessment for the US Magnesium LLC Site. November.
R9 BTAG = USEPA Region 9 Biological Technical Assisstance Group, values found in DON 1998
TRV = Toxicity reference value
U.S. Department of the Navy. (DON). 1998. Interim Final: Development of Toxicity Reference Values as Part of a Regional Approach for Conducting Risk Assessments at Naval Facilities in California. Prepared by Engineering Field Activity West, Naval Facilities Engineering Command.
UF = Uncertainty factor
USEPA R8 RCRA - Booz, Allen, Hamilton. 2012.

Table 2-29
Tissue Benchmarks
US Magnesium LLC
Tooele County, Utah

COPEC	Units	Tissue NOAEL Benchmark	Tissue LOAEL Benchmark	Benchmark Source
Aquatic/Benthic Invertebrates[a]				
PCBs	mg/kg dw	5.5	6.5	ERED
Hexachlorobenzene	mg/kg dw	0.315	13	ERED
Mercury	mg/kg dw	NA	0.24	ERED
Hexachlorobutadiene	mg/kg dw	NA	458	ERED
Pentachlorobenzene	mg/kg dw	287.9	NA	ERED
Soil Invertebrates[a]				
PCBs	mg/kg dw	1.8	515	ERED
Hexachlorobenzene	mg/kg dw	NA	NA	NA
Mercury	mg/kg dw	10	NA	ERED
Hexachlorobutadiene	mg/kg dw	NA	NA	NA
Pentachlorobenzene	mg/kg dw	NA	25.05	ERED
Plants[b]				
PCBs	mg/kg dw	209	959	McGrath et al 2004
Hexachlorobenzene	mg/kg dw	NA	NA	NA
Mercury	mg/kg dw	3	NA	Davis et al 1978
Hexachlorobutadiene	mg/kg dw	NA	NA	NA
Pentachlorobenzene	mg/kg dw	NA	NA	NA
Small mammals[c]				
Calculated TEQ, Mammalian	mg/kg dw	0.0355	0.355	Kociba et al. 1978 and Murray et al. 1979 in Beyer and Meador 2011
PCBs	mg/kg dw	76.7	335	Linder et al. 1974 and Grant et al. 1974 in Beyer and Meador 2011
Hexachlorobenzene	mg/kg dw	NA	NA	NA
Mercury	mg/kg dw	NA	13991	Beyer and Meador 2011
Hexachlorobutadiene	mg/kg dw	NA	NA	NA
Pentachlorobenzene	mg/kg dw	NA	NA	NA
Bird eggs				
Avian TEQ - Category 1 species	µg/kg ww	0.063	0.087	Cohen-Barnhouse et al. 2011
Avian TEQ - Category 2 species	µg/kg ww	0.10	0.18	Cohen-Barnhouse et al. 2011
Avian TEQ - Category 3 species	µg/kg ww	1.80	4.80	Cohen-Barnhouse et al. 2011
PCBs	mg/kg ww	0.080	0.190	Carro et al. 2013
Hexachlorobenzene	mg/kg ww	0.617	1.85	Boersma et al. 1986
Boron	mg/kg ww	8.90	17.8	King et al. 1991

Notes:
[a] All ERED study data was provided in wet weight. Conversions from wet weight to dry weight assumed 80% moisture content in aquatic invertebrates.
[b] Conversions from wet weight to dry weight were applied for studies on aquatic plants with assumed moisture content of 10%. All terrestrial plant study data was provided in dry weight.
[c] Conversions to dry weight concentrations for whole organisms are described in Notes section.
[d] EC20 was derived using Benchmark Dose Modeling (BMD) Software
COPEC = Constituent of potential ecological concern
dw = Dry weight
ERED = Environmental Residual Effects Database (https://ered.el.erdc.dren.mil/)
mg/kg = Milligrams per kilogram
NOEC = No observed effect concentration
LC20 = Lethal concentration for 20% of organisms
LOEC = Lowest observed effect concentration
µg/kg = Microgram per kilogram
PCB = Polychlorinated biphenyl
ww = Wet weight

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Webster, S.H. et al., 1947. Organ:body weight ratios for liver, kidneys and spleen of laboratory animals. Developmental Dynamics 81(3):477-513.

Table 3-1
Avian Chronic Dietary Dose HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	Dioxins/Furans avteq-nd2-cat1 Avian TEQ Category 1, ND=1/2DL		Dioxins/Furans avteq-nd2-cat2 Avian TEQ Category 2, ND=1/2DL		Dioxins/Furans avteq-nd2-cat3 Avian TEQ Category 3, ND=1/2DL		PCBs 1336-36-3 Total PCBs		Metals 7429-90-5 Aluminum		Metals 7440-62-2 Vanadium		SVOCs 118-74-1 Hexachlorobenzene		Cyanide 74-90-8 Total Cyanide	
		NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
PRI 5	Horned Lark	**3e+02**	**3e+01**	**2e+02**	**2e+01**	**2e+02**	**2e+01**	**4e+00**	4e-01	-	-	**2e+00**	9e-01	**3e+00**	8e-01	**2e+00**	2e-01
PRI 5	Tree Swallow	**6e+02**	**6e+01**	**4e+02**	**4e+01**	**6e+02**	**6e+01**	**1e+01**	1e+00	-	-	**2e+00**	8e-01	**9e+00**	**2e+00**	**2e+00**	2e-01
PRI 5	Mourning Dove	1e+00	1e-01	4e-01	4e-02	4e-01	4e-02	7e-03	7e-04	-	-	2e-02	9e-03	5e-03	1e-03	2e-02	2e-03
PRI 5	American Kestrel	**3e+02**	**3e+01**	**7e+01**	**7e+00**	**6e+01**	**6e+00**	**2e+00**	2e-01	-	-	1e+00	5e-01	9e-01	2e-01	1e+00	1e-01
PRI 6	Horned Lark	**8e+01**	**8e+00**	**8e+01**	**8e+00**	**1e+02**	**1e+01**	8e-01	8e-02	-	-	-	-	**2e+00**	5e-01	-	-
PRI 6	Tree Swallow	**2e+02**	**2e+01**	**1e+02**	**1e+01**	**2e+02**	**2e+01**	**2e+00**	2e-01	-	-	-	-	**3e+00**	7e-01	-	-
PRI 6	Mourning Dove	2e-01	2e-02	2e-01	2e-02	4e-01	4e-02	3e-04	3e-05	-	-	-	-	6e-03	1e-03	-	-
PRI 6	American Kestrel	**6e+01**	**6e+00**	**5e+01**	**5e+00**	**8e+01**	**8e+00**	9e-01	9e-02	-	-	-	-	1e+00	3e-01	-	-
PRI 8	Horned Lark	**1e+02**	**1e+01**	**9e+01**	**9e+00**	**1e+02**	**1e+01**	**2e+00**	2e-01	**2e+00**	2e-01	**2e+01**	**1e+01**	**2e+00**	5e-01	-	-
PRI 8	Tree Swallow	**3e+02**	**3e+01**	**3e+02**	**3e+01**	**4e+02**	**4e+01**	**5e+00**	5e-01	**2e+00**	2e-01	**3e+01**	**1e+01**	**6e+00**	**2e+00**	-	-
PRI 8	Mourning Dove	3e-01	3e-02	1e-01	1e-02	1e-01	1e-02	2e-03	2e-04	3e-02	3e-03	2e-01	9e-02	2e-03	5e-04	-	-
PRI 8	American Kestrel	**1e+02**	**1e+01**	**4e+01**	**4e+00**	**4e+01**	**4e+00**	1e+00	1e-01	1e+00	1e-01	**1e+01**	**7e+00**	6e-01	1e-01	-	-
PRI 10	Horned Lark	**4e+00**	4e-01	9e-01	9e-02	7e-01	7e-02	2e-02	2e-03	-	-	1e+00	7e-01	9e-03	2e-03	-	-
PRI 10	Tree Swallow	**1e+01**	1e+00	**3e+00**	3e-01	**2e+00**	2e-01	7e-02	7e-03	-	-	1e+00	5e-01	3e-02	7e-03	-	-
PRI 10	Mourning Dove	1e-03	1e-04	4e-04	4e-05	3e-04	3e-05	6e-06	6e-07	-	-	3e-03	1e-03	4e-06	9e-07	-	-
PRI 10	American Kestrel	9e-01	9e-02	8e-01	8e-02	1e+00	1e-01	3e-02	3e-03	-	-	2e-01	1e-01	2e-02	5e-03	-	-
PRI 12	Horned Lark	**2e+01**	**2e+00**	**4e+00**	4e-01	**3e+00**	3e-01	2e-01	2e-02	-	-	-	-	3e-02	8e-03	-	-
PRI 12	Tree Swallow	**5e+01**	**5e+00**	**1e+01**	1e+00	**8e+00**	8e-01	7e-01	7e-02	-	-	-	-	1e-01	3e-02	-	-
PRI 12	Mourning Dove	9e-03	9e-04	2e-03	2e-04	2e-03	2e-04	7e-05	7e-06	-	-	-	-	2e-05	5e-06	-	-
PRI 12	American Kestrel	**2e+01**	**2e+00**	**8e+00**	8e-01	**1e+01**	1e+00	5e-01	5e-02	-	-	-	-	2e-01	4e-02	-	-
PRI 14	Horned Lark	**1e+01**	1e+00	**3e+00**	3e-01	**3e+00**	3e-01	8e-02	8e-03	-	-	-	-	5e-02	1e-02	7e-01	7e-02
PRI 14	Tree Swallow	**3e+01**	**3e+00**	**1e+01**	1e+00	**1e+01**	1e+00	2e-01	2e-02	-	-	-	-	1e-01	4e-02	8e-01	8e-02
PRI 14	Mourning Dove	9e-02	9e-03	3e-02	3e-03	3e-02	3e-03	6e-04	6e-05	-	-	-	-	4e-04	1e-04	4e-02	4e-03
PRI 14	American Kestrel	**1e+01**	1e+00	**1e+01**	1e+00	**2e+01**	**2e+00**	3e-01	3e-02	-	-	-	-	3e-01	6e-02	5e-01	5e-02
PRI 15	Horned Lark	**5e+00**	5e-01	1e+00	1e-01	7e-01	7e-02	6e-02	6e-03	-	-	-	-	9e-03	2e-03	-	-
PRI 15	Tree Swallow	**2e+01**	**2e+00**	**3e+00**	3e-01	**2e+00**	2e-01	2e-01	2e-02	-	-	-	-	3e-02	7e-03	-	-
PRI 15	Mourning Dove	8e-01	8e-02	2e-01	2e-02	1e-01	1e-02	7e-03	7e-04	-	-	-	-	2e-03	5e-04	-	-
PRI 15	American Kestrel	**4e+00**	4e-01	**3e+00**	3e-01	**4e+00**	4e-01	3e-01	3e-02	-	-	-	-	6e-02	2e-02	-	-
PRI 16	Horned Lark	**3e+00**	3e-01	5e-01	5e-02	2e-01	2e-02	1e-02	1e-03	-	-	-	-	-	-	-	-
PRI 16	Tree Swallow	**8e+00**	8e-01	1e+00	1e-01	6e-01	6e-02	4e-02	4e-03	-	-	-	-	-	-	-	-
PRI 16	Mourning Dove	5e-01	5e-02	7e-02	7e-03	2e-02	2e-03	5e-04	5e-05	-	-	-	-	-	-	-	-
PRI 16	American Kestrel	9e-01	9e-02	2e-01	2e-02	2e-01	2e-02	4e-02	4e-03	-	-	-	-	-	-	-	-
Background	Horned Lark	**2e+00**	2e-01	4e-01	4e-02	2e-01	2e-02	7e-03	7e-04	**2e+00**	2e-01	1e+00	5e-01	2e-03	5e-04	-	-
Background	Tree Swallow	**7e+00**	7e-01	1e+00	1e-01	5e-01	5e-02	2e-02	2e-03	1e+00	1e-01	7e-01	3e-01	6e-03	1e-03	-	-
Background	Mourning Dove	6e-01	6e-02	9e-02	9e-03	2e-02	2e-03	1e-04	1e-05	**2e+00**	2e-01	1e+00	5e-01	1e-04	3e-05	-	-
Background	American Kestrel	7e-01	7e-02	2e-01	2e-02	1e-01	1e-02	1e-02	1e-03	1e+00	1e-01	5e-01	3e-01	2e-03	4e-04	-	-

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (not a COPEC for that exposure area, or no chemistry data available [background locations])
COPEC = Constituent of potential ecolocial concern
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND = Not detected
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor

Bolded text = HQ > 1
Blue highlight = 1 < HQ ≤ 10
Green highlight = 10 < HQ ≤ 100
Yellow highlight = HQ > 100

Table 3-2
Summary of Avian Acute Dietary Dose HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
							Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 2	Horned Lark	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	14	14	1	7%	3e-04	**2e+00**	0	0%	3e-05	2e-01
PRI 2	Horned Lark	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	14	14	0	0%	1e-04	1e+00	0	0%	1e-05	1e-01
PRI 2	Horned Lark	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	14	14	0	0%	1e-04	1e+00	0	0%	1e-05	1e-01
PRI 2	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	14	14	0	0%	2e-04	1e+00	0	0%	2e-05	1e-01
PRI 2	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	14	14	0	0%	7e-05	7e-01	0	0%	7e-06	7e-02
PRI 2	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	14	14	0	0%	7e-05	8e-01	0	0%	7e-06	8e-02
PRI 2	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	14	14	0	0%	7e-07	5e-03	0	0%	7e-08	5e-04
PRI 2	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	14	14	0	0%	2e-07	2e-03	0	0%	2e-08	2e-04
PRI 2	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	14	14	0	0%	3e-07	3e-03	0	0%	3e-08	3e-04
PRI 2	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	14	14	0	0%	6e-05	4e-01	0	0%	6e-06	4e-02
PRI 2	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	14	14	0	0%	2e-05	2e-01	0	0%	2e-06	2e-02
PRI 2	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	14	14	0	0%	2e-05	2e-01	0	0%	2e-06	2e-02
PRI 4	Horned Lark	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	2	12%	5e-02	**2e+00**	0	0%	5e-03	2e-01
PRI 4	Horned Lark	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	6e-02	1e+00	0	0%	6e-03	1e-01
PRI 4	Horned Lark	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	1	6%	9e-02	**2e+00**	0	0%	9e-03	2e-01
PRI 4	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	5e-02	1e+00	0	0%	5e-03	1e-01
PRI 4	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	7e-02	9e-01	0	0%	7e-03	9e-02
PRI 4	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	1e-01	1e+00	0	0%	1e-02	1e-01
PRI 4	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	4e-04	2e-02	0	0%	4e-05	2e-03
PRI 4	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	5e-04	2e-02	0	0%	5e-05	2e-03
PRI 4	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	8e-04	2e-02	0	0%	8e-05	2e-03
PRI 4	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	3e-02	9e-01	0	0%	3e-03	9e-02
PRI 4	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	4e-02	7e-01	0	0%	4e-03	7e-02
PRI 4	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	6e-02	1e+00	0	0%	6e-03	1e-01
PRI 9	Horned Lark	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	16	16	0	0%	5e-05	1e-02	0	0%	5e-06	1e-03
PRI 9	Horned Lark	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	16	16	0	0%	3e-05	6e-03	0	0%	3e-06	6e-04
PRI 9	Horned Lark	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	16	16	0	0%	3e-05	8e-03	0	0%	3e-06	8e-04
PRI 9	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	16	16	0	0%	4e-05	9e-03	0	0%	4e-06	9e-04
PRI 9	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	16	16	0	0%	2e-05	4e-03	0	0%	2e-06	4e-04
PRI 9	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	16	16	0	0%	2e-05	5e-03	0	0%	2e-06	5e-04
PRI 9	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	16	16	0	0%	4e-07	1e-04	0	0%	4e-08	1e-05
PRI 9	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	16	16	0	0%	2e-07	4e-05	0	0%	2e-08	4e-06
PRI 9	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	16	16	0	0%	3e-07	6e-05	0	0%	3e-08	6e-06
PRI 9	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	16	16	0	0%	3e-05	7e-03	0	0%	3e-06	7e-04
PRI 9	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	16	16	0	0%	1e-05	3e-03	0	0%	1e-06	3e-04
PRI 9	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	16	16	0	0%	2e-05	4e-03	0	0%	2e-06	4e-04
Background	Horned Lark	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	18	18	0	0%	3e-05	1e-04	0	0%	3e-06	1e-05
Background	Horned Lark	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	18	18	0	0%	2e-05	3e-05	0	0%	2e-06	3e-06
Background	Horned Lark	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	18	18	0	0%	3e-05	3e-05	0	0%	3e-06	3e-06
Background	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	18	18	0	0%	2e-05	9e-05	0	0%	2e-06	9e-06
Background	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	18	18	0	0%	1e-05	2e-05	0	0%	1e-06	2e-06
Background	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	18	18	0	0%	2e-05	2e-05	0	0%	2e-06	2e-06
Background	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	18	18	0	0%	4e-05	1e-04	0	0%	4e-06	1e-05
Background	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	18	18	0	0%	2e-05	4e-05	0	0%	2e-06	4e-06
Background	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	18	18	0	0%	3e-05	3e-05	0	0%	3e-06	3e-06
Background	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	18	18	0	0%	2e-05	7e-05	0	0%	2e-06	7e-06
Background	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	18	18	0	0%	1e-05	2e-05	0	0%	1e-06	2e-06
Background	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	18	18	0	0%	1e-05	2e-05	0	0%	1e-06	2e-06

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Intake Canal
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 3-3
Avian Chronic Dietary Dose HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	Dioxins/Furans avteq-nd2-cat1 Avian TEQ Category 1, ND=1/2DL		Dioxins/Furans avteq-nd2-cat2 Avian TEQ Category 2, ND=1/2DL		Dioxins/Furans avteq-nd2-cat3 Avian TEQ Category 3, ND=1/2DL		Metals 7429-90-5 Aluminum		Metals 7439-89-6 Iron		Metals 7440-62-2 Vanadium		SVOCs 118-74-1 Hexachlorobenzene		Cyanide 74-90-8 Total cyanide	
		NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
PRI 7	American Avocet	**3e+02**	**3e+01**	**2e+02**	**2e+01**	**2e+02**	**2e+01**	7e-02	7e-03	**9e+00**	9e-01	**4e+00**	**2e+00**	**3e+00**	7e-01	4e-01	4e-02
PRI 7	Snowy Plover	**3e+02**	**3e+01**	**2e+02**	**2e+01**	**2e+02**	**2e+01**	1e-01	1e-02	**9e+00**	9e-01	**3e+00**	**2e+00**	**3e+00**	7e-01	7e-01	7e-02
PRI 7	Tree Swallow	**2e+02**	**2e+01**	**1e+02**	**1e+01**	**2e+02**	**2e+01**	2e-01	2e-02	**3e+00**	3e-01	**2e+00**	8e-01	**2e+00**	6e-01	9e-01	9e-02
PRI 7	Mourning Dove	**8e+00**	8e-01	**4e+00**	4e-01	**4e+00**	4e-01	5e-03	5e-04	3e-01	3e-02	1e-01	5e-02	6e-02	2e-02	3e-02	3e-03
PRI 7	American Kestrel	**4e+02**	**4e+01**	**1e+02**	**1e+01**	**8e+01**	**8e+00**	9e-02	9e-03	**2e+00**	2e-01	1e+00	5e-01	1e+00	3e-01	5e-01	5e-02
PRI 8	American Avocet	2e-01	2e-02	8e-02	8e-03	9e-02	9e-03	3e-01	3e-02	6e-03	6e-04	6e-01	3e-01	1e-03	3e-04	2e-02	2e-03
PRI 8	Snowy Plover	**8e+00**	8e-01	**3e+00**	3e-01	**3e+00**	3e-01	**7e+00**	7e-01	3e-01	3e-02	**2e+01**	**1e+01**	5e-02	1e-02	1e+00	1e-01
PRI 8	Tree Swallow	**2e+01**	**2e+00**	**6e+00**	6e-01	**7e+00**	7e-01	**2e+00**	2e-01	4e-01	4e-02	**2e+01**	**1e+01**	1e-01	3e-02	**2e+00**	2e-01
PRI 8	Mourning Dove	1e-03	1e-04	5e-04	5e-05	5e-04	5e-05	3e-03	3e-04	2e-04	2e-05	1e-02	6e-03	7e-06	2e-06	7e-04	7e-05
PRI 8	American Kestrel	**3e+00**	3e-01	**2e+00**	2e-01	**3e+00**	3e-01	2e-01	2e-02	3e-02	3e-03	**2e+00**	9e-01	4e-02	1e-02	1e-01	1e-02
PRI 13	American Avocet	**5e+00**	5e-01	1e+00	1e-01	1e+00	1e-01	-	-	-	-	-	-	1e-02	3e-03	-	-
PRI 13	Snowy Plover	**7e+00**	7e-01	**2e+00**	2e-01	1e+00	1e-01	-	-	-	-	-	-	2e-02	5e-03	-	-
PRI 13	Tree Swallow	**2e+01**	**2e+00**	**4e+00**	4e-01	**3e+00**	3e-01	-	-	-	-	-	-	5e-02	1e-02	-	-
PRI 13	Mourning Dove	1e+00	1e-01	4e-01	4e-02	3e-01	3e-02	-	-	-	-	-	-	4e-03	1e-03	-	-
PRI 13	American Kestrel	**2e+01**	**2e+00**	**1e+01**	1e+00	**1e+01**	1e+00	-	-	-	-	-	-	2e-01	5e-02	-	-
PRI 14	American Avocet	**2e+01**	**2e+00**	**1e+01**	1e+00	**1e+01**	1e+00	-	-	2e-02	2e-03	-	-	2e-01	6e-02	**1e+01**	1e+00
PRI 14	Snowy Plover	**2e+01**	**2e+00**	**1e+01**	1e+00	**2e+01**	**2e+00**	-	-	5e-02	5e-03	-	-	3e-01	7e-02	**1e+01**	1e+00
PRI 14	Tree Swallow	**3e+01**	**3e+00**	**2e+01**	**2e+00**	**3e+01**	**3e+00**	-	-	6e-02	6e-03	-	-	4e-01	1e-01	**4e+00**	4e-01
PRI 14	Mourning Dove	**3e+00**	3e-01	**2e+00**	2e-01	**2e+00**	2e-01	-	-	2e-02	2e-03	-	-	3e-02	9e-03	**2e+00**	2e-01
PRI 14	American Kestrel	**5e+01**	**5e+00**	**3e+01**	**3e+00**	**3e+01**	**3e+00**	-	-	3e-02	3e-03	-	-	5e-01	1e-01	**3e+00**	3e-01
GSLIC	American Avocet	**2e+00**	2e-01	3e-01	3e-02	9e-02	9e-03	-	-	2e-01	2e-02	1e-01	5e-02	8e-04	2e-04	-	-
GSLIC	Snowy Plover	**3e+01**	**3e+00**	**5e+00**	5e-01	**2e+00**	2e-01	-	-	**3e+00**	3e-01	**2e+00**	9e-01	2e-02	6e-03	-	-
GSLIC	Tree Swallow	**2e+01**	**2e+00**	**5e+00**	5e-01	**4e+00**	4e-01	-	-	9e-01	9e-02	6e-01	3e-01	5e-02	1e-02	-	-
GSLIC	Mourning Dove	2e-02	2e-03	2e-03	2e-04	7e-04	7e-05	-	-	2e-03	2e-04	1e-03	5e-04	5e-06	1e-06	-	-
GSLIC	American Kestrel	**2e+01**	**2e+00**	**4e+00**	4e-01	**3e+00**	3e-01	-	-	1e-01	1e-02	8e-02	4e-02	4e-02	1e-02	-	-
SVDD	American Avocet	7e-01	7e-02	1e-01	1e-02	6e-02	6e-03	2e-03	2e-04	4e-01	4e-02	2e-01	1e-01	7e-04	2e-04	3e-02	3e-03
SVDD	Snowy Plover	**9e+00**	9e-01	**2e+00**	2e-01	9e-01	9e-02	5e-02	5e-03	**5e+00**	5e-01	**2e+00**	1e+00	1e-02	3e-03	5e-01	5e-02
SVDD	Tree Swallow	**2e+01**	**2e+00**	**3e+00**	3e-01	**2e+00**	2e-01	6e-02	6e-03	**3e+00**	3e-01	9e-01	5e-01	3e-02	7e-03	7e-01	7e-02
SVDD	Mourning Dove	6e-03	6e-04	1e-03	1e-04	5e-04	5e-05	7e-05	7e-06	6e-03	6e-04	2e-03	1e-03	5e-06	1e-06	8e-04	8e-05
SVDD	American Kestrel	**9e+00**	9e-01	**2e+00**	2e-01	**2e+00**	2e-01	1e-02	1e-03	6e-01	6e-02	2e-01	1e-01	3e-02	7e-03	1e-01	1e-02
Background	American Avocet	**4e+00**	4e-01	7e-01	7e-02	4e-01	4e-02	**5e+00**	5e-01	**5e+00**	5e-01	**3e+00**	**2e+00**	5e-03	1e-03	-	-
Background	Snowy Plover	**6e+00**	6e-01	1e+00	1e-01	6e-01	6e-02	**5e+00**	5e-01	**5e+00**	5e-01	**3e+00**	**2e+00**	7e-03	2e-03	-	-
Background	Tree Swallow	**1e+01**	1e+00	**3e+00**	3e-01	**2e+00**	2e-01	1e+00	1e-01	**2e+00**	2e-01	1e+00	5e-01	2e-02	5e-03	-	-
Background	Mourning Dove	8e-01	8e-02	2e-01	2e-02	1e-01	1e-02	**2e+00**	2e-01	**3e+00**	3e-01	**2e+00**	8e-01	1e-03	3e-04	-	-
Background	American Kestrel	**2e+00**	2e-01	**2e+00**	2e-01	**2e+00**	2e-01	1e+00	1e-01	1e+00	1e-01	8e-01	4e-01	4e-02	9e-03	-	-

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (not a COPEC for that exposure area, or no chemistry data available [background locations])
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Intake Canal
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND = Not detected
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley Diversion Ditch
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 3-4
Summary of Avian Acute Dietary Dose HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
							Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 5	American Avocet	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	12	12	3	25%	1e-01	1e+02	1	8%	1e-02	1e+01
PRI 5	American Avocet	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	12	12	3	25%	5e-02	1e+02	1	8%	5e-03	1e+01
PRI 5	American Avocet	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	12	12	3	25%	6e-02	1e+02	1	8%	6e-03	1e+01
PRI 5	American Avocet	SVOCs	Hexachlorobenzene	118-74-1	12	10	2	17%	2e-02	4e+01	1	8%	2e-03	4e+00
PRI 5	Snowy Plover	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	12	12	5	42%	4e-01	2e+02	1	8%	4e-02	2e+01
PRI 5	Snowy Plover	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	12	12	4	33%	2e-01	2e+02	1	8%	2e-02	2e+01
PRI 5	Snowy Plover	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	12	12	4	33%	2e-01	3e+02	2	17%	2e-02	3e+01
PRI 5	Snowy Plover	SVOCs	Hexachlorobenzene	118-74-1	12	10	3	25%	6e-02	7e+01	1	8%	6e-03	7e+00
PRI 5	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	12	12	3	25%	5e-01	8e+01	1	8%	5e-02	8e+00
PRI 5	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	12	12	3	25%	2e-01	6e+01	1	8%	2e-02	6e+00
PRI 5	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	12	12	3	25%	3e-01	9e+01	1	8%	3e-02	9e+00
PRI 5	Tree Swallow	SVOCs	Hexachlorobenzene	118-74-1	12	10	1	8%	7e-02	2e+01	1	8%	7e-03	2e+00
PRI 5	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	12	12	0	0%	3e-03	1e+00	0	0%	3e-04	1e-01
PRI 5	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	12	12	0	0%	1e-03	1e+00	0	0%	1e-04	1e-01
PRI 5	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	12	12	1	8%	2e-03	2e+00	0	0%	2e-04	2e-01
PRI 5	Mourning Dove	SVOCs	Hexachlorobenzene	118-74-1	12	10	0	0%	5e-04	4e-01	0	0%	5e-05	4e-02
PRI 5	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	12	12	2	17%	3e-01	6e+01	1	8%	3e-02	6e+00
PRI 5	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	12	12	2	17%	1e-01	5e+01	1	8%	1e-02	5e+00
PRI 5	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	12	12	3	25%	2e-01	7e+01	1	8%	2e-02	7e+00
PRI 5	American Kestrel	SVOCs	Hexachlorobenzene	118-74-1	12	10	1	8%	4e-02	2e+01	1	8%	4e-03	2e+00
PRI 6	American Avocet	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	6	6	0	0%	9e-02	8e-01	0	0%	9e-03	8e-02
PRI 6	American Avocet	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	6	6	0	0%	1e-01	8e-01	0	0%	1e-02	8e-02
PRI 6	American Avocet	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	6	6	0	0%	2e-01	1e+00	0	0%	2e-02	1e-01
PRI 6	American Avocet	SVOCs	Hexachlorobenzene	118-74-1	6	5	0	0%	5e-02	3e-01	0	0%	5e-03	3e-02
PRI 6	Snowy Plover	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	6	6	2	33%	5e-01	3e+00	0	0%	5e-02	3e-01
PRI 6	Snowy Plover	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	6	6	2	33%	7e-01	3e+00	0	0%	7e-02	3e-01
PRI 6	Snowy Plover	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	6	6	4	67%	1e+00	4e+00	0	0%	1e-01	4e-01
PRI 6	Snowy Plover	SVOCs	Hexachlorobenzene	118-74-1	6	5	0	0%	3e-01	1e+00	0	0%	3e-02	1e-01
PRI 6	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	6	6	0	0%	6e-01	1e+00	0	0%	6e-02	1e-01
PRI 6	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	6	6	1	17%	9e-01	2e+00	0	0%	9e-02	2e-01
PRI 6	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	6	6	6	100%	2e+00	2e+00	0	0%	2e-01	2e-01
PRI 6	Tree Swallow	SVOCs	Hexachlorobenzene	118-74-1	6	5	0	0%	4e-01	7e-01	0	0%	4e-02	7e-02
PRI 6	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	6	6	0	0%	3e-03	1e-02	0	0%	3e-04	1e-03
PRI 6	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	6	6	0	0%	4e-03	1e-02	0	0%	4e-04	1e-03
PRI 6	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	6	6	0	0%	6e-03	2e-02	0	0%	6e-04	2e-03
PRI 6	Mourning Dove	SVOCs	Hexachlorobenzene	118-74-1	6	5	0	0%	2e-03	4e-03	0	0%	2e-04	4e-04
PRI 6	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	6	6	0	0%	4e-01	9e-01	0	0%	4e-02	9e-02
PRI 6	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	6	6	0	0%	5e-01	1e+00	0	0%	5e-02	1e-01
PRI 6	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	6	6	1	17%	8e-01	2e+00	0	0%	8e-02	2e-01
PRI 6	American Kestrel	SVOCs	Hexachlorobenzene	118-74-1	6	5	0	0%	2e-01	4e-01	0	0%	2e-02	4e-02
PRI 7	American Avocet	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	23	23	2	9%	6e-04	9e+00	0	0%	6e-05	9e-01
PRI 7	American Avocet	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	23	23	2	9%	2e-04	4e+00	0	0%	2e-05	4e-01
PRI 7	American Avocet	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	23	23	2	9%	1e-04	5e+00	0	0%	1e-05	5e-01
PRI 7	American Avocet	SVOCs	Hexachlorobenzene	118-74-1	23	18	0	0%	3e-05	1e+00	0	0%	3e-06	1e-01
PRI 7	Snowy Plover	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	23	23	2	9%	8e-04	8e+00	0	0%	8e-05	8e-01
PRI 7	Snowy Plover	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	23	23	2	9%	2e-04	4e+00	0	0%	2e-05	4e-01
PRI 7	Snowy Plover	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	23	23	2	9%	2e-04	4e+00	0	0%	2e-05	4e-01
PRI 7	Snowy Plover	SVOCs	Hexachlorobenzene	118-74-1	23	18	0	0%	4e-05	1e+00	0	0%	4e-06	1e-01
PRI 7	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	23	23	2	9%	7e-04	3e+00	0	0%	7e-05	3e-01
PRI 7	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	23	23	0	0%	2e-04	1e+00	0	0%	2e-05	1e-01
PRI 7	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	23	23	0	0%	1e-04	1e+00	0	0%	1e-05	1e-01
PRI 7	Tree Swallow	SVOCs	Hexachlorobenzene	118-74-1	23	18	0	0%	3e-05	4e-01	0	0%	3e-06	4e-02
PRI 7	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	23	23	0	0%	3e-05	2e-01	0	0%	3e-06	2e-02
PRI 7	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	23	23	0	0%	7e-06	1e-01	0	0%	7e-07	1e-02
PRI 7	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	23	23	0	0%	6e-06	1e-01	0	0%	6e-07	1e-02
PRI 7	Mourning Dove	SVOCs	Hexachlorobenzene	118-74-1	23	18	0	0%	1e-06	3e-02	0	0%	1e-07	3e-03
PRI 7	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	23	23	1	4%	4e-04	2e+00	0	0%	4e-05	2e-01
PRI 7	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	23	23	0	0%	1e-04	9e-01	0	0%	1e-05	9e-02

Table 3-4
Summary of Avian Acute Dietary Dose HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
							Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 7	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	23	23	0	0%	8e-05	1e+00	0	0%	8e-06	1e-01
PRI 7	American Kestrel	SVOCs	Hexachlorobenzene	118-74-1	23	18	0	0%	2e-05	3e-01	0	0%	2e-06	3e-02
Background	American Avocet	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	1e-04	1e-03	0	0%	1e-05	1e-04
Background	American Avocet	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	5e-05	4e-04	0	0%	5e-06	4e-05
Background	American Avocet	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	6e-05	5e-04	0	0%	6e-06	5e-05
Background	American Avocet	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	2e-05	1e-04	0	0%	2e-06	1e-05
Background	Snowy Plover	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	1e-04	1e-03	0	0%	1e-05	1e-04
Background	Snowy Plover	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	5e-05	3e-04	0	0%	5e-06	3e-05
Background	Snowy Plover	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	6e-05	4e-04	0	0%	6e-06	4e-05
Background	Snowy Plover	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	2e-05	1e-04	0	0%	2e-06	1e-05
Background	Tree Swallow	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	3e-05	4e-04	0	0%	3e-06	4e-05
Background	Tree Swallow	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	2e-05	1e-04	0	0%	2e-06	1e-05
Background	Tree Swallow	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	2e-05	1e-04	0	0%	2e-06	1e-05
Background	Tree Swallow	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	5e-06	4e-05	0	0%	5e-07	4e-06
Background	Mourning Dove	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	5e-05	6e-04	0	0%	5e-06	6e-05
Background	Mourning Dove	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	2e-05	2e-04	0	0%	2e-06	2e-05
Background	Mourning Dove	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	3e-05	2e-04	0	0%	3e-06	2e-05
Background	Mourning Dove	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	8e-06	6e-05	0	0%	8e-07	6e-06
Background	American Kestrel	Dioxins/Furans	Avian TEQ Category 1, ND=1/2DL	avteq-nd2-cat1	17	17	0	0%	2e-05	3e-04	0	0%	2e-06	3e-05
Background	American Kestrel	Dioxins/Furans	Avian TEQ Category 2, ND=1/2DL	avteq-nd2-cat2	17	17	0	0%	1e-05	9e-05	0	0%	1e-06	9e-06
Background	American Kestrel	Dioxins/Furans	Avian TEQ Category 3, ND=1/2DL	avteq-nd2-cat3	17	17	0	0%	1e-05	1e-04	0	0%	1e-06	1e-05
Background	American Kestrel	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	4e-06	3e-05	0	0%	4e-07	3e-06

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 3-5
Avian Intermittent Longer-Term HQs using SWAC EPCs
US Magnesium, LLC
Tooele County, Utah

Land Use Scenario	Exposure Area	Habitat	Receptor	Analyte	Total Longer-Term Dose (mg/kg-bw-day)	AHUF	NOAEL Longer Term TRV (mg/kg-bw/day)	LOAEL Longer Term TRV (mg/kg-bw/day)	NOAEL HQ	LOAEL HQ
Current	CWP	Lakebed	American Avocet	Avian TEQ Category 1 ND=1/2DL	0.00065	0.033	0.0000021	0.000021	**1E+01**	1E+00
Current	CWP	Lakebed	American Avocet	Avian TEQ Category 2 ND=1/2DL	0.00350	0.033	0.000014	0.00014	**8E+00**	8E-01
Current	CWP	Lakebed	American Avocet	Avian TEQ Category 3 ND=1/2DL	0.03198	0.033	0.000087	0.00087	**1E+01**	1E+00
Current	CWP	Lakebed	Snowy Plover	Avian TEQ Category 1 ND=1/2DL	0.00139	0.033	0.0000021	0.000021	**2E+01**	**2E+00**
Current	CWP	Lakebed	Snowy Plover	Avian TEQ Category 2 ND=1/2DL	0.00752	0.033	0.000014	0.00014	**2E+01**	**2E+00**
Current	CWP	Lakebed	Snowy Plover	Avian TEQ Category 3 ND=1/2DL	0.06877	0.033	0.000087	0.00087	**3E+01**	**3E+00**
Current	PRI 7	Lakebed	American Avocet	Avian TEQ Category 1 ND=1/2DL	0.00010	0.033	0.0000021	0.000021	**2E+00**	2E-01
Current	PRI 7	Lakebed	American Avocet	Avian TEQ Category 2 ND=1/2DL	0.00027	0.033	0.000014	0.00014	6E-01	6E-02
Current	PRI 7	Lakebed	American Avocet	Avian TEQ Category 3 ND=1/2DL	0.00198	0.033	0.000087	0.00087	8E-01	8E-02
Current	PRI 7	Lakebed	Snowy Plover	Avian TEQ Category 1 ND=1/2DL	0.00010	0.033	0.0000021	0.000021	**2E+00**	2E-01
Current	PRI 7	Lakebed	Snowy Plover	Avian TEQ Category 2 ND=1/2DL	0.00026	0.033	0.000014	0.00014	6E-01	6E-02
Current	PRI 7	Lakebed	Snowy Plover	Avian TEQ Category 3 ND=1/2DL	0.00186	0.033	0.000087	0.00087	7E-01	7E-02

Notes:
AHUF = Acid habitat utilization factor
CWP = Current Waste Pond
EPC = exposure point concentration
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
mg/kg-bw-day = Milligrams per kilogram body weight per day
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
SWAC = Surface-weighted average concentration
TRV = Toxicity Reference Value
HQs>1 are bolded.

Table 3-6
Dose Contribution for all Avian Chronic HQs Above One
US Magnesium LLC
Tooele County, Utah

PRI	Receptor	COPEC	Habitat	% Dose From Solids	% Dose From Water	% Dose From Tissue	NOAEL HQ (Solids)	NOAEL HQ (Water)	NOAEL HQ (Tissue)	NOAEL HQ (Total)	LOAEL HQ (Solids)	LOAEL HQ (Water)	LOAEL HQ (Tissue)	LOAEL HQ (Total)
PRI 5	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	25%	15%	60%	7e+01	4e+01	2e+02	3e+02	7e+00	4e+00	2e+01	3e+01
PRI 5	Horned Lark	Avian TEQ Category 2, ND=1/2DL	Upland	13%	11%	77%	2e+01	2e+01	1e+02	2e+02	2e+00	2e+00	1e+01	2e+01
PRI 5	Horned Lark	Avian TEQ Category 3, ND=1/2DL	Upland	9%	10%	82%	2e+01	2e+01	2e+02	2e+02	2e+00	2e+00	2e+01	2e+01
PRI 5	Horned Lark	Total PCBs	Upland	12%	1%	87%	5e-01	4e-02	4e+00	4e+00	5e-02	4e-03	4e-01	4e-01
PRI 5	Horned Lark	Vanadium	Upland	61%	39%	-	1e+00	7e-01	-	2e+00	5e-01	3e-01	-	9e-01
PRI 5	Horned Lark	Hexachlorobenzene	Upland	8%	9%	82%	3e-01	3e-01	3e+00	3e+00	6e-02	8e-02	7e-01	8e-01
PRI 5	Horned Lark	Total cyanide	Upland	74%	26%	-	2e+00	6e-01	-	2e+00	2e-01	6e-02	-	2e-01
PRI 5	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	8%	8%	84%	5e+01	5e+01	5e+02	6e+02	5e+00	5e+00	5e+01	6e+01
PRI 5	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	3%	5%	92%	1e+01	2e+01	4e+02	4e+02	1e+00	2e+00	4e+01	4e+01
PRI 5	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	2%	4%	93%	1e+01	2e+01	5e+02	6e+02	1e+00	2e+00	5e+01	6e+01
PRI 5	Tree Swallow	Total PCBs	Upland	3%	0%	97%	4e-01	5e-02	1e+01	1e+01	4e-02	5e-03	1e+00	1e+00
PRI 5	Tree Swallow	Vanadium	Upland	47%	53%	-	8e-01	9e-01	-	2e+00	4e-01	4e-01	-	8e-01
PRI 5	Tree Swallow	Hexachlorobenzene	Upland	2%	4%	94%	2e-01	4e-01	8e+00	9e+00	4e-02	9e-02	2e+00	2e+00
PRI 5	Tree Swallow	Total cyanide	Upland	62%	38%	-	1e+00	7e-01	-	2e+00	1e-01	7e-02	-	2e-01
PRI 5	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Upland	12%	9%	79%	4e+01	3e+01	2e+02	3e+02	4e+00	3e+00	2e+01	3e+01
PRI 5	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Upland	14%	15%	71%	1e+01	1e+01	5e+01	7e+01	1e+00	1e+00	5e+00	7e+00
PRI 5	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Upland	15%	22%	62%	9e+00	1e+01	4e+01	6e+01	9e-01	1e+00	4e+00	6e+00
PRI 5	American Kestrel	Total PCBs	Upland	13%	1%	85%	3e-01	3e-02	2e+00	2e+00	3e-02	3e-03	2e-01	2e-01
PRI 6	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	5%	55%	41%	4e+00	5e+01	3e+01	8e+01	4e-01	5e+00	3e+00	8e+00
PRI 6	Horned Lark	Avian TEQ Category 2, ND=1/2DL	Upland	1%	83%	15%	1e+00	7e+01	1e+01	8e+01	1e-01	7e+00	1e+00	8e+00
PRI 6	Horned Lark	Avian TEQ Category 3, ND=1/2DL	Upland	1%	88%	11%	8e-01	1e+02	1e+01	1e+02	8e-02	1e+01	1e+00	1e+01
PRI 6	Horned Lark	Hexachlorobenzene	Upland	1%	89%	11%	1e-02	2e+00	2e-01	2e+00	3e-03	4e-01	5e-02	5e-01
PRI 6	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	2%	34%	64%	3e+00	6e+01	1e+02	2e+02	3e-01	6e+00	1e+01	2e+01
PRI 6	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	1%	68%	32%	7e-01	8e+01	4e+01	1e+02	7e-02	8e+00	4e+00	1e+01
PRI 6	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	0%	75%	24%	6e-01	1e+02	4e+01	2e+02	6e-02	1e+01	4e+00	2e+01
PRI 6	Tree Swallow	Total PCBs	Upland	1%	1%	98%	4e-02	2e-02	2e+00	2e+00	4e-03	2e-03	2e-01	2e-01
PRI 6	Tree Swallow	Hexachlorobenzene	Upland	0%	76%	23%	8e-03	2e+00	6e-01	3e+00	2e-03	5e-01	2e-01	7e-01
PRI 6	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Upland	2%	39%	59%	1e+00	2e+01	4e+01	6e+01	1e-01	2e+00	4e+00	6e+00
PRI 6	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Upland	1%	68%	32%	4e-01	3e+01	2e+01	5e+01	4e-02	3e+00	2e+00	5e+00
PRI 6	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Upland	0%	73%	26%	3e-01	6e+01	2e+01	8e+01	3e-02	6e+00	2e+00	8e+00
PRI 7	American Avocet	Avian TEQ Category 1, ND=1/2DL	Lakebed	96%	0%	4%	3e+02	2e-02	1e+01	3e+02	3e+01	2e-03	1e+00	3e+01
PRI 7	American Avocet	Avian TEQ Category 2, ND=1/2DL	Lakebed	90%	0%	10%	1e+02	5e-03	2e+01	2e+02	1e+01	5e-04	2e+00	2e+01
PRI 7	American Avocet	Avian TEQ Category 3, ND=1/2DL	Lakebed	87%	0%	13%	2e+02	4e-03	2e+01	2e+02	2e+01	4e-04	2e+00	2e+01
PRI 7	American Avocet	Iron	Lakebed	97%	3%	-	9e+00	3e-01	-	9e+00	9e-01	3e-02	-	9e-01
PRI 7	American Avocet	Vanadium	Lakebed	94%	6%	-	3e+00	2e-01	-	4e+00	2e+00	1e-01	-	2e+00
PRI 7	American Avocet	Hexachlorobenzene	Lakebed	87%	0%	13%	2e+00	5e-05	4e-01	3e+00	6e-01	1e-05	9e-02	7e-01
PRI 7	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	93%	0%	7%	3e+02	4e-02	2e+01	3e+02	3e+01	4e-03	2e+00	3e+01
PRI 7	Snowy Plover	Avian TEQ Category 2, ND=1/2DL	Lakebed	84%	0%	16%	1e+02	1e-02	2e+01	2e+02	1e+01	1e-03	2e+00	2e+01
PRI 7	Snowy Plover	Avian TEQ Category 3, ND=1/2DL	Lakebed	81%	0%	19%	2e+02	7e-03	4e+01	2e+02	2e+01	7e-04	4e+00	2e+01
PRI 7	Snowy Plover	Iron	Lakebed	95%	5%	-	8e+00	5e-01	-	9e+00	8e-01	5e-02	-	9e-01
PRI 7	Snowy Plover	Vanadium	Lakebed	89%	11%	-	3e+00	4e-01	-	3e+00	2e+00	2e-01	-	2e+00
PRI 7	Snowy Plover	Hexachlorobenzene	Lakebed	80%	0%	20%	2e+00	1e-04	6e-01	3e+00	6e-01	3e-05	1e-01	7e-01
PRI 7	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	63%	0%	37%	1e+02	5e-02	6e+01	2e+02	1e+01	5e-03	6e+00	2e+01
PRI 7	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	39%	0%	61%	4e+01	1e-02	6e+01	1e+02	4e+00	1e-03	6e+00	1e+01
PRI 7	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	34%	0%	66%	5e+01	1e-02	1e+02	2e+02	5e+00	1e-03	1e+01	2e+01
PRI 7	Tree Swallow	Iron	Lakebed	81%	19%	-	3e+00	6e-01	-	3e+00	3e-01	6e-02	-	3e-01
PRI 7	Tree Swallow	Vanadium	Lakebed	66%	34%	-	1e+00	5e-01	-	2e+00	5e-01	3e-01	-	8e-01
PRI 7	Tree Swallow	Hexachlorobenzene	Lakebed	33%	0%	67%	8e-01	1e-04	2e+00	2e+00	2e-01	3e-05	4e-01	6e-01
PRI 7	Mourning Dove	Avian TEQ Category 1, ND=1/2DL	Lakebed	99%	0%	1%	8e+00	2e-03	5e-02	8e+00	8e-01	2e-04	5e-03	8e-01
PRI 7	Mourning Dove	Avian TEQ Category 2, ND=1/2DL	Lakebed	100%	0%	0%	4e+00	4e-04	2e-02	4e+00	4e-01	4e-05	2e-03	4e-01
PRI 7	Mourning Dove	Avian TEQ Category 3, ND=1/2DL	Lakebed	100%	0%	0%	4e+00	3e-04	2e-02	4e+00	4e-01	3e-05	2e-03	4e-01
PRI 7	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	18%	0%	82%	7e+01	3e-02	3e+02	4e+02	7e+00	3e-03	3e+01	4e+01
PRI 7	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	32%	0%	68%	3e+01	7e-03	7e+01	1e+02	3e+00	7e-04	7e+00	1e+01
PRI 7	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	48%	0%	52%	4e+01	5e-03	4e+01	8e+01	4e+00	5e-04	4e+00	8e+00
PRI 7	American Kestrel	Iron	Lakebed	86%	14%	-	2e+00	3e-01	-	2e+00	2e-01	3e-02	-	2e-01
PRI 8	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	23%	0%	77%	2e+00	1e-02	6e+00	8e+00	2e-01	1e-03	6e-01	8e-01
PRI 8	Snowy Plover	Avian TEQ Category 2, ND=1/2DL	Lakebed	22%	0%	77%	7e-01	6e-03	2e+00	3e+00	7e-02	6e-04	2e-01	3e-01
PRI 8	Snowy Plover	Avian TEQ Category 3, ND=1/2DL	Lakebed	22%	0%	78%	8e-01	7e-03	3e+00	3e+00	8e-02	7e-04	3e-01	3e-01
PRI 8	Snowy Plover	Aluminum	Lakebed	100%	0%	-	7e+00	3e-02	-	7e+00	7e-01	3e-03	-	7e-01
PRI 8	Snowy Plover	Vanadium	Lakebed	26%	74%	-	7e+00	2e+01	-	2e+01	3e+00	9e+00	-	1e+01
PRI 8	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	18%	0%	82%	2e+01	1e-02	1e+02	1e+02	2e+00	1e-03	1e+01	1e+01

Table 3-6
Dose Contribution for all Avian Chronic HQs Above One
US Magnesium LLC
Tooele County, Utah

PRI	Receptor	COPEC	Habitat	% Dose From Solids	% Dose From Water	% Dose From Tissue	NOAEL HQ (Solids)	NOAEL HQ (Water)	NOAEL HQ (Tissue)	NOAEL HQ (Total)	LOAEL HQ (Solids)	LOAEL HQ (Water)	LOAEL HQ (Tissue)	LOAEL HQ (Total)
PRI 8	Horned Lark	Avian TEQ Category 2, ND=1/2DL	Upland	10%	0%	90%	1e+01	6e-03	8e+01	9e+01	1e+00	6e-04	8e+00	9e+00
PRI 8	Horned Lark	Avian TEQ Category 3, ND=1/2DL	Upland	9%	0%	91%	1e+01	7e-03	1e+02	1e+02	1e+00	7e-04	1e+01	1e+01
PRI 8	Horned Lark	Total PCBs	Upland	8%	0%	92%	1e-01	2e-04	1e+00	2e+00	1e-02	2e-05	1e-01	2e-01
PRI 8	Horned Lark	Aluminum	Upland	99%	1%	-	2e+00	3e-02	-	2e+00	2e-01	3e-03	-	2e-01
PRI 8	Horned Lark	Vanadium	Upland	9%	91%	-	2e+00	2e+01	-	2e+01	9e-01	1e+01	-	1e+01
PRI 8	Horned Lark	Hexachlorobenzene	Upland	8%	0%	92%	2e-01	1e-04	2e+00	2e+00	4e-02	3e-05	5e-01	5e-01
PRI 8	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	4%	0%	96%	6e-01	2e-02	2e+01	2e+01	6e-02	2e-03	2e+00	2e+00
PRI 8	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	5%	0%	95%	2e+01	2e-02	3e+02	3e+02	2e+00	2e-03	3e+01	3e+01
PRI 8	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	3%	0%	96%	2e-01	7e-03	6e+00	6e+00	2e-02	7e-04	6e-01	6e-01
PRI 8	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	2%	0%	98%	7e+00	7e-03	3e+02	3e+02	7e-01	7e-04	3e+01	3e+01
PRI 8	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	3%	0%	97%	2e-01	8e-03	7e+00	7e+00	2e-02	8e-04	7e-01	7e-01
PRI 8	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	2%	0%	98%	8e+00	9e-03	4e+02	4e+02	8e-01	9e-04	4e+01	4e+01
PRI 8	Tree Swallow	Total PCBs	Upland	2%	0%	98%	9e-02	3e-04	4e+00	5e+00	9e-03	3e-05	4e-01	5e-01
PRI 8	Tree Swallow	Aluminum	Lakebed	98%	2%	-	2e+00	4e-02	-	2e+00	2e-01	4e-03	-	2e-01
PRI 8	Tree Swallow	Aluminum	Upland	97%	3%	-	2e+00	4e-02	-	2e+00	2e-01	4e-03	-	2e-01
PRI 8	Tree Swallow	Vanadium	Lakebed	8%	92%	-	2e+00	2e+01	-	2e+01	1e+00	1e+01	-	1e+01
PRI 8	Tree Swallow	Vanadium	Upland	5%	95%	-	1e+00	2e+01	-	3e+01	6e-01	1e+01	-	1e+01
PRI 8	Tree Swallow	Hexachlorobenzene	Upland	2%	0%	98%	1e-01	1e-04	6e+00	6e+00	3e-02	3e-05	1e+00	2e+00
PRI 8	Tree Swallow	Total cyanide	Lakebed	-	100%	-	-	2e+00	-	2e+00	-	2e-01	-	2e-01
PRI 8	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	2%	0%	98%	6e-02	1e-03	3e+00	3e+00	6e-03	1e-04	3e-01	3e-01
PRI 8	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Upland	9%	0%	91%	1e+01	1e-02	1e+02	1e+02	1e+00	1e-03	1e+01	1e+01
PRI 8	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	1%	0%	99%	2e-02	5e-04	2e+00	2e+00	2e-03	5e-05	2e-01	2e-01
PRI 8	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Upland	13%	0%	87%	5e+00	4e-03	4e+01	4e+01	5e-01	4e-04	4e+00	4e+00
PRI 8	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	1%	0%	99%	2e-02	6e-04	3e+00	3e+00	2e-03	6e-05	3e-01	3e-01
PRI 8	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Upland	15%	0%	85%	6e+00	5e-03	3e+01	4e+01	6e-01	5e-04	3e+00	4e+00
PRI 8	American Kestrel	Vanadium	Lakebed	11%	89%	-	2e-01	2e+00	-	2e+00	1e-01	8e-01	-	9e-01
PRI 8	American Kestrel	Vanadium	Upland	7%	93%	-	1e+00	1e+01	-	1e+01	5e-01	7e+00	-	7e+00
PRI 10	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	1%	-	99%	2e-02	-	4e+00	4e+00	2e-03	-	4e-01	4e-01
PRI 10	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	0%	-	100%	2e-02	-	1e+01	1e+01	2e-03	-	1e+00	1e+00
PRI 10	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	0%	-	100%	9e-03	-	3e+00	3e+00	9e-04	-	3e-01	3e-01
PRI 10	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	1%	-	99%	1e-02	-	2e+00	2e+00	1e-03	-	2e-01	2e-01
PRI 12	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	5%	-	95%	9e-01	-	2e+01	2e+01	9e-02	-	2e+00	2e+00
PRI 12	Horned Lark	Avian TEQ Category 2, ND=1/2DL	Upland	4%	-	96%	2e-01	-	4e+00	4e+00	2e-02	-	4e-01	4e-01
PRI 12	Horned Lark	Avian TEQ Category 3, ND=1/2DL	Upland	4%	-	96%	1e-01	-	2e+00	3e+00	1e-02	-	2e-01	3e-01
PRI 12	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	1%	-	99%	6e-01	-	5e+01	5e+01	6e-02	-	5e+00	5e+00
PRI 12	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	1%	-	99%	1e-01	-	1e+01	1e+01	1e-02	-	1e+00	1e+00
PRI 12	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	1%	-	99%	7e-02	-	8e+00	8e+00	7e-03	-	8e-01	8e-01
PRI 12	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Upland	2%	-	98%	3e-01	-	2e+01	2e+01	3e-02	-	2e+00	2e+00
PRI 12	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Upland	1%	-	99%	7e-02	-	8e+00	8e+00	7e-03	-	8e-01	8e-01
PRI 12	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Upland	0%	-	100%	4e-02	-	1e+01	1e+01	4e-03	-	1e+00	1e+00
PRI 13	American Avocet	Avian TEQ Category 1, ND=1/2DL	Lakebed	29%	-	71%	2e+00	-	4e+00	5e+00	2e-01	-	4e-01	5e-01
PRI 13	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	20%	-	80%	1e+00	-	6e+00	7e+00	1e-01	-	6e-01	7e-01
PRI 13	Snowy Plover	Avian TEQ Category 2, ND=1/2DL	Lakebed	16%	-	84%	3e-01	-	2e+00	2e+00	3e-02	-	2e-01	2e-01
PRI 13	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	3%	-	97%	5e-01	-	2e+01	2e+01	5e-02	-	2e+00	2e+00
PRI 13	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	2%	-	98%	1e-01	-	4e+00	4e+00	1e-02	-	4e-01	4e-01
PRI 13	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	2%	-	98%	6e-02	-	3e+00	3e+00	6e-03	-	3e-01	3e-01
PRI 13	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	2%	-	98%	4e-01	-	2e+01	2e+01	4e-02	-	2e+00	2e+00
PRI 13	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	1%	-	99%	7e-02	-	1e+01	1e+01	7e-03	-	1e+00	1e+00
PRI 13	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	0%	-	100%	4e-02	-	1e+01	1e+01	4e-03	-	1e+00	1e+00
PRI 14	American Avocet	Avian TEQ Category 1, ND=1/2DL	Lakebed	65%	0%	35%	1e+01	3e-03	6e+00	2e+01	1e+00	3e-04	6e-01	2e+00
PRI 14	American Avocet	Avian TEQ Category 2, ND=1/2DL	Lakebed	62%	0%	38%	7e+00	2e-03	4e+00	1e+01	7e-01	2e-04	4e-01	1e+00
PRI 14	American Avocet	Avian TEQ Category 3, ND=1/2DL	Lakebed	61%	0%	39%	9e+00	3e-03	6e+00	1e+01	9e-01	3e-04	6e-01	1e+00
PRI 14	American Avocet	Total cyanide	Lakebed	98%	2%	-	1e+01	2e-01	-	1e+01	1e+00	2e-02	-	1e+00
PRI 14	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	52%	0%	48%	1e+01	6e-03	9e+00	2e+01	1e+00	6e-04	9e-01	2e+00
PRI 14	Snowy Plover	Avian TEQ Category 2, ND=1/2DL	Lakebed	49%	0%	50%	6e+00	5e-03	6e+00	1e+01	6e-01	5e-04	6e-01	1e+00
PRI 14	Snowy Plover	Avian TEQ Category 3, ND=1/2DL	Lakebed	49%	0%	51%	8e+00	7e-03	9e+00	2e+01	8e-01	7e-04	9e-01	2e+00
PRI 14	Snowy Plover	Total cyanide	Lakebed	95%	5%	-	9e+00	4e-01	-	1e+01	9e-01	4e-02	-	1e+00
PRI 14	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	2%	0%	98%	2e-01	6e-03	1e+01	1e+01	2e-02	6e-04	1e+00	1e+00
PRI 14	Horned Lark	Avian TEQ Category 2, ND=1/2DL	Upland	3%	0%	97%	1e-01	5e-03	3e+00	3e+00	1e-02	5e-04	3e-01	3e-01
PRI 14	Horned Lark	Avian TEQ Category 3, ND=1/2DL	Upland	4%	0%	96%	1e-01	7e-03	3e+00	3e+00	1e-02	7e-04	3e-01	3e-01

Table 3-6
Dose Contribution for all Avian Chronic HQs Above One
US Magnesium LLC
Tooele County, Utah

PRI	Receptor	COPEC	Habitat	% Dose From Solids	% Dose From Water	% Dose From Tissue	NOAEL HQ (Solids)	NOAEL HQ (Water)	NOAEL HQ (Tissue)	NOAEL HQ (Total)	LOAEL HQ (Solids)	LOAEL HQ (Water)	LOAEL HQ (Tissue)	LOAEL HQ (Total)
PRI 14	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	12%	0%	88%	3e+00	7e-03	2e+01	3e+01	3e-01	7e-04	2e+00	3e+00
PRI 14	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	1%	0%	99%	2e-01	7e-03	3e+01	3e+01	2e-02	7e-04	3e+00	3e+00
PRI 14	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	11%	0%	89%	2e+00	6e-03	2e+01	2e+01	2e-01	6e-04	2e+00	2e+00
PRI 14	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	1%	0%	99%	7e-02	6e-03	1e+01	1e+01	7e-03	6e-04	1e+00	1e+00
PRI 14	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	10%	0%	90%	3e+00	9e-03	2e+01	3e+01	3e-01	9e-04	2e+00	3e+00
PRI 14	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	1%	0%	99%	9e-02	9e-03	1e+01	1e+01	9e-03	9e-04	1e+00	1e+00
PRI 14	Tree Swallow	Total cyanide	Lakebed	84%	16%	-	3e+00	6e-01	-	4e+00	3e-01	6e-02	-	4e-01
PRI 14	Mourning Dove	Avian TEQ Category 1, ND=1/2DL	Lakebed	84%	0%	16%	2e+00	2e-03	5e-01	3e+00	2e-01	2e-04	5e-02	3e-01
PRI 14	Mourning Dove	Avian TEQ Category 2, ND=1/2DL	Lakebed	91%	0%	9%	2e+00	2e-03	1e-01	2e+00	2e-01	2e-04	1e-02	2e-01
PRI 14	Mourning Dove	Avian TEQ Category 3, ND=1/2DL	Lakebed	93%	0%	7%	2e+00	2e-03	2e-01	2e+00	2e-01	2e-04	2e-02	2e-01
PRI 14	Mourning Dove	Total cyanide	Lakebed	93%	7%	-	2e+00	2e-01	-	2e+00	2e-01	2e-02	-	2e-01
PRI 14	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	5%	0%	95%	2e+00	4e-03	5e+01	5e+01	2e-01	4e-04	5e+00	5e+00
PRI 14	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Upland	1%	0%	99%	1e-01	4e-03	1e+01	1e+01	1e-02	4e-04	1e+00	1e+00
PRI 14	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	6%	0%	94%	2e+00	3e-03	2e+01	3e+01	2e-01	3e-04	2e+00	3e+00
PRI 14	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Upland	0%	0%	99%	5e-02	3e-03	1e+01	1e+01	5e-03	3e-04	1e+00	1e+00
PRI 14	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	6%	0%	94%	2e+00	5e-03	3e+01	3e+01	2e-01	5e-04	3e+00	3e+00
PRI 14	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Upland	0%	0%	100%	6e-02	5e-03	2e+01	2e+01	6e-03	5e-04	2e+00	2e+00
PRI 14	American Kestrel	Total cyanide	Lakebed	88%	12%	-	2e+00	3e-01	-	3e+00	2e-01	3e-02	-	3e-01
PRI 15	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	1%	-	99%	4e-02	-	5e+00	5e+00	4e-03	-	5e-01	5e-01
PRI 15	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	0%	-	100%	3e-02	-	2e+01	2e+01	3e-03	-	2e+00	2e+00
PRI 15	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Upland	0%	-	100%	1e-02	-	3e+00	3e+00	1e-03	-	3e-01	3e-01
PRI 15	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Upland	1%	-	99%	1e-02	-	2e+00	2e+00	1e-03	-	2e-01	2e-01
PRI 15	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Upland	1%	-	99%	2e-02	-	4e+00	4e+00	2e-03	-	4e-01	4e-01
PRI 15	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Upland	0%	-	100%	8e-03	-	3e+00	3e+00	8e-04	-	3e-01	3e-01
PRI 15	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Upland	0%	-	100%	9e-03	-	4e+00	4e+00	9e-04	-	4e-01	4e-01
PRI 16	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	0%	-	100%	9e-03	-	3e+00	3e+00	9e-04	-	3e-01	3e-01
PRI 16	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	0%	-	100%	6e-03	-	8e+00	8e+00	6e-04	-	8e-01	8e-01
GSLIC	American Avocet	Avian TEQ Category 1, ND=1/2DL	Lakebed	87%	-	13%	1e+00	-	2e-01	2e+00	1e-01	-	2e-02	2e-01
GSLIC	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	81%	-	19%	2e+01	-	6e+00	3e+01	2e+00	-	6e-01	3e+00
GSLIC	Snowy Plover	Avian TEQ Category 2, ND=1/2DL	Lakebed	70%	-	30%	4e+00	-	2e+00	5e+00	4e-01	-	2e-01	5e-01
GSLIC	Snowy Plover	Avian TEQ Category 3, ND=1/2DL	Lakebed	35%	-	65%	8e-01	-	1e+00	2e+00	8e-02	-	1e-01	2e-01
GSLIC	Snowy Plover	Iron	Lakebed	100%	-	-	3e+00	-	-	3e+00	3e-01	-	-	3e-01
GSLIC	Snowy Plover	Vanadium	Lakebed	100%	-	-	2e+00	-	-	2e+00	9e-01	-	-	9e-01
GSLIC	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	34%	-	66%	8e+00	-	2e+01	2e+01	8e-01	-	2e+00	2e+00
GSLIC	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	22%	-	78%	1e+00	-	4e+00	5e+00	1e-01	-	4e-01	5e-01
GSLIC	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	6%	-	94%	2e-01	-	4e+00	4e+00	2e-02	-	4e-01	4e-01
GSLIC	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	7%	-	93%	1e+00	-	2e+01	2e+01	1e-01	-	2e+00	2e+00
GSLIC	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	4%	-	96%	2e-01	-	4e+00	4e+00	2e-02	-	4e-01	4e-01
GSLIC	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	1%	-	99%	4e-02	-	3e+00	3e+00	4e-03	-	3e-01	3e-01
SVDD	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	40%	0%	60%	4e+00	9e-03	6e+00	9e+00	4e-01	9e-04	6e-01	9e-01
SVDD	Snowy Plover	Avian TEQ Category 2, ND=1/2DL	Lakebed	33%	0%	67%	6e-01	8e-03	1e+00	2e+00	6e-02	8e-04	1e-01	2e-01
SVDD	Snowy Plover	Iron	Lakebed	78%	22%	-	4e+00	1e+00	-	5e+00	4e-01	1e-01	-	5e-01
SVDD	Snowy Plover	Vanadium	Lakebed	92%	8%	-	2e+00	2e-01	-	2e+00	1e+00	9e-02	-	1e+00
SVDD	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	8%	0%	92%	1e+00	1e-02	2e+01	2e+01	1e-01	1e-03	2e+00	2e+00
SVDD	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	6%	0%	94%	2e-01	1e-02	3e+00	3e+00	2e-02	1e-03	3e-01	3e-01
SVDD	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	2%	1%	97%	5e-02	1e-02	2e+00	2e+00	5e-03	1e-03	2e-01	2e-01
SVDD	Tree Swallow	Iron	Lakebed	47%	53%	-	1e+00	1e+00	-	3e+00	1e-01	1e-01	-	3e-01
SVDD	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	3%	0%	97%	3e-01	2e-03	9e+00	9e+00	3e-02	2e-04	9e-01	9e-01
SVDD	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	2%	0%	98%	5e-02	2e-03	2e+00	2e+00	5e-03	2e-04	2e-01	2e-01
SVDD	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	1%	0%	99%	1e-02	3e-03	2e+00	2e+00	1e-03	3e-04	2e-01	2e-01
Background	American Avocet	Avian TEQ Category 1, ND=1/2DL	Lakebed	2%	-	98%	6e-02	-	4e+00	4e+00	6e-03	-	4e-01	4e-01
Background	American Avocet	Aluminum	Lakebed	100%	-	-	5e+00	-	-	5e+00	5e-01	-	-	5e-01
Background	American Avocet	Iron	Lakebed	100%	-	-	5e+00	-	-	5e+00	5e-01	-	-	5e-01
Background	American Avocet	Vanadium	Lakebed	100%	-	-	3e+00	-	-	3e+00	2e+00	-	-	2e+00
Background	Snowy Plover	Avian TEQ Category 1, ND=1/2DL	Lakebed	1%	-	99%	5e-02	-	6e+00	6e+00	5e-03	-	6e-01	6e-01
Background	Snowy Plover	Aluminum	Lakebed	100%	-	-	5e+00	-	-	5e+00	5e-01	-	-	5e-01
Background	Snowy Plover	Iron	Lakebed	100%	-	-	5e+00	-	-	5e+00	5e-01	-	-	5e-01
Background	Snowy Plover	Vanadium	Lakebed	100%	-	-	3e+00	-	-	3e+00	2e+00	-	-	2e+00
Background	Horned Lark	Avian TEQ Category 1, ND=1/2DL	Upland	0%	-	100%	7e-03	-	2e+00	2e+00	7e-04	-	2e-01	2e-01
Background	Horned Lark	Aluminum	Upland	100%	-	-	2e+00	-	-	2e+00	2e-01	-	-	2e-01

Table 3-6
Dose Contribution for all Avian Chronic HQs Above One
US Magnesium LLC
Tooele County, Utah

PRI	Receptor	COPEC	Habitat	% Dose From Solids	% Dose From Water	% Dose From Tissue	NOAEL HQ (Solids)	NOAEL HQ (Water)	NOAEL HQ (Tissue)	NOAEL HQ (Total)	LOAEL HQ (Solids)	LOAEL HQ (Water)	LOAEL HQ (Tissue)	LOAEL HQ (Total)
Background	Horned Lark	Iron	Upland	100%	-	-	**2e+00**	-	-	**2e+00**	2e-01	-	-	2e-01
Background	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Lakebed	0%	-	100%	2e-02	-	**1e+01**	**1e+01**	2e-03	-	1e+00	1e+00
Background	Tree Swallow	Avian TEQ Category 1, ND=1/2DL	Upland	0%	-	100%	5e-03	-	**7e+00**	**7e+00**	5e-04	-	7e-01	7e-01
Background	Tree Swallow	Avian TEQ Category 2, ND=1/2DL	Lakebed	0%	-	100%	7e-03	-	**3e+00**	**3e+00**	7e-04	-	3e-01	3e-01
Background	Tree Swallow	Avian TEQ Category 3, ND=1/2DL	Lakebed	0%	-	100%	8e-03	-	**2e+00**	**2e+00**	8e-04	-	2e-01	2e-01
Background	Tree Swallow	Iron	Lakebed	100%	-	-	**2e+00**	-	-	**2e+00**	2e-01	-	-	2e-01
Background	Tree Swallow	Iron	Upland	100%	-	-	**2e+00**	-	-	**2e+00**	2e-01	-	-	2e-01
Background	Mourning Dove	Aluminum	Lakebed	100%	-	-	**2e+00**	-	-	**2e+00**	2e-01	-	-	2e-01
Background	Mourning Dove	Aluminum	Upland	100%	-	-	**2e+00**	-	-	**2e+00**	2e-01	-	-	2e-01
Background	Mourning Dove	Iron	Lakebed	100%	-	-	**3e+00**	-	-	**3e+00**	3e-01	-	-	3e-01
Background	Mourning Dove	Iron	Upland	100%	-	-	**3e+00**	-	-	**3e+00**	3e-01	-	-	3e-01
Background	Mourning Dove	Vanadium	Lakebed	100%	-	-	**2e+00**	-	-	**2e+00**	8e-01	-	-	8e-01
Background	American Kestrel	Avian TEQ Category 1, ND=1/2DL	Lakebed	1%	-	99%	1e-02	-	**2e+00**	**2e+00**	1e-03	-	2e-01	2e-01
Background	American Kestrel	Avian TEQ Category 2, ND=1/2DL	Lakebed	0%	-	100%	5e-03	-	**2e+00**	**2e+00**	5e-04	-	2e-01	2e-01
Background	American Kestrel	Avian TEQ Category 3, ND=1/2DL	Lakebed	0%	-	100%	6e-03	-	**2e+00**	**2e+00**	6e-04	-	2e-01	2e-01

Notes:
All results utilize 95 percent Upper Confidence Limits.
Percentages of doses were rounded to zero decimal places.
Only PRIs, habitats, receptors, and COPECs with a NOAEL HQ > 1 are shown in tables. Complete HQs are presented in Appendix D.
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Intake Canal
HQ = Hazard quotient
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversion ditch
TEQ = Dioxin/furan toxicity equivalence factor
- = media type was not evaluated
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 3-7
Egg Tissue HQs
US Magnesium, LLC
Tooele County, Utah

Exposure Area	Bird Species	Sample ID	Dioxins/Furans avteq-nd0-cat1 Avian TEQ Category 1, ND=0			Dioxins/Furans avteq-nd2-cat1 Avian TEQ Category 1, ND=1/2DL			Dioxins/Furans avteq-nd0-cat2 Avian TEQ Category 2, ND=0			Dioxins/Furans avteq-nd2-cat2 Avian TEQ Category 2, ND=1/2DL			Dioxins/Furans avteq-nd0-cat3 Avian TEQ Category 3, ND=0			Dioxins/Furans avteq-nd2-cat3 Avian TEQ Category 3, ND=1/2DL			PCBs 1336-36-3 Total PCBs			Metals 7440-42-8 Boron			SVOCs 118-74-1 Hexachlorobenzene		
			NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det	NOAEL	LOAEL	Det
PRI 5	Snowy Plover	06SPEG1S0101	**3e+00**	**2e+00**	Y	**5e+00**	**4e+00**	Y	**6e+00**	**4e+00**	Y	**8e+00**	**4e+00**	Y	**3e+00**	1e+00	Y	**3e+00**	1e+00	Y	-	-	-	-	-	-	8e-01	3e-01	Y
PRI 5	Horned Lark	06HLEG1S0201	**1e+01**	**9e+00**	Y	**2e+01**	**1e+01**	Y	**7e+01**	**4e+01**	Y	**8e+01**	**4e+01**	Y	**4e+01**	**2e+01**	Y	**4e+01**	**2e+01**	Y	-	-	-	-	-	-	**1e+01**	**4e+00**	Y
PRI 7	Snowy Plover	04SPS101	5e-01	3e-01	Y	**2e+00**	**2e+00**	Y	**2e+00**	1e+00	Y	**3e+00**	**2e+00**	Y	1e+00	4e-01	Y	1e+00	4e-01	Y	**7e+00**	**3e+00**	Y	-	-	-	3e-01	1e-01	Y
PRI 7	Snowy Plover	04SPS102	**3e+00**	**2e+00**	Y	**4e+00**	**3e+00**	Y	**7e+00**	**4e+00**	Y	**8e+00**	**5e+00**	Y	**3e+00**	1e+00	Y	**3e+00**	1e+00	Y	**1e+01**	**4e+00**	Y	-	-	-	1e+00	3e-01	Y
PRI 7	Snowy Plover	04SPS103	**2e+00**	**2e+00**	Y	**4e+00**	**3e+00**	Y	**8e+00**	**4e+00**	Y	**9e+00**	**5e+00**	Y	**4e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	**1e+01**	**4e+00**	Y	-	-	-	1e+00	4e-01	Y
PRI 7	Snowy Plover	04SPS104	**3e+00**	**2e+00**	Y	**4e+00**	**3e+00**	Y	**1e+01**	**5e+00**	Y	**1e+01**	**6e+00**	Y	**5e+00**	**2e+00**	Y	**5e+00**	**2e+00**	Y	**1e+01**	**5e+00**	Y	-	-	-	1e+00	5e-01	Y
PRI 7	Snowy Plover	04SPS105	1e+00	1e+00	Y	**3e+00**	**2e+00**	Y	**3e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	1e+00	6e-01	Y	**2e+00**	6e-01	Y	**4e+00**	**2e+00**	Y	-	-	-	4e-01	1e-01	Y
PRI 7	Snowy Plover	04SPS106	1e+00	1e+00	Y	**3e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	**5e+00**	**3e+00**	Y	**2e+00**	7e-01	Y	**2e+00**	7e-01	Y	**6e+00**	**2e+00**	Y	-	-	-	5e-01	2e-01	Y
PRI 7	Snowy Plover	04SPS301	**2e+00**	1e+00	Y	**3e+00**	**2e+00**	Y	**3e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	**2e+00**	6e-01	Y	**2e+00**	6e-01	Y	**7e+00**	**3e+00**	Y	-	-	-	4e-01	1e-01	Y
PRI 7	Snowy Plover	04SPS401	**3e+00**	**2e+00**	Y	**4e+00**	**3e+00**	Y	**4e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	1e+00	5e-01	Y	1e+00	5e-01	Y	**8e+00**	**4e+00**	Y	-	-	-	3e-01	1e-01	Y
PRI 7	Snowy Plover	05SPEG1S0109	**2e+00**	1e+00	Y	**3e+00**	**2e+00**	Y	**3e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	1e+00	5e-01	Y	1e+00	5e-01	Y	-	-	-	8e-02	4e-02	Y	4e-01	1e-01	Y
PRI 7	Snowy Plover	05SPEG1S0406	**2e+00**	**2e+00**	Y	**4e+00**	**3e+00**	Y	**7e+00**	**4e+00**	Y	**8e+00**	**4e+00**	Y	**3e+00**	1e+00	Y	**3e+00**	1e+00	Y	-	-	-	2e-01	8e-02	Y	1e+00	3e-01	Y
PRI 7	Snowy Plover	05SPEG1S0407	6e-01	5e-01	Y	**5e+00**	**3e+00**	Y	**4e+00**	**2e+00**	Y	**7e+00**	**4e+00**	Y	**2e+00**	9e-01	Y	**2e+00**	9e-01	Y	-	-	-	5e-02	2e-02	Y	7e-01	2e-01	Y
PRI 7	Snowy Plover	05SPEG1S0408	1e+00	9e-01	Y	**3e+00**	**2e+00**	Y	**3e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	1e+00	5e-01	Y	1e+00	5e-01	Y	-	-	-	9e-02	5e-02	Y	4e-01	1e-01	Y
PRI 7	Snowy Plover	06SPEG1S0202	**2e+00**	**2e+00**	Y	**4e+00**	**3e+00**	Y	**4e+00**	**2e+00**	Y	**6e+00**	**3e+00**	Y	**2e+00**	7e-01	Y	**2e+00**	7e-01	Y	-	-	-	-	-	-	5e-01	2e-01	Y
PRI 14	American Avocet	05AVEG1S0104	1e-01	9e-02	Y	**2e+00**	**2e+00**	Y	8e-01	4e-01	Y	**2e+00**	1e+00	Y	4e-01	2e-01	Y	5e-01	2e-01	Y	-	-	-	5e-02	2e-02	Y	1e-01	4e-02	Y
PRI 14	American Avocet	05AVEG1S0105	5e-02	4e-02	Y	**2e+00**	**2e+00**	Y	3e-01	2e-01	Y	**2e+00**	9e-01	Y	2e-01	7e-02	Y	3e-01	9e-02	Y	-	-	-	8e-02	4e-02	Y	5e-02	2e-02	Y
PRI 14	American Avocet	05AVEG1S0107	5e-01	4e-01	Y	**3e+00**	**2e+00**	Y	**3e+00**	**2e+00**	Y	**5e+00**	**3e+00**	Y	**2e+00**	7e-01	Y	**2e+00**	7e-01	Y	-	-	-	1e-01	5e-02	Y	6e-01	2e-01	Y
PRI 14	American Avocet	05AVEG1S0108	5e-01	3e-01	Y	**3e+00**	**2e+00**	Y	**3e+00**	**2e+00**	Y	**4e+00**	**2e+00**	Y	**2e+00**	6e-01	Y	**2e+00**	7e-01	Y	-	-	-	5e-02	3e-02	Y	5e-01	2e-01	Y
PRI 14	American Avocet	05AVEG1S0109	2e-02	2e-02	Y	**2e+00**	**2e+00**	Y	1e-01	8e-02	Y	1e+00	8e-01	Y	8e-02	3e-02	Y	2e-01	6e-02	Y	-	-	-	1e-01	5e-02	Y	2e-02	8e-03	Y
PRI 14	Snowy Plover	04SPS201	**4e+00**	**3e+00**	Y	**6e+00**	**4e+00**	Y	**4e+00**	**2e+00**	Y	**5e+00**	**3e+00**	Y	1e+00	5e-01	Y	1e+00	5e-01	Y	**8e+00**	**3e+00**	Y	-	-	-	3e-01	1e-01	Y
PRI 14	Snowy Plover	05SPEG1S0104	2e-01	1e-01	Y	**2e+00**	**2e+00**	Y	1e+00	6e-01	Y	**3e+00**	1e+00	Y	6e-01	2e-01	Y	7e-01	3e-01	Y	-	-	-	9e-02	4e-02	Y	2e-01	6e-02	Y
PRI 14	Snowy Plover	06SPEG1S0303	**5e+00**	**4e+00**	Y	**7e+00**	**5e+00**	Y	**1e+01**	**6e+00**	Y	**1e+01**	**7e+00**	Y	**5e+00**	**2e+00**	Y	**5e+00**	**2e+00**	Y	-	-	-	-	-	-	1e+00	5e-01	Y
PRI 14	Snowy Plover	06SPEG1S0404	2e-01	2e-01	Y	**3e+00**	**2e+00**	Y	**2e+00**	9e-01	Y	**3e+00**	**2e+00**	Y	9e-01	3e-01	Y	9e-01	4e-01	Y	-	-	-	-	-	-	2e-01	8e-02	Y
PRI 14	Horned Lark	05HLEG1S0101	2e-01	2e-01	Y	**4e+00**	**3e+00**	Y	**2e+00**	8e-01	Y	**4e+00**	**2e+00**	Y	8e-01	3e-01	Y	1e+00	4e-01	Y	-	-	-	-	-	-	2e-01	8e-02	Y
PRI 14	Horned Lark	06HLEG1S0302	4e-01	3e-01	Y	**5e+00**	**4e+00**	Y	**3e+00**	1e+00	Y	**6e+00**	**3e+00**	Y	1e+00	6e-01	Y	**2e+00**	6e-01	Y	-	-	-	-	-	-	4e-01	1e-01	Y
PRI 14	Horned Lark	06HLEG1S0403	1e+00	8e-01	Y	**3e+00**	**3e+00**	Y	**7e+00**	**4e+00**	Y	**8e+00**	**5e+00**	Y	**4e+00**	1e+00	Y	**4e+00**	1e+00	Y	-	-	-	-	-	-	1e+00	4e-01	Y
PRI 14	Horned Lark	06HLEG1S0504	2e-01	1e-01	Y	**5e+00**	**3e+00**	Y	1e+00	6e-01	Y	**4e+00**	**2e+00**	Y	6e-01	2e-01	Y	7e-01	3e-01	Y	-	-	-	-	-	-	2e-01	6e-02	Y
PRI 14	Horned Lark	06HLEG1S0605	9e-01	7e-01	Y	**6e+00**	**4e+00**	Y	**6e+00**	**3e+00**	Y	**9e+00**	**5e+00**	Y	**3e+00**	1e+00	Y	**3e+00**	1e+00	Y	-	-	-	-	-	-	9e-01	3e-01	Y
Background	American Avocet	04AVR101	4e-02	3e-02	Y	**2e+00**	1e+00	Y	5e-02	3e-02	Y	1e+00	6e-01	Y	2e-02	7e-03	Y	8e-02	3e-02	Y	**4e+00**	**2e+00**	Y	-	-	-	5e-03	2e-03	Y
Background	American Avocet	04AVR102	1e-02	8e-03	Y	**2e+00**	1e+00	Y	7e-02	4e-02	Y	1e+00	6e-01	Y	4e-02	1e-02	Y	1e-01	4e-02	Y	6e-01	2e-01	Y	-	-	-	1e-02	4e-03	Y
Background	American Avocet	04AVR103	1e-02	8e-03	Y	**2e+00**	1e+00	Y	5e-02	3e-02	Y	1e+00	6e-01	Y	3e-02	1e-02	Y	8e-02	3e-02	Y	7e-01	3e-01	Y	-	-	-	7e-03	2e-03	Y
Background	American Avocet	05AVEG1R0101	4e-03	3e-03	Y	**2e+00**	**2e+00**	Y	2e-02	1e-02	Y	1e+00	8e-01	Y	1e-02	5e-03	Y	9e-02	3e-02	Y	-	-	-	3e-02	1e-02	N	4e-03	1e-03	Y
Background	American Avocet	05AVEG1R0102	9e-03	7e-03	Y	**3e+00**	**2e+00**	Y	6e-02	3e-02	Y	**2e+00**	1e+00	Y	3e-02	1e-02	Y	1e-01	5e-02	Y	-	-	-	3e-02	1e-02	N	9e-03	3e-03	Y
Background	American Avocet	05AVEG1R0103	3e-03	2e-03	Y	**2e+00**	1e+00	Y	2e-02	1e-02	Y	1e+00	6e-01	Y	1e-02	4e-03	Y	7e-02	2e-02	Y	-	-	-	2e-02	1e-02	N	3e-03	1e-03	Y
Background	American Avocet	05SPEG1R0102	8e-03	6e-03	Y	**2e+00**	**2e+00**	Y	5e-02	3e-02	Y	**2e+00**	9e-01	Y	3e-02	1e-02	Y	1e-01	4e-02	Y	-	-	-	2e-02	1e-02	N	9e-03	3e-03	Y
Background	American Avocet	06AVEG1R0101	8e-03	6e-03	Y	**2e+00**	**2e+00**	Y	5e-02	3e-02	Y	**2e+00**	9e-01	Y	3e-02	1e-02	Y	1e-01	4e-02	Y	-	-	-	-	-	-	8e-03	3e-03	Y
Background	American Avocet	06AVEG1R0102	0e+00	0e+00	N	**2e+00**	**2e+00**	N	0e+00	0e+00	N	1e+00	8e-01	N	0e+00	0e+00	N	8e-02	3e-02	N	-	-	-	-	-	-	4e-03	1e-03	N
Background	American Avocet	06AVEG1R0103	7e-03	5e-03	Y	**2e+00**	**2e+00**	Y	4e-02	2e-02	Y	**2e+00**	8e-01	Y	2e-02	8e-03	Y	1e-01	4e-02	Y	-	-	-	-	-	-	7e-03	2e-03	Y
Background	Snowy Plover	04SPR101	1e-02	9e-03	Y	**2e+00**	1e+00	Y	5e-02	3e-02	Y	1e+00	6e-01	Y	3e-02	1e-02	Y	9e-02	3e-02	Y	**3e+00**	1e+00	Y	-	-	-	8e-03	3e-03	Y
Background	Snowy Plover	04SPR102	4e-03	3e-03	Y	**2e+00**	1e+00	Y	2e-02	1e-02	Y	1e+00	6e-01	Y	1e-02	5e-03	Y	7e-02	3e-02	Y	9e-01	4e-01	Y	-	-	-	4e-03	1e-03	Y
Background	Snowy Plover	04SPR103	9e-03	6e-03	Y	**2e+00**	1e+00	Y	2e-02	1e-02	Y	1e+00	6e-01	Y	9e-03	3e-03	Y	7e-02	3e-02	Y	**2e+00**	9e-01	Y	-	-	-	3e-03	9e-04	Y
Background	Snowy Plover	04SPR104	1e-02	9e-03	Y	**2e+00**	1e+00	Y	5e-02	3e-02	Y	1e+00	6e-01	Y	3e-02	1e-02	Y	9e-02	3e-02	Y	1e+00	5e-01	Y	-	-	-	8e-03	3e-03	Y
Background	Snowy Plover	05SPEG1R0101	3e-03	2e-03	Y	**2e+00**	1e+00	Y	2e-02	1e-02	Y	1e+00	7e-01	Y	1e-02	4e-03	Y	8e-02	3e-02	Y	-	-	-	3e-02	1e-02	N	3e-03	1e-03	Y
Background	Sage Thrasher	06STEG1R0101	0e+00	0e+00	N	**3e+00**	**2e+00**	N	0e+00	0e+00	N	**2e+00**	1e+00	N	0e+00	0e+00	N	1e-01	4e-02	N	-	-	-	-	-	-	5e-03	2e-03	N

Notes:
There is a discrepancy in USEPA (2006) in the sample coordinates for sample 05SPEG1S0104 and the description of the sample location. Based on the sample location notes, the sample is assumed to be in PRI 14.
There is a discrepancy in USEPA (2006) in the sample coordinates for sample 05SPEG1S0406 and the description of the sample location. Based on the sample location notes, the sample is assumed to be in PRI 7.
Latitude coordinates for 05AVEG1S0104 and 05AVEG1S0108 had a typo in USEPA (2006), which placed the egg sample locations roughly 70 miles north of the site. The latitude coordinates were changed from N 41 degrees to N 40 degrees, which is consistent with the descriptions provided in USEPA (2006).
USEPA Region 8. 2006. Field Sampling Plan/Quality Assurance Project Plan for Sampling and Analysis of Bird Eggs at U.S. Magnesium Corporation, Rowley, Utah. Revision 4, April 27, 2006.
- = Not applicable (sample not analyzed for that analyte)
Det = Detected
LOAEL = HQs calculated using a lowest observed adverse effect level
HQ = Hazard quotient
ND = Not detected
ND=0 = Non-detected values substituted with 0
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQ calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
USEPA = United States Environmental Protection Agency
Bolded text = HQ > 1
Blue highlight = 1 < HQ ≤ 10
Green highlight = 10 < HQ ≤ 100
Yellow highlight = HQ > 100

Table 3-8
PRI 14 Hazard Quotient Comparisons
US Magnesium LLC
Tooele County, Utah

Habitat	Receptor	TEQ Category	Selected Sample	NOAEL Chronic TRV HQ		LOAEL Chronic TRV HQ	
				EPC = Original 95UCL	EPC = Max Detected Concentration South of P-11 Canal	EPC = Original 95UCL	EPC = Max Detected Concentration South of P-11 Canal
Lakebed	American Kestrel	Cat 1	14-25	**5E+01**	**6E+00**	**5E+00**	6E-01
		Cat 2	14-25	**3E+01**	**3E+00**	**3E+00**	3E-01
		Cat 3	14-25	**3E+01**	**3E+00**	**3E+00**	3E-01
	Avocet	Cat 1	14-28	**2E+01**	**4E+00**	**2E+00**	4E-01
		Cat 2	14-25	**1E+01**	8E-01	1E+00	8E-02
		Cat 3	14-25	**1E+01**	4E-01	1E+00	4E-02
	Mourning Dove	Cat 1	14-28	**3E+00**	5E-01	3E-01	5E-02
		Cat 2	14-25	**2E+00**	1E-01	2E-01	1E-02
		Cat 3	14-25	**2E+00**	6E-02	2E-01	6E-03
	Snowy Plover	Cat 1	14-25	**2E+01**	**6E+00**	**2E+00**	6E-01
		Cat 2	14-25	**1E+01**	1E+00	1E+00	1E-01
		Cat 3	14-25	**2E+01**	7E-01	**2E+00**	7E-02
	Tree Swallow	Cat 1	14-25	**3E+01**	**2E+01**	**3E+00**	**2E+00**
		Cat 2	14-25	**2E+01**	**3E+00**	**2E+00**	3E-01
		Cat 3	14-25	**3E+01**	**2E+00**	**3E+00**	2E-01
Upland	American Kestrel	Cat 1	14-32	**1E+01**	**9E+00**	1E+00	9E-01
		Cat 2	14-32	**1E+01**	**8E+00**	1E+00	8E-01
		Cat 3	14-32	**2E+01**	**1E+01**	**2E+00**	1E+00
	Horned Lark	Cat 1	14-32	**1E+01**	**9E+00**	1E+00	9E-01
		Cat 2	14-32	**3E+00**	**2E+00**	3E-01	2E-01
		Cat 3	14-32	**3E+00**	**2E+00**	3E-01	2E-01
	Mourning Dove	Cat 1	14-32	9E-02	8E-02	9E-03	8E-03
		Cat 2	14-32	3E-02	2E-02	3E-03	2E-03
		Cat 3	14-32	3E-02	2E-02	3E-03	2E-03
	Tree Swallow	Cat 1	14-32	**3E+01**	**3E+01**	**3E+00**	**3E+00**
		Cat 2	14-32	**1E+01**	**7E+00**	1E+00	7E-01
		Cat 3	14-32	**1E+01**	**6E+00**	1E+00	6E-01

Notes:
95UCL = 95 Percent Upper Confidence Limit
Cat = Category
HQ = Hazard quotient
EPC = Exposure point concentration
HQ = Hazard quotient
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
TEQ = Toxic equivalency
TRV = Toxicity reference value

Table 4-1
Large Mammal Chronic Dietary Dose HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	Dioxins/Furans		Metals	
		calc-dx-2		7429-90-5	
		Mammalian TEQ, ND=1/2DL		Aluminum	
		NOAEL	LOAEL	NOAEL	LOAEL
PRI 5	Badger	**3e+01**	**3e+00**	-	-
PRI 6	Badger	1e+00	1e-01	-	-
PRI 8	Badger	**9e+00**	9e-01	**7e+00**	7e-01
PRI 10	Badger	2e-02	2e-03	-	-
PRI 12	Badger	6e-01	6e-02	-	-
PRI 14	Badger	**2e+00**	2e-01	-	-
PRI 14	Pronghorn Antelope	1e-01	1e-02	-	-
PRI 15	Badger	5e-01	5e-02	-	-
PRI 15	Pronghorn Antelope	1e-01	1e-02	-	-
PRI 16	Badger	2e-01	2e-02	-	-
PRI 16	Pronghorn Antelope	1e-01	1e-02	-	-
Background	Badger	2e-01	2e-02	**2e+01**	**2e+00**
Background	Pronghorn Antelope	9e-02	9e-03	**2e+00**	2e-01

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (not a COPEC for that exposure area, or no chemistry data available [background locations])
LOAEL = HQs calculated using a lowest observed adverse effect level
NB = No benchmark
ND = Not detected
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ ≤ 10
Green highlight = 10 < HQ ≤ 100
Yellow highlight = HQ > 100

Table 4-2
Summary of Large Mammal Acute and Small Mammal Acute and Chronic Dietary Dose HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	COPEC Group	COPEC	CAS #	Exposure	Number of Samples	Number of Detects	NOAEL				LOAEL			
								Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 2	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	14	14	0	0%	2e-05	1e-01	0	0%	2e-06	1e-02
PRI 2	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Acute	14	14	0	0%	1e-07	1e-03	0	0%	1e-08	1e-04
PRI 2	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Acute	14	14	0	0%	3e-07	4e-03	0	0%	3e-08	4e-04
PRI 2	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	14	14	0	0%	2e-05	1e-01	0	0%	2e-06	1e-02
PRI 2	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Acute	14	14	0	0%	1e-07	1e-03	0	0%	1e-08	1e-04
PRI 2	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Acute	14	14	0	0%	3e-07	4e-03	0	0%	3e-08	4e-04
PRI 2	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	14	14	0	0%	2e-06	1e-02	0	0%	2e-07	1e-03
PRI 2	Badger	PCBs	Total PCBs	1336-36-3	Acute	14	14	0	0%	1e-08	1e-04	0	0%	1e-09	1e-05
PRI 2	Badger	SVOCs	Hexachlorobenzene	118-74-1	Acute	14	14	0	0%	3e-08	3e-04	0	0%	3e-09	3e-05
PRI 4	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	17	17	0	0%	1e-03	1e-01	0	0%	1e-04	1e-02
PRI 4	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Acute	17	17	0	0%	9e-06	4e-04	0	0%	9e-07	4e-05
PRI 4	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Acute	17	16	0	0%	2e-03	8e-03	0	0%	2e-04	8e-04
PRI 4	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	17	17	0	0%	1e-03	1e-01	0	0%	1e-04	1e-02
PRI 4	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Acute	17	17	0	0%	8e-06	3e-04	0	0%	8e-07	3e-05
PRI 4	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Acute	17	16	0	0%	1e-03	7e-03	0	0%	1e-04	7e-04
PRI 4	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	17	17	0	0%	4e-04	5e-02	0	0%	4e-05	5e-03
PRI 4	Badger	PCBs	Total PCBs	1336-36-3	Acute	17	17	0	0%	3e-06	1e-04	0	0%	3e-07	1e-05
PRI 4	Badger	SVOCs	Hexachlorobenzene	118-74-1	Acute	17	16	0	0%	3e-04	3e-03	0	0%	3e-05	3e-04
PRI 5	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	20	20	20	100%	**4e+01**	**1e+02**	20	100%	**4e+00**	**1e+01**
PRI 5	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	20	20	1	5%	5e-02	**6e+00**	0	0%	5e-03	6e-01
PRI 5	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	20	14	1	5%	2e-01	**5e+00**	0	0%	5e-02	1e+00
PRI 5	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	20	20	20	100%	**3e+01**	**5e+01**	20	100%	**3e+00**	**5e+00**
PRI 5	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	20	20	0	0%	4e-02	2e-01	0	0%	4e-03	2e-02
PRI 5	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	20	14	0	0%	2e-01	3e-01	0	0%	5e-02	7e-02
PRI 6	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	10	10	10	100%	**3e+00**	**3e+01**	3	30%	3e-01	**3e+00**
PRI 6	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	10	10	0	0%	2e-02	8e-01	0	0%	2e-03	8e-02
PRI 6	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	10	6	1	10%	1e+00	**2e+00**	0	0%	3e-01	3e-01
PRI 6	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	10	10	4	40%	1e+00	**2e+00**	0	0%	1e-01	2e-01
PRI 6	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	10	10	0	0%	1e-02	3e-02	0	0%	1e-03	3e-03
PRI 6	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	10	6	0	0%	1e+00	1e+00	0	0%	3e-01	3e-01
PRI 8	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	22	22	22	100%	**2e+00**	**6e+01**	9	41%	2e-01	**6e+00**
PRI 8	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	22	22	0	0%	1e-02	1e+00	0	0%	1e-03	1e-01
PRI 8	Grasshopper Mouse	Metals	Aluminum	7429-90-5	Chronic	22	22	22	100%	**8e+00**	**3e+01**	18	82%	8e-01	**3e+00**
PRI 8	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	22	14	2	9%	2e-03	**4e+00**	0	0%	3e-04	8e-01
PRI 8	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	22	22	5	23%	5e-01	**6e+00**	0	0%	5e-02	6e-01
PRI 8	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	22	22	0	0%	6e-04	3e-02	0	0%	6e-05	3e-03
PRI 8	Ord's Kangaroo Rat	Metals	Aluminum	7429-90-5	Chronic	22	22	22	100%	**7e+00**	**2e+01**	18	82%	7e-01	**2e+00**
PRI 8	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	22	14	0	0%	1e-04	9e-02	0	0%	3e-05	2e-02
PRI 9	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	16	16	0	0%	2e-06	1e-03	0	0%	2e-07	1e-04
PRI 9	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Acute	16	16	0	0%	1e-08	9e-06	0	0%	1e-09	9e-07
PRI 9	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Acute	16	9	0	0%	1e-07	3e-05	0	0%	1e-08	3e-06
PRI 9	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	16	16	0	0%	2e-06	1e-03	0	0%	2e-07	1e-04
PRI 9	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Acute	16	16	0	0%	1e-08	8e-06	0	0%	1e-09	8e-07
PRI 9	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Acute	16	9	0	0%	1e-07	2e-05	0	0%	1e-08	2e-06
PRI 9	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	16	16	0	0%	5e-07	3e-04	0	0%	5e-08	3e-05
PRI 9	Badger	PCBs	Total PCBs	1336-36-3	Acute	16	16	0	0%	3e-09	2e-06	0	0%	3e-10	2e-07
PRI 9	Badger	SVOCs	Hexachlorobenzene	118-74-1	Acute	16	9	0	0%	3e-08	6e-06	0	0%	3e-09	6e-07
PRI 10	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	14	14	14	100%	**2e+00**	**4e+00**	0	0%	2e-01	4e-01
PRI 10	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	14	14	0	0%	1e-03	3e-02	0	0%	1e-04	3e-03
PRI 10	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	14	1	0	0%	2e-03	7e-03	0	0%	3e-04	1e-03
PRI 10	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	14	14	0	0%	4e-01	6e-01	0	0%	4e-02	6e-02
PRI 10	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	14	14	0	0%	1e-05	3e-03	0	0%	1e-06	3e-04
PRI 10	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	14	1	0	0%	7e-05	1e-03	0	0%	1e-05	2e-04
PRI 12	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	14	14	14	100%	**3e+00**	**2e+01**	2	14%	3e-01	**2e+00**
PRI 12	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	14	14	0	0%	1e-02	4e-01	0	0%	1e-03	4e-02
PRI 12	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	14	12	0	0%	2e-03	4e-02	0	0%	3e-04	8e-03
PRI 12	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	14	14	0	0%	5e-01	1e+00	0	0%	5e-02	1e-01
PRI 12	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	14	14	0	0%	4e-04	8e-03	0	0%	4e-05	8e-04

Table 4-2
Summary of Large Mammal Acute and Small Mammal Acute and Chronic Dietary Dose HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	COPEC Group	COPEC	CAS #	Exposure	Number of Samples	Number of Detects	NOAEL				LOAEL			
								Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 12	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	14	12	0	0%	8e-05	2e-03	0	0%	2e-05	5e-04
PRI 14	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	9	9	9	100%	**4e+00**	**9e+00**	0	0%	4e-01	9e-01
PRI 14	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	9	9	0	0%	4e-03	8e-02	0	0%	4e-04	8e-03
PRI 14	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	9	2	0	0%	7e-03	4e-02	0	0%	1e-03	9e-03
PRI 14	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	9	9	0	0%	6e-01	7e-01	0	0%	6e-02	7e-02
PRI 14	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	9	9	0	0%	3e-05	4e-03	0	0%	3e-06	4e-04
PRI 14	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	9	2	0	0%	1e-03	3e-03	0	0%	2e-04	5e-04
PRI 15	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	21	21	21	100%	**2e+00**	**6e+00**	0	0%	2e-01	6e-01
PRI 15	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	21	21	0	0%	6e-03	1e-01	0	0%	6e-04	1e-02
PRI 15	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	21	4	0	0%	1e-03	3e-02	0	0%	3e-04	6e-03
PRI 15	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	21	21	0	0%	4e-01	6e-01	0	0%	4e-02	6e-02
PRI 15	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	21	21	0	0%	5e-05	5e-03	0	0%	5e-06	5e-04
PRI 15	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	21	4	0	0%	6e-05	2e-03	0	0%	1e-05	4e-04
PRI 16	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	14	14	13	93%	1e+00	**3e+00**	0	0%	1e-01	3e-01
PRI 16	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	14	14	0	0%	3e-03	2e-02	0	0%	3e-04	2e-03
PRI 16	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	14	14	0	0%	3e-01	5e-01	0	0%	3e-02	5e-02
PRI 16	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	14	14	0	0%	2e-05	1e-03	0	0%	2e-06	1e-04
Background	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	18	18	0	0%	2e-06	1e-05	0	0%	2e-07	1e-06
Background	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	18	18	17	94%	1e+00	**3e+00**	0	0%	1e-01	3e-01
Background	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Acute	18	18	0	0%	2e-08	8e-08	0	0%	2e-09	8e-09
Background	Grasshopper Mouse	PCBs	Total PCBs	1336-36-3	Chronic	18	18	0	0%	4e-03	1e-02	0	0%	4e-04	1e-03
Background	Grasshopper Mouse	Metals	Aluminum	7429-90-5	Chronic	30	30	30	100%	**1e+01**	**2e+01**	21	70%	1e+00	**2e+00**
Background	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Acute	18	0	0	0%	9e-08	9e-08	0	0%	9e-09	9e-09
Background	Grasshopper Mouse	SVOCs	Hexachlorobenzene	118-74-1	Chronic	18	0	0	0%	1e-03	1e-03	0	0%	3e-04	3e-04
Background	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	18	18	0	0%	2e-06	9e-06	0	0%	2e-07	9e-07
Background	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	18	18	0	0%	4e-01	5e-01	0	0%	4e-02	5e-02
Background	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Acute	18	18	0	0%	2e-08	7e-08	0	0%	2e-09	7e-09
Background	Ord's Kangaroo Rat	PCBs	Total PCBs	1336-36-3	Chronic	18	18	0	0%	2e-05	3e-04	0	0%	2e-06	3e-05
Background	Ord's Kangaroo Rat	Metals	Aluminum	7429-90-5	Chronic	30	30	30	100%	**1e+01**	**2e+01**	14	47%	1e+00	**2e+00**
Background	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Acute	18	0	0	0%	9e-08	9e-08	0	0%	9e-09	9e-09
Background	Ord's Kangaroo Rat	SVOCs	Hexachlorobenzene	118-74-1	Chronic	18	0	0	0%	6e-05	6e-05	0	0%	1e-05	1e-05
Background	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	18	18	0	0%	2e-06	1e-05	0	0%	2e-07	1e-06
Background	Badger	PCBs	Total PCBs	1336-36-3	Acute	18	18	0	0%	2e-08	9e-08	0	0%	2e-09	9e-09
Background	Badger	SVOCs	Hexachlorobenzene	118-74-1	Acute	18	0	0	0%	1e-07	1e-07	0	0%	1e-08	1e-08
Background	Pronghorn Antelope	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	18	18	0	0%	2e-07	1e-06	0	0%	2e-08	1e-07
Background	Pronghorn Antelope	PCBs	Total PCBs	1336-36-3	Acute	18	18	0	0%	2e-09	9e-09	0	0%	2e-10	9e-10
Background	Pronghorn Antelope	SVOCs	Hexachlorobenzene	118-74-1	Acute	18	0	0	0%	1e-08	1e-08	0	0%	1e-09	1e-09

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 4-3
Large Mammal Chronic Dietary Dose HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	Dioxins/Furans		Metals	
		calc-dx-2		7429-90-5	
		Mammalian TEQ, ND=1/2DL		Aluminum	
		NOAEL	LOAEL	NOAEL	LOAEL
PRI 7	Badger	**1e+02**	**1e+01**	**4e+00**	4e-01
PRI 8	Badger	1e-01	1e-02	7e-01	7e-02
PRI 13	Badger	**4e+00**	4e-01	-	-
PRI 14	Badger	**1e+01**	1e+00	-	-
GSLIC	Badger	7e-01	7e-02	-	-
SVDD	Badger	4e-01	4e-02	8e-02	8e-03
Background	Badger	4e-01	4e-02	**2e+01**	**2e+00**

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (not a COPEC for that exposure area, or no chemistry data available [background locations])
GSLIC = Great Salt Lake Intake Canal
LOAEL = HQs calculated using a lowest observed adverse effect level
ND = Not detected
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley Diversion Ditch
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ ≤ 10
Green highlight = 10 < HQ ≤ 100
Yellow highlight = HQ > 100

Table 4-4
Summary of Large Mammal Acute and Small Mammal Acute and Chronic Dietary Dose HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	Receptor	COPEC Group	COPEC	CAS #	Exposure	Number of Samples	Number of Detects	NOAEL				LOAEL			
								Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 5	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	12	12	1	8%	2e-01	**6e+00**	0	0%	2e-02	6e-01
PRI 5	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	12	12	1	8%	2e-01	**6e+00**	0	0%	2e-02	6e-01
PRI 5	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	12	12	1	8%	3e-02	**2e+00**	0	0%	3e-03	2e-01
PRI 6	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	6	6	0	0%	4e-03	5e-02	0	0%	4e-04	5e-03
PRI 6	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	6	6	0	0%	4e-03	4e-02	0	0%	4e-04	4e-03
PRI 6	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	6	6	0	0%	5e-04	1e-02	0	0%	5e-05	1e-03
PRI 7	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	23	23	0	0%	2e-04	3e-01	0	0%	2e-05	3e-02
PRI 7	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	23	23	0	0%	2e-04	2e-01	0	0%	2e-05	2e-02
PRI 7	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	23	23	0	0%	1e-04	3e-01	0	0%	1e-05	3e-02
PRI 7	Grasshopper Mouse	Metals	Iron	7439-89-6	Acute	23	23	0	0%	9e-03	4e-02	0	0%	9e-04	4e-03
PRI 7	Ord's Kangaroo Rat	Metals	Iron	7439-89-6	Acute	23	23	0	0%	8e-03	3e-02	0	0%	8e-04	3e-03
PRI 7	Badger	Metals	Iron	7439-89-6	Acute	23	23	0	0%	6e-03	4e-02	0	0%	6e-04	4e-03
Background	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	17	17	0	0%	2e-06	4e-05	0	0%	2e-07	4e-06
Background	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	17	17	0	0%	2e-06	4e-05	0	0%	2e-07	4e-06
Background	Badger	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Acute	17	17	0	0%	2e-06	5e-05	0	0%	2e-07	5e-06
Background	Grasshopper Mouse	Metals	Iron	7439-89-6	Acute	29	29	0	0%	4e-04	1e-02	0	0%	4e-05	1e-03
Background	Ord's Kangaroo Rat	Metals	Iron	7439-89-6	Acute	29	29	0	0%	4e-04	9e-03	0	0%	4e-05	9e-04
Background	Badger	Metals	Iron	7439-89-6	Acute	29	29	0	0%	5e-04	1e-02	0	0%	5e-05	1e-03
PRI 7	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	23	23	23	100%	**4e+00**	**6e+01**	2	9%	4e-01	**6e+00**
PRI 7	Grasshopper Mouse	Metals	Iron	7439-89-6	Chronic	23	23	2	9%	4e-01	**2e+00**	0	0%	4e-02	2e-01
PRI 7	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	23	23	13	57%	6e-01	**5e+01**	2	9%	6e-02	**5e+00**
PRI 7	Ord's Kangaroo Rat	Metals	Iron	7439-89-6	Chronic	23	23	1	4%	4e-01	**2e+00**	0	0%	4e-02	2e-01
PRI 8	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	5	5	5	100%	**4e+00**	**4e+00**	0	0%	4e-01	4e-01
PRI 8	Grasshopper Mouse	Metals	Aluminum	7429-90-5	Chronic	5	5	5	100%	**1e+01**	**3e+01**	4	80%	1e+00	**3e+00**
PRI 8	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	5	5	0	0%	7e-01	7e-01	0	0%	7e-02	7e-02
PRI 8	Ord's Kangaroo Rat	Metals	Aluminum	7429-90-5	Chronic	5	5	5	100%	**1e+01**	**3e+01**	4	80%	1e+00	**3e+00**
PRI 13	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	20	20	20	100%	**4e+00**	**4e+00**	0	0%	4e-01	4e-01
PRI 13	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	20	20	0	0%	5e-01	1e+00	0	0%	5e-02	1e-01
PRI 14	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	34	34	34	100%	**4e+00**	**6e+00**	0	0%	4e-01	6e-01
PRI 14	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	34	34	2	6%	5e-01	**3e+00**	0	0%	5e-02	3e-01
GSLIC	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	9	9	9	100%	**4e+00**	**6e+00**	0	0%	4e-01	6e-01
GSLIC	Grasshopper Mouse	Metals	Iron	7439-89-6	Chronic	9	9	0	0%	5e-02	3e-01	0	0%	5e-03	3e-02
GSLIC	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	9	9	3	33%	6e-01	**3e+00**	0	0%	6e-02	3e-01
GSLIC	Ord's Kangaroo Rat	Metals	Iron	7439-89-6	Chronic	9	9	0	0%	5e-02	3e-01	0	0%	5e-03	3e-02
SVDD	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	13	13	13	100%	**4e+00**	**5e+00**	0	0%	4e-01	5e-01
SVDD	Grasshopper Mouse	Metals	Iron	7439-89-6	Chronic	13	13	0	0%	1e+00	1e+00	0	0%	1e-01	1e-01
SVDD	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	13	13	1	8%	5e-01	**2e+00**	0	0%	5e-02	2e-01
SVDD	Ord's Kangaroo Rat	Metals	Iron	7439-89-6	Chronic	13	13	0	0%	9e-01	1e+00	0	0%	9e-02	1e-01
Background	Grasshopper Mouse	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	17	17	17	100%	**4e+00**	**4e+00**	0	0%	4e-01	4e-01
Background	Grasshopper Mouse	Metals	Aluminum	7429-90-5	Chronic	29	29	27	93%	1e+00	**3e+01**	12	41%	1e-01	**3e+00**
Background	Grasshopper Mouse	Metals	Iron	7439-89-6	Chronic	29	29	0	0%	2e-02	5e-01	0	0%	2e-03	5e-02
Background	Ord's Kangaroo Rat	Dioxins/Furans	Mammalian TEQ, ND=1/2DL	calc-dx-2	Chronic	17	17	0	0%	3e-01	6e-01	0	0%	3e-02	6e-02
Background	Ord's Kangaroo Rat	Metals	Aluminum	7429-90-5	Chronic	29	29	27	93%	1e+00	**2e+01**	11	38%	1e-01	**2e+00**
Background	Ord's Kangaroo Rat	Metals	Iron	7439-89-6	Chronic	29	29	0	0%	2e-02	5e-01	0	0%	2e-03	5e-02

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Intake Canal
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level

PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversion ditch
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 4-5
Dose Contribution for all Mammal Chronic HQs Above One
US Magnesium LLC
Tooele County, Utah

PRI	Receptor	COPEC	Habitat	% Dose From Solids	% Dose From Water	% Dose From Tissue	NOAEL HQ (Solids)	NOAEL HQ (Water)	NOAEL HQ (Tissue)	NOAEL HQ (Total)	LOAEL HQ (Solids)	LOAEL HQ (Water)	LOAEL HQ (Tissue)	LOAEL HQ (Total)
PRI 5	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	1%	79%	20%	1e+00	3e+01	1e+01	5e+01	1e-01	3e+00	1e+00	5e+00
PRI 5	Grasshopper Mouse	Total PCBs	Upland	1%	43%	56%	1e-02	4e-02	4e-01	5e-01	1e-03	4e-03	4e-02	5e-02
PRI 5	Grasshopper Mouse	Hexachlorobenzene	Upland	0%	81%	19%	7e-03	2e-01	3e-01	6e-01	1e-03	5e-02	6e-02	1e-01
PRI 5	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Upland	2%	96%	2%	1e+00	3e+01	6e-01	3e+01	1e-01	3e+00	6e-02	3e+00
PRI 5	Badger	Mammalian TEQ, ND=1/2DL	Upland	16%	22%	62%	4e+00	6e+00	2e+01	3e+01	4e-01	6e-01	2e+00	3e+00
PRI 6	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	1%	9%	90%	2e-01	8e-01	1e+01	1e+01	2e-02	8e-02	1e+00	1e+00
PRI 6	Grasshopper Mouse	Hexachlorobenzene	Upland	0%	94%	6%	1e-03	1e+00	9e-02	1e+00	2e-04	3e-01	2e-02	3e-01
PRI 6	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Upland	10%	50%	40%	2e-01	8e-01	6e-01	2e+00	2e-02	8e-02	6e-02	2e-01
PRI 6	Ord's Kangaroo Rat	Hexachlorobenzene	Upland	0%	100%	0%	9e-04	1e+00	2e-03	1e+00	2e-04	3e-01	4e-04	3e-01
PRI 7	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	27%	1%	72%	5e+00	4e-02	4e+00	9e+00	5e-01	4e-03	4e-01	9e-01
PRI 7	Grasshopper Mouse	Iron	Lakebed	48%	52%	-	5e-01	4e-01	-	9e-01	5e-02	4e-02	-	9e-02
PRI 7	Grasshopper Mouse	Hexachlorobenzene	Lakebed	8%	1%	92%	4e-02	8e-05	9e-02	1e-01	7e-03	2e-05	2e-02	3e-02
PRI 7	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Lakebed	52%	3%	45%	4e+00	4e-02	6e-01	5e+00	4e-01	4e-03	6e-02	5e-01
PRI 7	Ord's Kangaroo Rat	Iron	Lakebed	47%	53%	-	5e-01	4e-01	-	8e-01	5e-02	4e-02	-	8e-02
PRI 7	Badger	Mammalian TEQ, ND=1/2DL	Lakebed	24%	0%	76%	2e+01	3e-02	8e+01	1e+02	2e+00	3e-03	8e+00	1e+01
PRI 7	Badger	Aluminum	Lakebed	-	100%	-	-	4e+00	-	4e+00	-	4e-01	-	4e-01
PRI 8	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	2%	0%	98%	7e-02	8e-03	4e+00	4e+00	7e-03	8e-04	4e-01	4e-01
PRI 8	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	2%	0%	98%	7e-01	8e-03	2e+01	2e+01	7e-02	8e-04	2e+00	2e+00
PRI 8	Grasshopper Mouse	Total PCBs	Upland	1%	1%	99%	6e-03	2e-04	4e-01	4e-01	6e-04	2e-05	4e-02	4e-02
PRI 8	Grasshopper Mouse	Aluminum	Lakebed	92%	8%	-	2e+01	2e+00	-	2e+01	2e+00	2e-01	-	2e+00
PRI 8	Grasshopper Mouse	Aluminum	Upland	92%	8%	-	2e+01	2e+00	-	2e+01	2e+00	2e-01	-	2e+00
PRI 8	Grasshopper Mouse	Vanadium	Lakebed	2%	98%	-	3e-02	1e+00	-	1e+00	2e-02	6e-01	-	7e-01
PRI 8	Grasshopper Mouse	Vanadium	Upland	2%	98%	-	2e-02	1e+00	-	1e+00	1e-02	6e-01	-	7e-01
PRI 8	Grasshopper Mouse	Hexachlorobenzene	Upland	1%	1%	98%	9e-03	8e-05	5e-01	5e-01	2e-03	2e-05	9e-02	1e-01
PRI 8	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Upland	26%	1%	73%	6e-01	8e-03	6e-01	1e+00	6e-02	8e-04	6e-02	1e-01
PRI 8	Ord's Kangaroo Rat	Aluminum	Lakebed	92%	8%	-	2e+01	1e+00	-	2e+01	2e+00	1e-01	-	2e+00
PRI 8	Ord's Kangaroo Rat	Aluminum	Upland	91%	9%	-	2e+01	1e+00	-	2e+01	2e+00	1e-01	-	2e+00
PRI 8	Ord's Kangaroo Rat	Vanadium	Lakebed	2%	98%	-	3e-02	1e+00	-	1e+00	1e-02	6e-01	-	6e-01
PRI 8	Ord's Kangaroo Rat	Vanadium	Upland	1%	99%	-	2e-02	1e+00	-	1e+00	9e-03	6e-01	-	6e-01
PRI 8	Badger	Mammalian TEQ, ND=1/2DL	Upland	13%	0%	87%	1e+00	2e-03	8e+00	9e+00	1e-01	2e-04	8e-01	9e-01
PRI 8	Badger	Aluminum	Upland	96%	4%	-	7e+00	3e-01	-	7e+00	7e-01	3e-02	-	7e-01
PRI 10	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	0%	-	100%	2e-03	-	3e+00	3e+00	2e-04	-	3e-01	3e-01
PRI 12	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	1%	-	99%	8e-02	-	9e+00	9e+00	8e-03	-	9e-01	9e-01
PRI 12	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Upland	9%	-	91%	7e-02	-	6e-01	7e-01	7e-03	-	6e-02	7e-02
PRI 13	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	2%	-	98%	6e-02	-	4e+00	4e+00	6e-03	-	4e-01	4e-01
PRI 13	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Lakebed	7%	-	93%	6e-02	-	6e-01	6e-01	6e-03	-	6e-02	6e-02
PRI 13	Badger	Mammalian TEQ, ND=1/2DL	Lakebed	4%	-	96%	2e-01	-	4e+00	4e+00	2e-02	-	4e-01	4e-01
PRI 14	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	4%	0%	96%	2e-01	2e-03	4e+00	4e+00	2e-02	2e-04	4e-01	4e-01
PRI 14	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	0%	0%	100%	3e-02	2e-03	7e+00	7e+00	3e-03	2e-04	7e-01	7e-01
PRI 14	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Lakebed	14%	0%	86%	2e-01	2e-03	6e-01	8e-01	2e-02	2e-04	6e-02	8e-02
PRI 14	Badger	Mammalian TEQ, ND=1/2DL	Lakebed	7%	0%	93%	7e-01	1e-03	9e+00	1e+01	7e-02	1e-04	9e-01	1e+00
PRI 14	Badger	Mammalian TEQ, ND=1/2DL	Upland	2%	0%	98%	4e-02	1e-03	2e+00	2e+00	4e-03	1e-04	2e-01	2e-01
PRI 15	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	0%	-	100%	3e-03	-	3e+00	3e+00	3e-04	-	3e-01	3e-01
PRI 16	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	0%	-	100%	1e-03	-	2e+00	2e+00	1e-04	-	2e-01	2e-01
GSLIC	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	13%	-	87%	7e-01	-	4e+00	4e+00	7e-02	-	4e-01	4e-01
GSLIC	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Lakebed	35%	-	65%	6e-01	-	6e-01	1e+00	6e-02	-	6e-02	1e-01
SVDD	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	2%	0%	97%	1e-01	4e-03	4e+00	4e+00	1e-02	4e-04	4e-01	4e-01
SVDD	Grasshopper Mouse	Iron	Lakebed	16%	84%	-	2e-01	9e-01	-	1e+00	2e-02	9e-02	-	1e-01
SVDD	Ord's Kangaroo Rat	Mammalian TEQ, ND=1/2DL	Lakebed	9%	1%	91%	1e-01	4e-03	6e-01	7e-01	1e-02	4e-04	6e-02	7e-02
SVDD	Ord's Kangaroo Rat	Iron	Lakebed	15%	85%	-	2e-01	9e-01	-	1e+00	2e-02	9e-02	-	1e-01
Background	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Lakebed	0%	-	100%	2e-03	-	4e+00	4e+00	2e-04	-	4e-01	4e-01
Background	Grasshopper Mouse	Mammalian TEQ, ND=1/2DL	Upland	0%	-	100%	8e-04	-	2e+00	2e+00	8e-05	-	2e-01	2e-01
Background	Grasshopper Mouse	Aluminum	Lakebed	100%	-	-	1e+01	-	-	1e+01	1e+00	-	-	1e+00
Background	Grasshopper Mouse	Aluminum	Upland	100%	-	-	2e+01	-	-	2e+01	2e+00	-	-	2e+00
Background	Grasshopper Mouse	Mercury	Lakebed	0%	-	100%	4e-03	-	3e+00	3e+00	4e-04	-	3e-01	3e-01
Background	Ord's Kangaroo Rat	Aluminum	Lakebed	100%	-	-	1e+01	-	-	1e+01	1e+00	-	-	1e+00
Background	Ord's Kangaroo Rat	Aluminum	Upland	100%	-	-	1e+01	-	-	1e+01	1e+00	-	-	1e+00
Background	Badger	Aluminum	Lakebed	100%	-	-	2e+01	-	-	2e+01	2e+00	-	-	2e+00
Background	Badger	Aluminum	Upland	100%	-	-	2e+01	-	-	2e+01	2e+00	-	-	2e+00
Background	Pronghorn Antelope	Aluminum	Upland	100%	-	-	2e+00	-	-	2e+00	2e-01	-	-	2e-01

Table 4-5
Dose Contribution for all Mammal Chronic HQs Above One
US Magnesium LLC
Tooele County, Utah

Notes:
Grasshopper Mouse and Ord's Kangaroo Rat percent dosage and HQ values are means of point-by-point values. Remaining values are from 95 UCLs.
Percentages of doses were rounded to zero decimal places.
Only PRIs, habitats, receptors, and COPECs with a NOAEL HQ > 1 are shown in tables. Complete HQs are presented in Appendix D.
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Intake Canal
HQ = Hazard quotient
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversion ditch
TEQ = Dioxin/furan toxicity equivalence factor
- = media type was not evaluated
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 5-1
Summary of Terrestrial Plant Chronic Direct Contact HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 5	Metals	Antimony	7440-36-0	20	15	-	-	-	-	0	0%	9e-03	2e-01
PRI 5	Metals	Barium	7440-39-3	20	20	-	-	-	-	0	0%	2e-01	8e-01
PRI 5	Metals	Chromium	7440-47-3	20	20	-	-	-	-	20	100%	**2e+00**	**2e+01**
PRI 5	Metals	Molybdenum	7439-98-7	20	19	1	5%	2e-03	**2e+00**	0	0%	1e-03	6e-01
PRI 5	Metals	Selenium	7782-49-2	20	11	1	5%	8e-02	**4e+00**	1	5%	4e-02	**2e+00**
PRI 5	Metals	Vanadium	7440-62-2	20	20	5	25%	4e-01	**4e+00**	0	0%	4e-02	4e-01
PRI 6	Metals	Antimony	7440-36-0	10	9	-	-	-	-	0	0%	2e-02	2e-01
PRI 6	Metals	Barium	7440-39-3	10	10	-	-	-	-	0	0%	4e-01	8e-01
PRI 6	Metals	Molybdenum	7439-98-7	10	10	0	0%	3e-03	1e+00	0	0%	1e-03	5e-01
PRI 6	Metals	Selenium	7782-49-2	10	9	1	10%	1e-01	**3e+00**	1	10%	6e-02	**2e+00**
PRI 8	Metals	Aluminum	7429-90-5	22	22	-	-	-	-	22	100%	**9e+01**	**3e+02**
PRI 8	Metals	Antimony	7440-36-0	22	16	-	-	-	-	0	0%	1e-02	3e-01
PRI 8	Metals	Barium	7440-39-3	22	22	-	-	-	-	1	5%	9e-02	**2e+00**
PRI 8	Metals	Vanadium	7440-62-2	22	22	18	82%	1e+00	**6e+00**	0	0%	1e-01	7e-01
PRI 8	SVOCs	Pentachlorophenol	87-86-5	22	3	1	5%	2e-03	**4e+00**	0	0%	7e-04	1e+00
PRI 10	Metals	Antimony	7440-36-0	14	5	-	-	-	-	0	0%	2e-02	1e-01
PRI 10	Metals	Barium	7440-39-3	14	14	-	-	-	-	1	7%	4e-01	**2e+00**
PRI 10	Metals	Vanadium	7440-62-2	14	14	14	100%	**2e+00**	**3e+00**	0	0%	2e-01	4e-01
PRI 12	Metals	Antimony	7440-36-0	14	2	-	-	-	-	1	7%	2e-02	**2e+00**
PRI 14	Metals	Antimony	7440-36-0	9	8	-	-	-	-	0	0%	2e-02	2e-01
PRI 14	Metals	Manganese	7439-96-5	9	9	2	22%	2e-01	**2e+00**	0	0%	1e-01	9e-01
PRI 15	Metals	Antimony	7440-36-0	21	19	-	-	-	-	0	0%	2e-02	8e-02
PRI 15	Metals	Barium	7440-39-3	21	21	-	-	-	-	0	0%	1e-01	8e-01
PRI 16	Metals	Antimony	7440-36-0	14	12	-	-	-	-	0	0%	2e-02	8e-02
Background	Metals	Aluminum	7429-90-5	30	30	-	-	-	-	30	100%	**2e+02**	**3e+02**
Background	Metals	Antimony	7440-36-0	30	30	-	-	-	-	0	0%	2e-02	7e-02
Background	Metals	Barium	7440-39-3	30	30	-	-	-	-	0	0%	2e-01	6e-01
Background	Metals	Chromium	7440-47-3	30	30	-	-	-	-	30	100%	**8e+00**	**2e+01**
Background	Metals	Manganese	7439-96-5	30	30	28	93%	1e+00	**3e+00**	0	0%	5e-01	1e+00
Background	Metals	Molybdenum	7439-98-7	29	29	0	0%	2e-02	6e-02	0	0%	8e-03	3e-02
Background	Metals	Selenium	7782-49-2	30	30	0	0%	3e-01	6e-01	0	0%	2e-01	3e-01
Background	Metals	Vanadium	7440-62-2	30	30	19	63%	1e+00	**2e+00**	0	0%	1e-01	2e-01

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level

PRI = Preliminary Remediation Investigation
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 6-1
Summary of Soil Invertebrate Chronic Direct Contact HQs in Upland Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 5	Metals	Barium	7440-39-3	20	20	0	0%	4e-01	1e+00	-	-	-	-
PRI 5	Metals	Chromium	7440-47-3	20	20	-	-	-	-	20	100%	**5e+00**	**6e+01**
PRI 6	Metals	Barium	7440-39-3	10	10	0	0%	6e-01	1e+00	-	-	-	-
PRI 6	Metals	Mercury	7439-97-6	10	6	-	-	-	-	2	20%	4e-02	**2e+00**
PRI 8	Metals	Barium	7440-39-3	22	22	1	5%	1e-01	**2e+00**	-	-	-	-
PRI 10	Metals	Barium	7440-39-3	14	14	1	7%	6e-01	**3e+00**	-	-	-	-
PRI 15	Metals	Barium	7440-39-3	21	21	0	0%	2e-01	1e+00	-	-	-	-
Background	Metals	Barium	7440-39-3	30	30	0	0%	4e-01	8e-01	-	-	-	-
Background	Metals	Chromium	7440-47-3	30	30	-	-	-	-	30	100%	**2e+01**	**4e+01**
Background	Metals	Mercury	7439-97-6	30	30	-	-	-	-	0	0%	2e-01	7e-01

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
NOAEL = HQs calculated using a no observed adverse effect level
PRI = Preliminary Remediation Investigation
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 6-2
Summary of Benthic Invertebrate Chronic Direct Contact HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 7	PCBs	Total PCBs	1336-36-3	23	23	18	78%	5e-02	**1e+02**	10	43%	6e-03	**1e+01**
PRI 7	Metals	Arsenic	7440-38-2	23	23	16	70%	6e-01	**4e+00**	0	0%	2e-01	1e+00
PRI 7	Metals	Iron	7439-89-6	23	23	5	22%	6e-02	**2e+00**	0	0%	3e-02	1e+00
PRI 7	Metals	Manganese	7439-96-5	23	23	21	91%	1e+00	**1e+01**	0	0%	5e-02	5e-01
PRI 7	SVOCs	Hexachlorobenzene	118-74-1	23	18	1	4%	3e-05	**2e+00**	-	-	-	-
PRI 7	SVOCs	Pentachlorobenzene	608-93-5	20	1	1	5%	1e-02	**9e+00**	-	-	-	-
PRI 7	VOCs	1,1-Dichloroethane	75-34-3	20	1	1	5%	3e-01	**2e+00**	0	0%	9e-04	5e-03
PRI 7	VOCs	1,2,4-Trichlorobenzene	120-82-1	20	9	3	15%	5e-02	**1e+01**	0	0%	5e-03	1e+00
PRI 7	VOCs	2-Butanone	78-93-3	19	15	2	11%	5e-02	**2e+00**	0	0%	6e-05	2e-03
PRI 7	VOCs	Carbon disulfide	75-15-0	20	14	4	20%	1e-02	**7e+00**	-	-	-	-
PRI 8	PCBs	Total PCBs	1336-36-3	5	5	2	40%	3e-02	**2e+00**	0	0%	4e-03	2e-01
PRI 8	Metals	Barium	7440-39-3	5	5	5	100%	**1e+01**	**2e+01**	-	-	-	-
PRI 8	SVOCs	Hexachlorobenzene	118-74-1	5	1	0	0%	3e-05	4e-03	-	-	-	-
PRI 13	PCBs	Total PCBs	1336-36-3	20	20	2	10%	1e-02	**4e+00**	0	0%	1e-03	5e-01
PRI 13	SVOCs	Hexachlorobenzene	118-74-1	20	7	0	0%	3e-05	3e-03	-	-	-	-
PRI 14	PCBs	Total PCBs	1336-36-3	34	34	10	29%	2e-02	**3e+01**	6	18%	2e-03	**4e+00**
PRI 14	Metals	Manganese	7439-96-5	34	34	31	91%	5e-01	**4e+01**	1	3%	2e-02	**2e+00**
PRI 14	SVOCs	Hexachlorobenzene	118-74-1	34	14	0	0%	3e-05	2e-01	-	-	-	-
PRI 14	SVOCs	Phenol	108-95-2	28	3	9	32%	1e+00	**1e+01**	-	-	-	-
GSLIC	PCBs	Total PCBs	1336-36-3	9	9	6	67%	1e-02	**2e+01**	3	33%	1e-03	**2e+00**
GSLIC	Metals	Arsenic	7440-38-2	9	9	0	0%	4e-01	1e+00	0	0%	1e-01	3e-01
GSLIC	Metals	Iron	7439-89-6	9	9	0	0%	8e-02	5e-01	0	0%	4e-02	2e-01
GSLIC	Metals	Manganese	7439-96-5	9	9	8	89%	1e+00	**5e+00**	0	0%	6e-02	2e-01
GSLIC	SVOCs	Hexachlorobenzene	118-74-1	9	3	0	0%	3e-05	8e-03	-	-	-	-
GSLIC	VOCs	1,2,4-Trichlorobenzene	120-82-1	7	3	1	14%	4e-02	**5e+00**	0	0%	4e-03	5e-01
GSLIC	VOCs	2-Butanone	78-93-3	7	6	1	14%	4e-02	**3e+00**	0	0%	5e-05	3e-03
GSLIC	VOCs	Carbon disulfide	75-15-0	7	4	0	0%	1e-02	8e-01	-	-	-	-
SVDD	PCBs	Total PCBs	1336-36-3	13	13	2	15%	5e-02	**7e+00**	0	0%	6e-03	9e-01
SVDD	Metals	Arsenic	7440-38-2	13	13	1	8%	5e-01	**2e+00**	0	0%	1e-01	5e-01
SVDD	Metals	Iron	7439-89-6	13	13	0	0%	1e-01	1e+00	0	0%	5e-02	5e-01
SVDD	Metals	Manganese	7439-96-5	13	13	13	100%	**2e+00**	**1e+01**	0	0%	9e-02	4e-01
SVDD	SVOCs	Hexachlorobenzene	118-74-1	13	3	0	0%	4e-05	3e-03	-	-	-	-
SVDD	VOCs	1,2,4-Trichlorobenzene	120-82-1	9	1	0	0%	2e-02	1e-01	0	0%	2e-03	1e-02
SVDD	VOCs	2-Butanone	78-93-3	9	6	2	22%	2e-02	**2e+00**	0	0%	2e-05	3e-03
SVDD	VOCs	Carbon disulfide	75-15-0	9	6	0	0%	7e-03	4e-01	-	-	-	-
Background	PCBs	Total PCBs	1336-36-3	17	17	0	0%	5e-03	1e-01	0	0%	6e-04	1e-02
Background	Metals	Arsenic	7440-38-2	29	29	7	24%	6e-01	**3e+00**	0	0%	1e-01	7e-01
Background	Metals	Barium	7440-39-3	29	29	29	100%	**6e+00**	**2e+01**	-	-	-	-
Background	Metals	Iron	7439-89-6	29	29	0	0%	4e-02	8e-01	0	0%	2e-02	4e-01
Background	Metals	Manganese	7439-96-5	29	29	19	66%	5e-01	**8e+00**	0	0%	2e-02	3e-01
Background	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	3e-05	2e-04	-	-	-	-

Table 6-2
Summary of Benthic Invertebrate Chronic Direct Contact HQs in Lakebed Habitat
US Magnesium LLC
Tooele County, Utah

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
GSLIC = Great Salt Lake Intake Canal
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
NOAEL = HQs calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversion ditch
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
VOC = Volatile organic compound
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 6-3
Summary of Aquatic Biota Chronic Direct Contact HQs in Surface Water
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 7	PCBs	Total PCBs	1336-36-3	6	6	2	33%	2e-01	**2e+01**	-	-	-	-
PRI 7	Metals	Aluminum	7429-90-5	6	4	3	50%	3e-01	**2e+03**	-	-	-	-
PRI 7	Metals	Barium	7440-39-3	6	6	6	100%	**3e+01**	**7e+02**	0	0%	3e-05	6e-04
PRI 7	Metals	Beryllium	7440-41-7	6	5	2	33%	3e-01	**2e+01**	0	0%	6e-03	3e-01
PRI 7	Metals	Cadmium	7440-43-9	6	1	2	33%	7e-01	**3e+01**	0	0%	2e-02	8e-01
PRI 7	Metals	Chromium	7440-47-3	6	2	1	17%	1e-02	**1e+01**	1	17%	2e-03	**2e+00**
PRI 7	Metals	Cobalt	7440-48-4	6	6	4	67%	2e-01	**4e+00**	0	0%	3e-03	6e-02
PRI 7	Metals	Copper	7440-50-8	6	4	5	83%	3e-01	**1e+02**	1	17%	1e-02	**4e+00**
PRI 7	Metals	Iron	7439-89-6	6	6	6	100%	**3e+00**	**1e+03**	-	-	-	-
PRI 7	Metals	Lead	7439-92-1	6	1	2	33%	2e-01	**2e+02**	0	0%	1e-03	1e+00
PRI 7	Metals	Manganese	7439-96-5	6	6	6	100%	**1e+02**	**7e+02**	1	17%	2e-01	**2e+00**
PRI 7	Metals	Mercury	7439-97-6	6	2	6	100%	**4e+00**	**4e+02**	1	17%	4e-02	**3e+00**
PRI 7	Metals	Nickel	7440-02-0	6	6	5	83%	7e-01	**4e+01**	0	0%	4e-03	2e-01
PRI 7	Metals	Selenium	7782-49-2	6	3	2	33%	2e-01	**5e+00**	0	0%	3e-03	9e-02
PRI 7	Metals	Thallium	7440-28-0	6	1	1	17%	4e-02	**2e+00**	0	0%	5e-03	2e-01
PRI 7	Metals	Vanadium	7440-62-2	6	1	2	33%	2e-01	**1e+02**	1	17%	1e-02	**8e+00**
PRI 7	Metals	Zinc	7440-66-6	6	5	1	17%	5e-02	**1e+01**	1	17%	1e-02	**3e+00**
PRI 7	SVOCs	Pentachlorophenol	87-86-5	6	2	2	33%	1e-01	**3e+00**	0	0%	3e-03	9e-02
PRI 7	VOCs	Carbon disulfide	75-15-0	6	6	3	50%	6e-01	**2e+01**	0	0%	3e-02	1e+00
PRI 7	VOCs	Chloroform	67-66-3	6	5	1	17%	4e-03	**2e+00**	0	0%	2e-04	9e-02
PRI 7	Cyanide	Total cyanide	74-90-8	6	6	6	100%	**8e+00**	**3e+01**	0	0%	5e-04	2e-03
PRI 7	WQ Anions	Chlorine	7782-50-5	5	5	2	40%	0e+00	**2e+01**	2	40%	0e+00	**1e+01**
PRI 8	PCBs	Total PCBs	1336-36-3	5	5	4	80%	6e-01	**2e+01**	-	-	-	-
PRI 8	Metals	Aluminum	7429-90-5	5	5	5	100%	**4e+01**	**3e+02**	-	-	-	-
PRI 8	Metals	Barium	7440-39-3	5	5	5	100%	**6e+01**	**2e+02**	0	0%	5e-05	2e-04
PRI 8	Metals	Beryllium	7440-41-7	5	5	4	80%	6e-01	**3e+00**	0	0%	1e-02	7e-02
PRI 8	Metals	Cadmium	7440-43-9	5	4	5	100%	**2e+00**	**3e+00**	0	0%	4e-02	8e-02
PRI 8	Metals	Chromium	7440-47-3	5	4	0	0%	3e-02	1e+00	0	0%	4e-03	2e-01
PRI 8	Metals	Cobalt	7440-48-4	5	5	2	40%	1e+00	**4e+00**	0	0%	2e-02	7e-02
PRI 8	Metals	Copper	7440-50-8	5	5	5	100%	**2e+00**	**2e+01**	0	0%	7e-02	8e-01
PRI 8	Metals	Iron	7439-89-6	5	5	5	100%	**9e+01**	**2e+02**	-	-	-	-
PRI 8	Metals	Lead	7439-92-1	5	4	4	80%	6e-01	**1e+01**	0	0%	3e-03	7e-02
PRI 8	Metals	Manganese	7439-96-5	5	5	5	100%	**4e+01**	**1e+02**	0	0%	9e-02	3e-01
PRI 8	Metals	Mercury	7439-97-6	5	3	5	100%	**4e+00**	**2e+01**	0	0%	4e-02	2e-01
PRI 8	Metals	Nickel	7440-02-0	5	5	5	100%	**1e+01**	**3e+01**	0	0%	8e-02	2e-01
PRI 8	Metals	Selenium	7782-49-2	5	5	0	0%	5e-01	6e-01	0	0%	8e-03	1e-02
PRI 8	Metals	Vanadium	7440-62-2	5	4	4	80%	4e-01	**2e+01**	0	0%	3e-02	1e+00
PRI 8	Metals	Zinc	7440-66-6	5	5	3	60%	7e-01	**3e+00**	0	0%	2e-01	6e-01
PRI 8	SVOCs	Pentachlorophenol	87-86-5	5	1	1	20%	1e+00	**3e+00**	0	0%	3e-02	9e-02
PRI 8	VOCs	Carbon disulfide	75-15-0	5	2	1	20%	4e-01	**2e+00**	0	0%	2e-02	9e-02

Table 6-3
Summary of Aquatic Biota Chronic Direct Contact HQs in Surface Water
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 8	VOCs	Chloroform	67-66-3	5	5	0	0%	2e-01	6e-01	0	0%	1e-02	4e-02
PRI 8	Cyanide	Total cyanide	74-90-8	5	5	5	100%	**5e+00**	**4e+01**	0	0%	3e-04	2e-03
PRI 8	WQ Anions	Chlorine	7782-50-5	5	5	4	80%	0e+00	**2e+01**	4	80%	0e+00	**9e+00**
PRI 14	PCBs	Total PCBs	1336-36-3	4	4	0	0%	5e-02	2e-01	-	-	-	-
PRI 14	Metals	Barium	7440-39-3	4	4	4	100%	**3e+01**	**9e+01**	0	0%	2e-05	8e-05
PRI 14	Metals	Cobalt	7440-48-4	4	1	0	0%	3e-02	7e-01	0	0%	4e-04	1e-02
PRI 14	Metals	Copper	7440-50-8	4	2	3	75%	3e-01	**3e+00**	0	0%	1e-02	1e-01
PRI 14	Metals	Iron	7439-89-6	4	4	1	25%	5e-02	**4e+01**	-	-	-	-
PRI 14	Metals	Lead	7439-92-1	4	1	0	0%	2e-01	1e+00	0	0%	1e-03	6e-03
PRI 14	Metals	Manganese	7439-96-5	4	4	3	75%	2e-01	**1e+02**	0	0%	5e-04	3e-01
PRI 14	Metals	Mercury	7439-97-6	4	1	4	100%	**4e+00**	**5e+01**	0	0%	4e-02	5e-01
PRI 14	Metals	Nickel	7440-02-0	4	3	1	25%	1e-01	**2e+00**	0	0%	7e-04	1e-02
PRI 14	Metals	Selenium	7782-49-2	4	2	0	0%	2e-01	1e+00	0	0%	3e-03	2e-02
PRI 14	Metals	Zinc	7440-66-6	4	2	0	0%	5e-02	3e-01	0	0%	1e-02	7e-02
PRI 14	VOCs	Carbon disulfide	75-15-0	4	1	1	25%	9e-02	**3e+00**	0	0%	5e-03	2e-01
PRI 14	VOCs	Chloroform	67-66-3	4	1	0	0%	2e-03	1e-01	0	0%	1e-04	7e-03
PRI 14	Cyanide	Total cyanide	74-90-8	4	1	4	100%	**2e+00**	**2e+01**	0	0%	1e-04	1e-03
PRI 14	WQ Anions	Chlorine	7782-50-5	4	4	2	50%	0e+00	**1e+01**	2	50%	0e+00	**8e+00**
SVDD	PCBs	Total PCBs	1336-36-3	2	2	1	50%	8e-01	**6e+00**	-	-	-	-
SVDD	Metals	Aluminum	7429-90-5	2	1	2	100%	**7e+00**	**4e+02**	-	-	-	-
SVDD	Metals	Barium	7440-39-3	2	2	2	100%	**8e+02**	**8e+02**	0	0%	6e-04	7e-04
SVDD	Metals	Beryllium	7440-41-7	2	1	1	50%	9e-01	**4e+00**	0	0%	2e-02	7e-02
SVDD	Metals	Cadmium	7440-43-9	2	2	2	100%	**4e+00**	**7e+00**	0	0%	9e-02	2e-01
SVDD	Metals	Chromium	7440-47-3	2	1	1	50%	3e-01	**3e+00**	0	0%	4e-02	3e-01
SVDD	Metals	Cobalt	7440-48-4	2	2	2	100%	**3e+00**	**4e+00**	0	0%	5e-02	6e-02
SVDD	Metals	Copper	7440-50-8	2	2	2	100%	**2e+00**	**3e+01**	0	0%	1e-01	1e+00
SVDD	Metals	Iron	7439-89-6	2	2	1	50%	9e-01	**4e+02**	-	-	-	-
SVDD	Metals	Lead	7439-92-1	2	2	1	50%	1e+00	**4e+01**	0	0%	6e-03	2e-01
SVDD	Metals	Manganese	7439-96-5	2	2	2	100%	**1e+02**	**3e+02**	0	0%	3e-01	8e-01
SVDD	Metals	Mercury	7439-97-6	2	2	2	100%	**2e+01**	**9e+01**	0	0%	2e-01	8e-01
SVDD	Metals	Nickel	7440-02-0	2	2	2	100%	**9e+00**	**3e+01**	0	0%	5e-02	1e-01
SVDD	Metals	Selenium	7782-49-2	2	2	1	50%	1e+00	**3e+00**	0	0%	2e-02	5e-02
SVDD	Metals	Silver	7440-22-4	2	2	1	50%	1e+00	**2e+00**	0	0%	1e+00	1e+00
SVDD	Metals	Thallium	7440-28-0	2	1	0	0%	2e-01	1e+00	0	0%	2e-02	1e-01
SVDD	Metals	Vanadium	7440-62-2	2	1	2	100%	**4e+00**	**2e+01**	0	0%	3e-01	1e+00
SVDD	Metals	Zinc	7440-66-6	2	2	1	50%	1e+00	**7e+00**	1	50%	2e-01	**2e+00**
SVDD	SVOCs	Pentachlorophenol	87-86-5	2	1	2	100%	**2e+00**	**3e+00**	0	0%	6e-02	9e-02
SVDD	VOCs	Carbon disulfide	75-15-0	2	2	2	100%	**2e+00**	**3e+00**	0	0%	8e-02	2e-01
SVDD	VOCs	Chloroform	67-66-3	2	1	0	0%	4e-03	2e-01	0	0%	2e-04	9e-03
SVDD	Cyanide	Total cyanide	74-90-8	2	2	2	100%	**1e+01**	**2e+01**	0	0%	6e-04	1e-03

Table 6-3
Summary of Aquatic Biota Chronic Direct Contact HQs in Surface Water
US Magnesium LLC
Tooele County, Utah

Notes:
Only COPECs with an HQ > 1 are shown in the table. Complete HQs are presented in Appendix D.
- = Not applicable (no benchmark available)
COPEC = Constituent of potential ecological concern
HQ = Hazard quotient
LOAEL = HQs calculated using a lowest observed adverse effect level
ND=1/2DL = Non-detected values substituted with half the detection limit
NOAEL = HQs calculated using a no observed adverse effect level
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
SVDD = Skull Valley diversion ditch
SVOC = Semivolatile organic compound
TEQ = Dioxin/furan toxicity equivalence factor
VOC = Volatile organic compound
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 6-4
Summary of Tissue HQs for Soil Invertebrates
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 5	PCBs	Total PCBs	1336-36-3	20	20	1	5%	2e-03	**2e+00**	0	0%	5e-06	7e-03
PRI 6	PCBs	Total PCBs	1336-36-3	10	10	0	0%	3e-03	3e-01	0	0%	9e-06	1e-03
PRI 8	PCBs	Total PCBs	1336-36-3	22	22	0	0%	4e-03	5e-01	0	0%	1e-05	2e-03
PRI 10	PCBs	Total PCBs	1336-36-3	14	14	0	0%	5e-04	1e-02	0	0%	2e-06	4e-05
PRI 12	PCBs	Total PCBs	1336-36-3	14	14	0	0%	4e-03	1e-01	0	0%	1e-05	5e-04
PRI 14	PCBs	Total PCBs	1336-36-3	9	9	0	0%	2e-03	3e-02	0	0%	5e-06	1e-04
PRI 15	PCBs	Total PCBs	1336-36-3	21	21	0	0%	2e-03	4e-02	0	0%	8e-06	2e-04
PRI 16	PCBs	Total PCBs	1336-36-3	14	14	0	0%	1e-03	6e-03	0	0%	4e-06	2e-05
Background	PCBs	Total PCBs	1336-36-3	18	18	0	0%	1e-03	4e-03	0	0%	5e-06	1e-05

Notes:
Only COPECs with an HQ > 1 are shown in the table.
- = Not applicable (not a COPEC for that exposure area, or no chemistry data available [background locations])
HQ = Hazard quotient
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
PCB = Polychlorinated biphenyl
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 6-5
Summary of Tissue HQs for Aquatic Invertebrates
US Magnesium LLC
Tooele County, Utah

Exposure Area	COPEC Group	COPEC	CAS #	Number of Samples	Number of Detects	NOAEL				LOAEL			
						Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ	Number of Samples with HQ>1	Percent of HQs>1	Minimum HQ	Maximum HQ
PRI 7	SVOCs	Hexachlorobenzene	118-74-1	23	18	5	22%	3e-02	**8e+00**	0	0%	7e-04	2e-01
PRI 8	SVOCs	Hexachlorobenzene	118-74-1	5	1	0	0%	3e-02	3e-01	0	0%	8e-04	8e-03
PRI 13	SVOCs	Hexachlorobenzene	118-74-1	20	7	0	0%	3e-02	3e-01	0	0%	7e-04	7e-03
PRI 14	SVOCs	Hexachlorobenzene	118-74-1	34	14	1	3%	3e-02	**3e+00**	0	0%	7e-04	6e-02
GSLIC	SVOCs	Hexachlorobenzene	118-74-1	9	3	0	0%	3e-02	5e-01	0	0%	8e-04	1e-02
SVDD	SVOCs	Hexachlorobenzene	118-74-1	13	3	0	0%	3e-02	3e-01	0	0%	8e-04	7e-03
Background	SVOCs	Hexachlorobenzene	118-74-1	17	2	0	0%	3e-02	8e-02	0	0%	7e-04	2e-03

Notes:
Only COPECs with an HQ > 1 are shown in the table.
- = Not applicable (not a COPEC for that exposure area, or no chemistry data available [background locations])
HQ = Hazard quotient
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
SVOC = Semivolatile organic compound
Bolded text = HQ > 1
Blue highlight = 1 < HQ≤ 10
Green highlight = 10 < HQ≤ 100
Yellow highlight = HQ > 100

Table 7-1
Uncertainty Summary by LOE
US Magnesium LLC
Tooele County, Utah

Uncertainty	Applicability to Receptor Groups			
	Birds	Mammals	Plants	Invertebrates and Aquatic Biota
HQs LOEs (Direct Contact, Dietary Dose, Tissue)				
Representative Species	↑	↑	-	-
Site Use Factors	↑	↑	-	-
Bioaccessibility	↑	↑	↑	↑
Bioaccumulation Models (particularly TEQ Models for Brine Fly)	0/?	0/?	0	0/?
Avian TEQ Concentrations (Interspecies Differences in Sensitivity and Relative Potency of Dioxin-Like Compounds, Inter-Individual Variation of Aryl Hydrocarbon Receptor)	?	-	-	-
Intermittent Longer-Term Dose Estimation	↑	-	-	-
Scenarios Not Evaluated (Inhalation Pathway, Dermal Contact Pathway)	0	0	-	-
Use of Chronic NOAEL-Equivalent TRVs	↑	↑	↑	↑
Species-to-Species Extrapolations	↑/?	↑/?	↑/?	↑/?
Constituent-to-Constituent Extrapolations	↑	↑	↑	↑
Laboratory-to-Field Extrapolations	↑	↑	↑	↑
Organism-to-Population or -Community Level Effect Extrapolations	↑	↑	↑	↑
Unbounded NOAEL Effects Levels	-	-	↑	↑
Direct Contact Benchmarks	-	-	↑	↑
Tissue Benchmarks	↑	0	0	0
Avian TRVs	↑/?	-	-	-
Uncertain COPECs Not Quantitatively Evaluated	0	0	0	0
Threatened and Endangered Species	0	-	-	-
Cumulative Effects Due to Exposure to Multiple COPECs	0/?	0/?	0/?	0/?
Site-Specific Toxicity Studies LOE				
Representativeness of Single Wastewater Sample	↑	-	-	-
Lack of Analysis for other COPECs	0/?	-	-	-
Unrealistic Exposure Conditions	↑	-	-	-
Wild-Caught Test Subjects	?	-	-	-
Limited Number of Test Species and Small Sample Sizes	?	-	-	-
Temporal Variability in House Finch Responses	?	-	-	-
Ecological Field Studies LOE				
Lack of Quantitative Comparison Between Site and Reference	0	?	?	-
Variable Applicability Across Spatial Areas	↑/?	?	?	-
Potential for Confounding from Stressors Other than COPECs	?	-	-	-
Species Applicability	0	-	-	-
Interpretation of Adult Body Mass Endpoint	?	-	-	-

Notes:

↑ = Likely to overestimate the potential for adverse effects

↓ = Likely to underestimate the potential for adverse effects

0 = Likely to have a negligible influence on the potential for adverse effects

? = Likely to have an unidentified (direction and/or magnitude) influence on the potential for adverse effects

- = Not applicable

COPEC = Constituent of potential ecological concern

EPC = Exposure point concentration

HQ = Hazard quotient

LOE = Line of evidence

NOAEL = No observed adverse effect level

TEQ = Toxic equivalency

TRV = Toxicity reference value

Table 7-2
Avian Intermittent Longer-Term HQs using 95UCL EPCs
US Magnesium, LLC
Tooele County, Utah

Land Use Scenario	Exposure Area	Habitat	Receptor	Analyte	Total Longer-Term Dose (mg/kg-bw/day)	NOAEL Longer Term TRV (mg/kg-bw/day)	LOAEL Longer Term TRV (mg/kg-bw/day)	AHUF	NOAEL HQ	LOAEL HQ
Current	CWP	Lakebed	American Avocet	Acetone	0.001643858	201	2010	0.033	3E-07	3E-08
Current	CWP	Lakebed	American Avocet	Arsenic	0.629767108	2.24	4.5	0.033	9E-03	5E-03
Current	CWP	Lakebed	American Avocet	Avian TEQ Category 1 ND=1/2DL	0.01272624	0.0000021	0.000021	0.033	**2E+02**	**2E+01**
Current	CWP	Lakebed	American Avocet	Avian TEQ Category 2 ND=1/2DL	0.066639659	0.000014	0.00014	0.033	**2E+02**	**2E+01**
Current	CWP	Lakebed	American Avocet	Avian TEQ Category 3 ND=1/2DL	0.605773856	0.000087	0.00087	0.033	**2E+02**	**2E+01**
Current	CWP	Lakebed	American Avocet	Barium	9.212398029	208	417	0.033	1E-03	7E-04
Current	CWP	Lakebed	American Avocet	Chromium	0.378008894	2.66	15.6	0.033	5E-03	8E-04
Current	CWP	Lakebed	American Avocet	Hexachlorobenzene	59.90379959	0.56	2.25	0.033	**4E+00**	9E-01
Current	CWP	Lakebed	American Avocet	Hexachlorobutadiene	2.25568774	3.5	35	0.033	2E-02	2E-03
Current	CWP	Lakebed	American Avocet	Mercury	0.000862505	2.25	4.5	0.033	1E-05	6E-06
Current	CWP	Lakebed	American Avocet	Molybdenum	0.718180552	3.5	35	0.033	7E-03	7E-04
Current	CWP	Lakebed	American Avocet	PCBs, Total	1.926031449	0.112	1.12	0.033	6E-01	6E-02
Current	CWP	Lakebed	American Avocet	Phenol	0.46789492	0.113	1.13	0.033	1E-01	1E-02
Current	CWP	Lakebed	American Avocet	Selenium	0.007544662	0.29	0.579	0.033	9E-04	4E-04
Current	CWP	Lakebed	American Avocet	Total cyanide	0.01164591	0.004	0.04	0.033	1E-01	1E-02
Current	CWP	Lakebed	American Avocet	Vanadium	1.30126164	0.344	0.688	0.033	1E-01	6E-02
Current	CWP	Lakebed	Snowy Plover	Acetone	0.003534796	201	2010	0.033	6E-07	6E-08
Current	CWP	Lakebed	Snowy Plover	Arsenic	1.388944681	2.24	4.5	0.033	2E-02	1E-02
Current	CWP	Lakebed	Snowy Plover	Avian TEQ Category 1 ND=1/2DL	0.027386025	0.0000021	0.000021	0.033	**4E+02**	**4E+01**
Current	CWP	Lakebed	Snowy Plover	Avian TEQ Category 2 ND=1/2DL	0.143343838	0.000014	0.00014	0.033	**3E+02**	**3E+01**
Current	CWP	Lakebed	Snowy Plover	Avian TEQ Category 3 ND=1/2DL	1.30292197	0.000087	0.00087	0.033	**5E+02**	**5E+01**
Current	CWP	Lakebed	Snowy Plover	Barium	19.90167256	208	417	0.033	3E-03	2E-03
Current	CWP	Lakebed	Snowy Plover	Chromium	0.843560921	2.66	15.6	0.033	1E-02	2E-03
Current	CWP	Lakebed	Snowy Plover	Hexachlorobenzene	128.8420146	0.56	2.25	0.033	**8E+00**	**2E+00**
Current	CWP	Lakebed	Snowy Plover	Hexachlorobutadiene	4.850680388	3.5	35	0.033	5E-02	5E-03
Current	CWP	Lakebed	Snowy Plover	Mercury	0.001988764	2.25	4.5	0.033	3E-05	1E-05
Current	CWP	Lakebed	Snowy Plover	Molybdenum	1.563660416	3.5	35	0.033	1E-02	1E-03
Current	CWP	Lakebed	Snowy Plover	PCBs, Total	4.143040689	0.112	1.12	0.033	1E+00	1E-01
Current	CWP	Lakebed	Snowy Plover	Phenol	1.00611695	0.113	1.13	0.033	3E-01	3E-02
Current	CWP	Lakebed	Snowy Plover	Selenium	0.016780248	0.29	0.579	0.033	2E-03	1E-03
Current	CWP	Lakebed	Snowy Plover	Total cyanide	0.02695208	0.004	0.04	0.033	2E-01	2E-02
Current	CWP	Lakebed	Snowy Plover	Vanadium	2.913487854	0.344	0.688	0.033	3E-01	1E-01

Table 7-2
Avian Intermittent Longer-Term HQs using 95UCL EPCs
US Magnesium, LLC
Tooele County, Utah

Land Use Scenario	Exposure Area	Habitat	Receptor	Analyte	Total Longer-Term Dose (mg/kg-bw/day)	NOAEL Longer Term TRV (mg/kg-bw/day)	LOAEL Longer Term TRV (mg/kg-bw/day)	AHUF	NOAEL HQ	LOAEL HQ
Current	PRI 7	Lakebed	American Avocet	Acetone	0.006008029	201	2010	0.033	1E-06	1E-07
Current	PRI 7	Lakebed	American Avocet	Arsenic	0.808273415	2.24	4.5	0.033	1E-02	6E-03
Current	PRI 7	Lakebed	American Avocet	Avian TEQ Category 1 ND=1/2DL	0.000655072	0.0000021	0.000021	0.033	**1E+01**	1E+00
Current	PRI 7	Lakebed	American Avocet	Avian TEQ Category 2 ND=1/2DL	0.00190249	0.000014	0.00014	0.033	**4E+00**	4E-01
Current	PRI 7	Lakebed	American Avocet	Avian TEQ Category 3 ND=1/2DL	0.014376674	0.000087	0.00087	0.033	**5E+00**	5E-01
Current	PRI 7	Lakebed	American Avocet	Cadmium	0.007541113	1.47	6.35	0.033	2E-04	4E-05
Current	PRI 7	Lakebed	American Avocet	Chromium	1.199534131	2.66	15.6	0.033	1E-02	3E-03
Current	PRI 7	Lakebed	American Avocet	Hexachlorobenzene	1.386020415	0.56	2.25	0.033	8E-02	2E-02
Current	PRI 7	Lakebed	American Avocet	Iron	899.0742532	3.5	35	0.033	**8E+00**	8E-01
Current	PRI 7	Lakebed	American Avocet	Manganese	13.41360113	179	377	0.033	2E-03	1E-03
Current	PRI 7	Lakebed	American Avocet	Molybdenum	0.364254984	3.5	35	0.033	3E-03	3E-04
Current	PRI 7	Lakebed	American Avocet	PCBs, Total	0.029668839	0.112	1.12	0.033	9E-03	9E-04
Current	PRI 7	Lakebed	American Avocet	Selenium	0.033977762	0.29	0.579	0.033	4E-03	2E-03
Current	PRI 7	Lakebed	American Avocet	Vanadium	1.139039491	0.344	0.688	0.033	1E-01	5E-02
Current	PRI 7	Lakebed	Snowy Plover	Acetone	0.005626184	201	2010	0.033	9E-07	9E-08
Current	PRI 7	Lakebed	Snowy Plover	Arsenic	0.769418675	2.24	4.5	0.033	1E-02	6E-03
Current	PRI 7	Lakebed	Snowy Plover	Avian TEQ Category 1 ND=1/2DL	0.000613467	0.0000021	0.000021	0.033	**1E+01**	1E+00
Current	PRI 7	Lakebed	Snowy Plover	Avian TEQ Category 2 ND=1/2DL	0.001781631	0.000014	0.00014	0.033	**4E+00**	4E-01
Current	PRI 7	Lakebed	Snowy Plover	Avian TEQ Category 3 ND=1/2DL	0.013463267	0.000087	0.00087	0.033	**5E+00**	5E-01
Current	PRI 7	Lakebed	Snowy Plover	Cadmium	0.007061831	1.47	6.35	0.033	2E-04	4E-05
Current	PRI 7	Lakebed	Snowy Plover	Chromium	1.123296788	2.66	15.6	0.033	1E-02	2E-03
Current	PRI 7	Lakebed	Snowy Plover	Hexachlorobenzene	1.29795955	0.56	2.25	0.033	8E-02	2E-02
Current	PRI 7	Lakebed	Snowy Plover	Iron	851.6634971	3.5	35	0.033	**8E+00**	8E-01
Current	PRI 7	Lakebed	Snowy Plover	Manganese	15.36788048	179	377	0.033	3E-03	1E-03
Current	PRI 7	Lakebed	Snowy Plover	Molybdenum	0.343040585	3.5	35	0.033	3E-03	3E-04
Current	PRI 7	Lakebed	Snowy Plover	PCBs, Total	0.027784741	0.112	1.12	0.033	8E-03	8E-04
Current	PRI 7	Lakebed	Snowy Plover	Selenium	0.032608749	0.29	0.579	0.033	4E-03	2E-03
Current	PRI 7	Lakebed	Snowy Plover	Vanadium	1.066646933	0.344	0.688	0.033	1E-01	5E-02

Notes:
AHUF = Acid habitat utilization factor
CWP = Current Waste Pond
EPC = Exposure point concentration
HQ = Hazard quotient
mg/kg-bw/day = Milligrams per kilogram body weight per day
ND=1/2DL = Non-detected values substituted with half the detection limit
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
TEQ = Toxic equivalency
TRV = Toxicity Reference Value
HQs>1 are bolded.

Table 7-3
Chemicals with Nondetects and Maximum Detection Limits Greater than the RBESL
US Magnesium LLC
Tooele County, Utah

Chemical	CAS	Media	PRI 1	PRI 2	PRI 3	PRI 4	PRI 5	PRI 6	PRI 7	PRI 8	PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14	PRI 15	PRI 16	SVDD
1,1'-Biphenyl	92-52-4	Solids	(12, 58.33 %)			(16, 81.25 %)	(25, 24 %)												
1,1-Dichloroethane	75-34-3	Solids			(14, 14.29 %)														
2-Chloronaphthalene	91-58-7	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2-Chlorophenol	95-57-8	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2-Methylphenol	95-48-7	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2-Nitroaniline	88-74-4	Solids	(12, 33.33 %)																
2-Nitrophenol	88-75-5	Solids	(12, 83.33 %)		(14, 35.71 %)	(16, 87.5 %)	(25, 44 %)	(17, 58.82 %)	(19, 31.58 %)										
2,3,4,6-Tetrachlorophenol	58-90-2	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)							(16, 31.25 %)			(3, 66.67 %)
2,4-Dichlorophenol	120-83-2	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(10, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2,4-Dimethylphenol	105-67-9	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2,4-Dinitrophenol	51-28-5	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(24, 100 %)		(14, 100 %)			(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2,4-Dinitrotoluene	121-14-2	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2,4,5-Trichlorophenol	95-95-4	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
2,4,6-Trichlorophenol	88-06-2	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 88 %)	(17, 70.59 %)	(19, 94.74 %)							(16, 43.75 %)	(15, 6.67 %)		(3, 66.67 %)
2,6-Dinitrotoluene	606-20-2	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
3-Nitroaniline	99-09-2	Solids	(12, 83.33 %)		(14, 42.86 %)	(16, 87.5 %)	(25, 44 %)	(17, 64.71 %)	(19, 31.58 %)										
3 & 4 Methylphenol	15831-10-4	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)		(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
3,3'-Dichlorobenzidine	91-94-1	Solids	(12, 100 %)	(14, 78.57 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 94.74 %)		(16, 68.75 %)				(14, 42.86 %)	(16, 43.75 %)			(3, 66.67 %)
4-Bromophenyl-phenylether	101-55-3	Solids	(12, 83.33 %)		(14, 42.86 %)	(16, 87.5 %)	(25, 44 %)	(17, 64.71 %)	(19, 31.58 %)										
4-Chloro-3-methylphenol	59-50-7	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)										(3, 66.67 %)
4-Chloroaniline	106-47-8	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)										(3, 66.67 %)
4-Nitroaniline	100-01-6	Solids	(12, 50 %)																
4-Nitrophenol	100-02-7	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
4,6-Dinitro-2-methylphenol	534-52-1	Solids	(12, 100 %)	(14, 78.57 %)	(14, 100 %)	(16, 100 %)	(28, 78.57 %)	(17, 70.59 %)	(19, 94.74 %)	(27, 59.26 %)	(16, 68.75 %)				(14, 50 %)	(16, 50 %)			(3, 66.67 %)
Acenaphthene	83-32-9	Solids			(14, 35.71 %)		(25, 28 %)												
Acenaphthylene	208-96-8	Solids			(14, 35.71 %)		(25, 24 %)												
bis(2-Chloroethoxy)methane	111-91-1	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)										(3, 66.67 %)
bis(2-Chloroethyl)ether	111-44-4	Solids	(12, 100 %)		(14, 78.57 %)	(16, 93.75 %)	(25, 44 %)	(17, 70.59 %)	(19, 73.68 %)										
bis(2-Ethylhexyl)phthalate	117-81-7	Solids	(12, 100 %)			(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)							(16, 18.75 %)			(3, 66.67 %)
Bromomethane	74-83-9	Solids			(14, 35.71 %)	(14, 85.71 %)	(25, 44 %)	(15, 60 %)	(17, 76.47 %)										
Butylbenzylphthalate	85-68-7	Solids	(12, 100 %)		(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)		(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Di-n-butylphthalate	84-74-2	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)							(16, 25 %)			(3, 66.67 %)
Di-n-octylphthalate	117-84-0	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 60 %)	(17, 70.59 %)	(19, 89.47 %)										(3, 66.67 %)
Dibenzo(a,h)anthracene	53-70-3	Solids	(12, 66.67 %)		(14, 35.71 %)		(25, 8 %)												
Dibenzofuran	132-64-9	Solids	(12, 100 %)	(14, 78.57 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 94.74 %)		(16, 68.75 %)				(14, 42.86 %)	(16, 43.75 %)			(3, 66.67 %)
Diethylphthalate	84-66-2	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Dimethylphthalate	131-11-3	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Hexachlorocyclopentadiene	77-47-4	Solids		(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Hexachloroethane	67-72-1	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Isophorone	78-59-1	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)										(3, 66.67 %)
N-Nitroso-di-n-propylamine	621-64-7	Solids	(12, 100 %)	(14, 71.43 %)	(14, 100 %)	(16, 100 %)	(25, 84 %)	(17, 70.59 %)	(19, 89.47 %)										(3, 66.67 %)
N-Nitrosodimethylamine	62-75-9	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
N-Nitrosodiphenylamine	86-30-6	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Nitrobenzene	98-95-3	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)	(15, 100 %)	(14, 100 %)	(3, 100 %)
Pentachlorophenol	87-86-5	Solids			(14, 100 %)	(16, 100 %)	(25, 100 %)	(17, 100 %)	(19, 100 %)						(14, 100 %)	(16, 100 %)		(14, 100 %)	(3, 100 %)
Phenol	108-95-2	Solids	(12, 100 %)	(14, 100 %)	(14, 100 %)	(16, 100 %)			(19, 100 %)	(7, 100 %)	(16, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)	(14, 100 %)		(15, 100 %)	(14, 100 %)	(3, 100 %)
1,1'-Biphenyl	92-52-4	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
1,4-Dioxane	123-91-1	Water	(8, 87.5 %)			(2, 100 %)	(6, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
2-Chloronaphthalene	91-58-7	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
2-Chlorophenol	95-57-8	Water	(6, 83.33 %)			(2, 100 %)	(5, 80 %)	(5, 100 %)		(5, 80 %)									
2-Nitroaniline	88-74-4	Water				(2, 100 %)		(5, 100 %)											
2,3,4,6-Tetrachlorophenol	58-90-2	Water	(6, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
2,3,7,8-TCDD	1746-01-6	Water							(3, 100 %)										
2,4-Dichlorophenol	120-83-2	Water	(6, 83.33 %)			(2, 100 %)	(5, 80 %)	(5, 100 %)		(5, 80 %)						(4, 25 %)			
2,4-Dinitrophenol	51-28-5	Water	(6, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
2,4-Dinitrotoluene	121-14-2	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
2,4,6-Trichlorophenol	88-06-2	Water				(2, 100 %)	(5, 80 %)	(5, 100 %)		(5, 80 %)									
2,6-Dinitrotoluene	606-20-2	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
3,3'-Dichlorobenzidine	91-94-1	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
4-Bromophenyl-phenylether	101-55-3	Water	(8, 87.5 %)			(2, 100 %)	(5, 80 %)	(5, 100 %)		(5, 80 %)						(4, 25 %)			
4-Chloroaniline	106-47-8	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
4-Nitroaniline	100-01-6	Water	(8, 87.5 %)			(2, 100 %)	(5, 80 %)	(5, 100 %)		(5, 80 %)									
4-Nitrophenol	100-02-7	Water				(2, 100 %)	(9, 77.78 %)												
4,6-Dinitro-2-methylphenol	534-52-1	Water	(6, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Benzo(a)anthracene	56-55-3	Water	(8, 87.5 %)			(2, 100 %)	(6, 100 %)	(5, 100 %)		(5, 80 %)						(4, 50 %)			

Table 7-3
Chemicals with Nondetects and Maximum Detection Limits Greater than the RBESL
US Magnesium LLC
Tooele County, Utah

Chemical	CAS	Media	PRI 1	PRI 2	PRI 3	PRI 4	PRI 5	PRI 6	PRI 7	PRI 8	PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14	PRI 15	PRI 16	SVDD
Benzo(a)pyrene	50-32-8	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(6, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Benzo(b)fluoranthene	205-99-2	Water	(8, 87.5 %)			(2, 100 %)	(6, 100 %)	(5, 100 %)		(5, 80 %)						(4, 50 %)			
Benzo(k)fluoranthene	207-08-9	Water	(8, 87.5 %)			(2, 100 %)	(6, 100 %)	(5, 100 %)		(5, 80 %)						(4, 50 %)			
Bis(2-chloroethoxy)methane	111-91-1	Water	(8, 87.5 %)			(2, 100 %)	(5, 80 %)	(5, 100 %)		(5, 80 %)									
bis(2-Chloroethyl) ether	111-44-4	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)		(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Bis(2-ethylhexyl)phthalate	117-81-7	Water					(10, 100 %)	(8, 100 %)	(12, 100 %)	(7, 100 %)						(8, 100 %)			(8, 100 %)
Bromomethane	74-83-9	Water			(2, 100 %)	(2, 100 %)		(8, 62.5 %)	(12, 16.67 %)	(7, 57.14 %)									
Carbon tetrachloride	56-23-5	Water							(3, 33.33 %)										
Chrysene	218-01-9	Water	(8, 87.5 %)			(2, 100 %)	(6, 100 %)	(5, 100 %)		(5, 80 %)									
Di-n-butylphthalate	84-74-2	Water	(8, 87.5 %)		(2, 100 %)	(2, 100 %)	(5, 80 %)	(5, 100 %)	(5, 20 %)	(5, 100 %)						(4, 25 %)			
Dibenzo(a,h)anthracene	53-70-3	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(6, 100 %)	(4, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Dibenzofuran	132-64-9	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Hexachlorocyclopentadiene	77-47-4	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Hexachloroethane	67-72-1	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Indeno(1,2,3-cd)pyrene	193-39-5	Water	(8, 87.5 %)			(2, 100 %)	(6, 100 %)	(4, 100 %)		(5, 80 %)						(4, 50 %)			
N-Nitroso-di-n-propylamine	621-64-7	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
N-Nitrosodimethylamine	62-75-9	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Naphthalene	91-20-3	Water							(3, 33.33 %)										
Nitrite as N	14797-65-0	Water							(1, 100 %)										
Nitrobenzene	98-95-3	Water	(8, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Pentachlorophenol	87-86-5	Water			(2, 100 %)	(2, 100 %)										(8, 100 %)			
Phenol	108-95-2	Water	(6, 100 %)		(2, 100 %)	(2, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)	(5, 100 %)						(4, 100 %)			
Trichloroethene	79-01-6	Water							(3, 33.33 %)										

Notes:
Values in cells display the total number of nondetects in PRI per analyte and the number that exceeds the respective RBESL.
PRI = Preliminary Remediation Investigation
RBESL = Risk-based ecological screening level
SVDD = Skull Valley Diversion Ditch

Table 7-4
Chemicals Lacking Screening Values by Media
US Magnesium LLC
Tooele County, Utah

Chemical	CAS #	Chemical Group	Broader Group	Screening Values			Receptor Benchmarks				Detection Frequency				Potentially Site-related	Solids FOD (%)	Water FOD (%)
							Direct Contact		Dietary		Solids[a]		Water[b]				
				Soil	Sediment	Water	Invertebrates	Plants	Birds	Mammals	Detects	Samples	Detects	Samples			
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	Chlorofluorocarbon	VOCs	NSV	NSV	NSV					0	154	0	38	Unlikely	0	0
1,1'-Biphenyl	92-52-4	Aromatic hydrocarbon	SVOCs		NSV						0	249	0	37	Unlikely	0	0
1,2,3-Trichlorobenzene	87-61-6	Halogenated aromatic hydrocarbon	VOCs		NSV	NSV					9	152	1	38	Unknown	6	3
1,2-Dibromo-3-chloropropane	96-12-8	Halogenated aliphatic hydrocarbon	VOCs		NSV	NSV					0	154	0	38	Unlikely	0	0
1,2-Dibromoethane	106-93-4	Halomethane	VOCs		NSV	NSV					0	154	0	38	Unlikely	0	0
2,2-Oxybis(1-chloropropane)	108-60-1	Halogenated aliphatic hydrocarbon	SVOCs		NSV	NSV					0	249	0	35	Unlikely	0	0
2,4,5-Trichlorophenol	95-95-4	Halogenated aromatic hydrocarbon	SVOCs			NSV					0	249	0	35	Unlikely	0	0
2-Methylnaphthalene	91-57-6	PAH	PAHs	NSV							97	249	9	38	Plausible	39	24
2-Nitroaniline	88-74-4	Aromatic amine	SVOCs		NSV	NSV					0	249	0	37	Unlikely	0	0
2-Nitrophenol	88-75-5	Aromatic amine	SVOCs		NSV						0	249	0	35	Unlikely	0	0
3-Nitroaniline	99-09-2	Aromatic amine	SVOCs		NSV	NSV					0	249	0	37	Unlikely	0	0
4-Bromophenyl-phenylether	101-55-3	Halogenated aromatic hydrocarbon	SVOCs	NSV							0	249	0	37	Unlikely	0	0
4-Chlorophenyl-phenylether	7005-72-3	Halogenated aromatic hydrocarbon	SVOCs	NSV	NSV	NSV					0	249	0	35	Unlikely	0	0
4-Nitroaniline	100-01-6	Aromatic amine	SVOCs		NSV	NSV					0	249	0	37	Unlikely	0	0
Acenaphthene	83-32-9	PAH	PAHs	NSV							21	249	2	38	Unknown	8	5
Acenaphthylene	208-96-8	PAH	PAHs	NSV							11	249	1	38	Unknown	4	3
Acetophenone	98-86-2	Aromatic ketone	SVOCs		NSV	NSV					16	249	5	37	Plausible	6	14
Anthracene	120-12-7	PAH	PAHs	NSV							29	249	1	38	Plausible	12	3
Benzaldehyde	100-52-7	Aromatic aldehyde	SVOCs	NSV	NSV	NSV					5	249	0	37	Unknown	2	0
Benzo(a)anthracene	56-55-3	PAH	PAHs	NSV							49	249	0	38	Plausible	20	0
Benzo(a)pyrene	50-32-8	PAH	PAHs	NSV							84	249	0	38	Plausible	34	0
Benzo(b)fluoranthene	205-99-2	PAH	PAHs	NSV							44	249	0	38	Plausible	18	0
Benzo(g,h,i)perylene	191-24-2	PAH	PAHs	NSV							24	249	0	38	Plausible	10	0
Benzo(k)fluoranthene	207-08-9	PAH	PAHs	NSV							24	249	0	38	Plausible	10	0
Bis(2-chloroethoxy)methane	111-91-1	Chlorinated ether	SVOCs		NSV	NSV					0	249	0	37	Unlikely	0	0
Bromide[c]	24959-67-9	Halogen	WQ Anions	na	na	NSV							23	38	-	-	61
Bromochloromethane	74-97-5	Halomethane	VOCs	NSV	NSV	NSV					10	154	9	38	Plausible	6	24
Bromodichloromethane	75-27-4	Halomethane	VOCs		NSV	NSV	N	N	N	Y	47	154	29	38	Plausible	31	76
Carbazole	86-74-8	Heterocyclic	SVOCs	NSV	NSV	NSV					0	249	0	37	Unlikely	0	0
Chloroethane	75-00-3	Halogenated aliphatic hydrocarbon	VOCs	NSV	NSV	NSV					15	154	2	38	Plausible	10	5
Chloromethane	74-87-3	Halomethane	VOCs		NSV						40	154	15	38	Plausible	26	39
Chrysene	218-01-9	PAH	PAHs	NSV							76	249	0	38	Plausible	31	0
cis-1,2-Dichloroethene	156-59-2	Halogenated aliphatic hydrocarbon	VOCs	NSV	NSV	NSV					5	154	1	38	Unknown	3	3
cis-1,3-Dichloropropene	10061-01-5	Halogenated aliphatic hydrocarbon	VOCs		NSV	NSV					0	154	0	38	Unlikely	0	0
Cyclohexane	110-82-7	Cycloalkane	VOCs	NSV	NSV	NSV					4	154	0	38	Unknown	3	0
Dibenzo(a,h)anthracene	53-70-3	PAH	PAHs	NSV							12	249	0	37	Unknown	5	0
Dibenzofuran	132-64-9	Heterocyclic	SVOCs	NSV							2	249	0	37	Unknown	1	0
Dibromoacetic acid	631-64-1	Halogenated acetic acid	HAAs	na	na	NSV							33	38	Plausible	-	87
Dibromochloromethane	124-48-1	Halomethane	VOCs		NSV	NSV	N	N	N	Y	67	154	33	38	Plausible	44	87
Dichloroacetic Acid	79-43-6	Halogenated acetic acid	HAAs	na	na	NSV							31	38	Plausible	-	82
Dichlorodifluoromethane (Freon-12)	75-71-8	Chlorofluorocarbon	VOCs		NSV	NSV					0	154	0	38	Unlikely	0	0
Fluoranthene	206-44-0	PAH	PAHs	NSV							84	249	3	38	Plausible	34	8
Fluorene	86-73-7	PAH	PAHs	NSV							41	249	3	38	Plausible	16	8
Fluoride[c]	16984-48-8	Halogen	WQ Anions	na	na	NSV							38	38	-	-	100
High Molecular Weight PAH (ND=0)	HPAH-0	PAH	PAHs		NSV	NSV			Y	Y	130	249	3	38	Plausible	52	8
High Molecular Weight PAH (ND=1/2DL)	HPAH-5	PAH	PAHs		NSV	NSV					130	249	3	38	Plausible	52	8
Indeno(1,2,3-cd)pyrene	193-39-5	PAH	PAHs	NSV							31	249	0	37	Plausible	12	0
Isopropylbenzene	98-82-8	Aromatic hydrocarbon	VOCs	NSV	NSV	NSV					24	154	1	38	Plausible	16	3
Low Molecular Weight PAH (ND=0)	LPAH-0	PAH	PAHs		NSV	NSV					157	249	11	38	Plausible	63	29
Low Molecular Weight PAH (ND=1/2DL)	LPAH-5	PAH	PAHs		NSV	NSV					157	249	11	38	Plausible	63	29
m,p Xylenes	179601-23-1	Aromatic hydrocarbon	VOCs	NSV	NSV				Y	Y	46	154	4	38	Plausible	30	11
Methyl tert-butyl ether (MTBE)	1634-04-4	Ether	VOCs	NSV	NSV	NSV					0	154	0	38	Unlikely	0	0

Table 7-4
Chemicals Lacking Screening Values by Media
US Magnesium LLC
Tooele County, Utah

Chemical	CAS #	Chemical Group	Broader Group	Screening Values			Receptor Benchmarks				Detection Frequency				Potentially Site-related	Solids FOD (%)	Water FOD (%)
							Direct Contact		Dietary		Solids[a]		Water[b]				
				Soil	Sediment	Water	Invertebrates	Plants	Birds	Mammals	Detects	Samples	Detects	Samples			
Monobromoacetic acid	79-08-3	Halogenated acetic acid	HAAs	na	na	NSV							24	38	Plausible	-	63
Monochloroacetic Acid	79-11-8	Halogenated acetic acid	HAAs	na	na	NSV							29	38	Plausible	-	76
Naphthalene	91-20-3	PAH	PAHs	NSV					Y	Y	73	249	7	38	Plausible	29	18
Nitrite as N[c]	14797-65-0	Conventional Parameter	WQ Anions	na	na	NSV							25	38	-	-	66
N-Nitrosodimethylamine	62-75-9	Nitrosamine	SVOCs		NSV	NSV					0	249	0	37	Unlikely	0	0
N-Nitroso-di-n-propylamine	621-64-7	Nitrosamine	SVOCs		NSV	NSV					0	249	0	37	Unlikely	0	0
Orthophosphate as P[c]	PHOSPHATE AS P,	Conventional Parameter	Conventional Parameter	na	na	NSV							12	34	-	-	35
o-Xylene	95-47-6	Aromatic hydrocarbon	VOCs	NSV	NSV	NSV					47	154	3	38	Plausible	31	8
Perchlorate	14797-73-0	Perchlorate	Perchlorate	NSV	NSV	NSV					32	235	28	38	Plausible	14	74
Phenanthrene	85-01-8	PAH	PAHs	NSV							108	249	6	38	Plausible	43	16
Pyrene	129-00-0	PAH	PAHs	NSV							78	249	3	38	Plausible	31	8
Sulfate[c]	14808-79-8	Conventional Parameter	WQ Anions	na	na	NSV							38	38	-	-	100
Total Alkalinity[c]	ALK	Conventional Parameter	Conventional Parameter	na	na	NSV							14	36	-	-	39
Total Beryllium	7440-41-7	Metal	Metals		NSV		N	N	N	Y	238	249	21	38	Plausible	96	55
Total Dissolved Solids[c]	TDS	Conventional Parameter	Conventional Parameter	na	na	NSV							36	36	-	-	100
Total Iron	7439-89-6	Metal	Metals	NSV			N	N	Y	Y	249	249	38	38	Plausible	100	100
Total Molybdenum	7439-98-7	Metal	Metals		NSV		N	Y	Y	Y	227	249	37	38	Plausible	91	97
trans-1,3-Dichloropropene	10061-02-6	Halogenated aliphatic hydrocarbon	VOCs		NSV	NSV					0	154	1	38	Unknown	0	3
Trichloroacetic acid	76-03-9	Halogenated acetic acid	HAAs	na	na	NSV							33	38	Plausible	-	87
Trichlorofluoromethane (Freon-11)	75-69-4	Chlorofluorocarbon	VOCs		NSV	NSV					6	154	0	38	Unknown	4	0

Notes:
[a] Summaries for number of samples and number of detects include PRIs 1, 2 , & 4-12 and do not include buffer areas (13, 14, 15, and 16) since the purpose of this table is to identify "site related" chemicals.
[b] Summaries for number of samples and number of detects include PRI 17 (surface water)
[c] Given that conventional water quality parameters and anions are frequently detected, as they are present in GSL water, they do not have potentially Site-related designations.
Empty cells under soil, sediment, and water media infer the presence of a screening value.
na = Not applicable (the chemical is not assessed for this media)
HHA = Haloacetic acid
NSV = No screening value
PAH = Polycyclic aromatic hydrocarbon
PRI = Preliminary Remediation Investigation
SVOC = Semivolatile organic compound
VOC = Volatile organic compound
WQ = Water quality

Table 8-1
Summary of Risk Findings
US Magnesium LLC
Tooele County, Utah

Exposure Area	PRI 1	PRI 2	PRI 3	PRI 4	PRI 5		PRI 6		PRI 7	PRI 8		PRI 9	PRI 10	PRI 11	PRI 12	PRI 13	PRI 14		PRI 15	PRI 16	GSLIC	SVDD
Habitat	NA	Upland	NA	Upland	Upland	Lakebed	Upland	Lakebed	Lakebed	Upland	Lakebed	Upland	Upland	Upland	Upland	Lakebed	Upland	Lakebed	Upland	Upland	Lakebed	Lakebed
Birds	NA	-	NA	-	TEQ, HCB, Total PCBs	-	TEQ, HCB, Total PCBs	-	TEQ	TEQ	-	-	-	NA	-	-	-	TEQ	-	-	-	-
Mammals	NA	-	NA	-	TEQ	-	-	-	TEQ	TEQ	-	-	-	NA	-	-	-	-	-	-	-	-
Plants	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-
Soil Invertebrates	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-
Benthic Invertebrates	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-
Aquatic Biota	NA	-	NA	-	-	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-	-	-

Notes:
Constituents of potential ecological concern listed for a receptor and exposure unit were found to potentially result in risk based on Weight of Evidence findings.
NA = Not applicable because PRI was remediated (PRI 1 and 3) or no ecological habitat is present (PRI 11).
HCB = Hexachlorobenzene
PCB = Polychlorinated biphenyl
PRI = Preliminary Remediation Investigation
TEQ = Dioxin/furan toxicity equivalence factor