APPENDIX B-1: DRAFT ECOLOGICAL INVESTIGATIONS FOR THE PIT LAKE OPERABLE UNIT

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ACRONYMS AND ABBREVIATIONS

BERA	baseline ecological risk assessment
CHSO	corporate health and safety officer
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
HEP	habitat evaluation procedures
HSI	habitat suitability index
OSHA	Federal Occupational Health and Safety Administration
Pit Lake OU	pit lake operable unit
PPE	personal protective equipment
QAPP	quality assurance project plan
SAP	sampling and analysis plan
SHSP	site-specific health and safety plan
SI	suitability index
SLERA	Screening Level Ecological Risk Assessment
SLV	screening level value
SSHO	site safety and health officer
TSI	trophic state index
USFWS	U.S Fish and Wildlife Service

1 INTRODUCTION

The pit lake operable unit (Pit Lake OU) of the Yerington Mine Site covers approximately 173 acres within the southern portion of the approximately 3,400-acre site. Current activities in the pit lake are limited to environmental characterization, and public access is restricted. The area bears evidence of extensive human disturbance; however, some vegetation grows in upland portions of the area. In the absence of extensive human activity, colonizing plant species may provide shelter or food to wildlife species, and the pit lake waters may provide habitat for birds, fish, invertebrates and plants.

The objective of the Pit Lake OU ecological investigation is to characterize current conditions in the pit lake and surrounding terrestrial habitats through the following:

- Section 2—Review of historical and background information pertinent to understanding the pit lake and designing appropriate ecological investigations
- Section 3—Upland areas[1] assessments of soil chemistry and plant and wildlife habitat
- Section 4—Aquatic areas assessment of water and sediment quality, the aquatic macroinvertebrate community, fish presence or absence, and aquatic wildlife habitat.

The results of the ecological characterization will be synthesized with OU-specific investigations of chemicals (including radiochemicals) in soil, surface water, and sediment to estimate exposure to aquatic and upland receptors of concern as described in the SLERA work plan (Appendix B-2). Specific details of the sampling and analyses required for each of these project elements will be presented following U.S. Environmental Protection Agency (EPA) review and approval of this work plan, in a sampling and analysis plan (SAP). If needed, the Screening Level Ecological Risk Assessment (SLERA) results and a revised conceptual site model (CSM) will subsequently be used to define the scope of a baseline ecological risk assessment (BERA) for the Pit Lake OU and determine the assessment and measurement endpoints and the analytical design for the BERA.

[1] Upland areas are defined as elevations extending from the surface of the Pit Lake (the shoreline) to the top of the berm that defines the perimeter of the pit.

2 HISTORICAL DATA

Previous studies and information germane to the upland and aquatic habitats within the Pit Lake OU are summarized below.

2.1 UPLAND HABITAT

Knowledge of the types and quality of upland habitat present at the Pit Lake OU has been limited by the absence of quantitative and systematic studies done to assess these characteristics on site. Most available information comprises qualitative observations of plant and wildlife species present in and around the pit lake.

2.1.1 Vegetation

Past observations of vegetation have focused on species found in or near the water of the pit lake (Wiemeyer et al. 2004). Plant species noted near the water's edge or seeps include cottonwoods, willows, tamarisk, cattails, and unidentified shrubs (Wiemeyer et al. 2004). In the spring of 2007, bryophyte (moss) and horsetail species were observed growing in and near spring inflows to the pit lake (Mattison 2007, pers. comm.). Small patches of additional plant species were also observed in upland portions of the Pit Lake OU (including the lake rim and surrounding land and roadways) including spiny hopsage, rabbitbrush, and graminoid (grasses, sedges, and rushes) species.

2.1.2 Wildlife

Historical data of wildlife in the Pit Lake OU are limited to observational studies conducted by Wiemeyer et al. (2004), incidental observations gathered by on-site NORWEST personnel from March through December 2007, and incidental observations by Integral scientists from April 5 to 9 and May 14 to 19, 2007 (Mattison 2007, pers. comm.).

Wiemeyer et al. (2004) noted mammalian, avian, and reptilian wildlife species on or near the pit lake during three days in June of 2000 and the following winter. Mule deer were the only mammalian species noted (Wiemeyer et al. 2004). Avian species observed included bank swallows, western and eared grebes, an unidentified cormorant, Canada geese, unidentified ducks, killdeer, and unidentified passerines (Wiemeyer et al. 2004). The pit walls provided nesting sites for bank swallows (Wienmeyer et al. 2004) and roosting sites for Canada geese and other waterfowl (Mattison 2007, pers. comm.). Unidentified lizard species were also reported in the area (Wiemeyer et al. 2004; Mattison 2007, pers. comm.).

In addition to mule deer, NORWEST personnel sighted coyotes and cottontail rabbits in the Pit Lake OU in 2007. They also noted raptors (turkey vultures, red-tailed hawks, and a prairie

falcon), waterfowl (Canada geese and redheads), waterbirds (unidentified gulls), songbirds (ravens and magpies), a galliform (California quail), and a dove (rock dove) in the area. Observations of additional species by Mattison (2007, pers. comm.) included signs of small rodents (probably mouse species) near the pit lake, eared grebes in breeding plumage (on May 16, 2007) and mallards on the pit lake, swallow species, and a western kingbird.

2.2 AQUATIC HABITAT

Like other pit lakes, the Yerington Pit Lake is a deep, steeply sloped artificial impoundment with a high depth-to-surface area ratio. It was created following cessation of mining operations by infilling of groundwater. The Yerington Pit Lake is still in its formative stages and is forecast to continue gaining surface elevation until its inflows and outflows reach a hydraulic equilibrium. Based on studies conducted from 1995 to 2001, the Yerington Pit Lake is pH neutral to slightly alkaline and seasonally stratified by formation of a summer thermocline where temperatures in the lake's surface layer (the epilimnion) are higher than those below about 40 m (130 ft) (the hypolimnion) (Atkins et al. 1997; Jewell 1999; Hershey 2002; Wiemeyer et al. 2004). Summer temperatures are approximately 25°C in the epilimnion and 6 to 7°C in the hypolimnion. The surface of the lake cools in the fall, resulting in one or more turnover events in winter when it is completely mixed with winter temperatures of 6 to 7°C throughout the water column. The winter mixing results in relatively will oxygenated conditions throughout the year, even during periods of peak stratification.

Low nutrient levels and low densities and biomass of phytoplankton and zooplankton indicate that the Yerington Pit Lake is a low productivity, oligotrophic[2] ecosystem. Atkins et al. (1997) measured nutrient concentrations (phosphorus, nitrate, and ammonia), phytoplankton density and biomass, and zooplankton densities in the Yerington Pit Lake and two other pit lakes in northern Nevada from 1995 to 1996. Nutrient concentrations in the Yerington Pit Lake ranged from 5 to 8.9 μg/L for total phosphorus, 80 to 125 μg/L for nitrate, and 6 to 14.5 μg/L for ammonia). Phytoplankton densities ranged from 37,000 to 58,000 cells/mL and were dominated by green algae in the summer and blue-green algae in the winter. Phytoplankton biomass as measured by chlorophyll-a was approximately 0.1 μg/L. Zooplankton abundances ranged from 69 to 682 organisms/m^3 and were dominated (>80 percent) by rotifers. Wiemeyer et al. (2004) sampled aquatic macroinvertebrates by a variety of techniques (plankton net, kick net, light trap) and found a variety of cladocerans, copepods, and insects, including dragonfly larvae and creeping water bugs.

Additional monitoring data (Hershey 2007, pers. comm.) for the Yerington Pit Lake show that concentrations of nutrients essential for phytoplankton and aquatic plant growth are low, averaging 5.4 μg/L for phosphate, 6.3 μg/L for ammonia nitrogen, and 556 μg/L for nitrate.

[2] Oligotrophic refers to low productivity associated with low levels of phosphorus and nitrogen.

These average concentrations yield an N:P ratio[3] of 165:1 and a trophic state index (TSI) for phosphorus of 12.3, both of which indicate that the pit lake is nutrient limited and oligotrophic.

Several studies have documented trace element chemistry in the Yerington Pit Lake (Jewell 1999; Hershey 2007, pers. comm.). Water samples were collected over multiple seasons and depths to characterize conditions when the pit lake was stratified and when it was well mixed (Tables 2-1 and 2-2). The results of these studies indicate that copper, mercury, and selenium exceeded USEPA (2006) Aquatic Life Criteria (Table 2-3).

Wiemeyer et al. (2004) surveyed environmental contaminant concentrations in composite samples of aquatic vegetation and macroinvertebrates collected from the Yerington Pit Lake in 2001. Wiemeyer et al. (2004) sampled aquatic macroinvertebrates by a variety of techniques (plankton net, kick net, light trap) and found a variety of cladocerans, copepods, and insects, including dragonfly larvae and creeping water bugs.

[3] C:N ratio is based on converting from mass concentration to molar concentrations.

3 UPLAND AREAS ASSESSMENT

Assessment of upland areas of the Yerington Pit Lake may be performed at increasing levels of detail, depending on the level of detail needed to support a SLERA. The first level of detail involves sampling soils that can be used in to assess potential exposure to plant and wildlife communities and quantifying the amount of general plant and wildlife habitat through the use of remote sensing technology. The second, more specific level of assessment consists of two interrelated parts: an upland vegetation survey and a wildlife habitat assessment. These vegetation and wildlife habitat assessments may be performed at two levels of detail, investigative and comparative. The objectives of an investigative vegetation survey are to describe plant species and the condition of vegetated upland habitats in the pit lake area, and to generate data that support the methods to be used for the investigative wildlife habitat assessment. The objectives of an investigative wildlife habitat assessment are to determine the suitability of the pit lake area as habitat for terrestrial mammals and birds and to quantify the areas suitable as wildlife habitat. Parameters measured or recorded in the vegetation survey both describe the plant community and will be used in the wildlife habitat assessment. The wildlife habitat assessment includes physical habitat parameters not measured by a typical vegetation survey. Both vegetation and wildlife surveys may be performed at a comparative level, where data gathered in both would be compared to data gathered in a reference area. Comparative survey design would undergo power analyses to ensure that adequate sample sizes are taken in site and reference areas to determine differences in measured parameters.

Any investigative or comparative pit lake vegetation surveys will use standard methods (Chambers and Brown 1983; Herrick et al. 2005; Pellant et al. 1999) to identify appropriate sampling areas, define metrics of habitat quality, and measure the extent and condition of upland vegetated habitat. Investigative or comparative wildlife habitat assessments of terrestrial portions of pit lake areas will integrate information from vegetation surveys and standard U.S Fish and Wildlife Service (USFWS 1980) habitat evaluation procedures (HEPs) to determine habitat quality for selected wildlife species. The HEP method was selected for this task because it is a widely accepted tool for judging habitat quality that can be performed using qualitative and simple quantitative metrics. Qualitative assessments of wildlife habitats for those species that lack applicable habitat suitability index (HSI) models will also be performed.

The upland areas assessment will inform development of the SLERA by indicating whether the pit lake area can support terrestrial wildlife, and the extent to which terrestrial wildlife might use the area. Assessment of habitat for avian wildlife that could use the pit lake itself will also be conducted, as described in Section 4. Pit lake wildlife assessment requires evaluation of the riparian and littoral habitats of the pit lake.

3.1 SOIL SAMPLING

To evaluate potential ecological risks in the Pit Lake OU, sampling is proposed for soil surfaces of the Pit Lake OU above the current level of the surface of the lake. Samples will be taken at two elevations:

- Soil within 75 ft above the present level of the lake, with the expectation that this zone will be inundated as the pit lake continues to fill and these soils will likely become a potential source of chemicals as sediments below the lake surface in the future
- Soils higher than 75 ft above the current surface of the lake, which are expected to remain soils after the lake has reached equilibrium.

Figure 3-1 shows the proposed soil sampling locations for fringe area that is within 75 ft of the pit lake surface. These locations are preliminary and may be relocated pursuant to field verification of such factors as local topography, areas of vegetation, inflows of seeps and springs, and safe accessibility. Sample locations higher than 75 ft above the current lake surface are not shown. However, approximately 10 samples are proposed in vegetated areas near seeps and springs at the east and west ends of the pit lake, with another 10 samples distributed systematically along the periphery of the lake in barren areas that are safely accessible.

Samples will be collected from surface soils (0 to 2 feet bgs) and subsurface soils. Subsurface soil samples will target the 2 to 10 ft interval; the lower extent of subsurface soil sampling will be determined in the field contingent on the ability of personnel and equipment to safely collect samples at these depths. Soil samples will be collected using sonic core, hollow-stem auger with split spoon, or direct push methods in order to retrieve a relatively undisturbed core sample. The core sample retrieved should contain enough volume of material to allow for collection of all normal as well as duplicate samples. Core samples from the desired sample interval will be prepared and packaged into sampling containers using standard procedures outlined in SOP-SL5. Samples will be transported to the laboratory using standard chain of custody procedures as described in the quality assurance project plan (QAPP) (Section 6) of the RI pit lake work plan. All soil samples will be analyzed for total metals by EPA Method SW846-6000/7000 Series and for radiochemicals by HASL 300 methods (see Table 5-4 in the RI work plan for the pit lake). The total metals analyses will be used for comparisons with screening level values as described in Appendix B-2.

3.2 IDENTIFICATION OF VEGETATION AND WILDLIFE SAMPLING AREAS

Initial assessment of vegetation cover in upland areas within the Pit Lake OU will be performed through examination of aerial orthographic quadrangle photographs (ortho-quads) combined with geographic information system (GIS) area calculations (ESRI ArcGIS; Herrick et al. 2005). Land cover with the potential to provide wildlife habitats will be delineated based on a visual

evaluation of ortho-quads, and habitats will be generally classified. Based on a preliminary review of existing ortho-quads, two or three upland vegetative classes are expected to be of interest to this analysis: densely vegetated, sparsely vegetated (including formerly used roads or other disturbed soils supporting early-successional-stage plant communities), and barren. This mapping exercise by itself may be sufficient to support the SLERA and provide perspective on habitat conditions needed to make informed site management decisions with respect to the need for a BERA (see Appendix B-2). Otherwise, the mapping exercise will be used to delineate areas to be sampled in investigative or comparative vegetation and wildlife habitat surveys. If comparative vegetation and wildlife surveys are needed, the above methods will be used to identify and delineate an appropriate reference area for the site.

For any necessary field investigations, areas containing each of the vegetation classes will be sampled randomly using point intercept transect techniques (described below), resulting in a stratified random sample of the entire upland area. Maps showing the approximate boundary of each upland vegetation cover type will be generated prior to performing field work. Once in the field, the boundaries of each vegetation cover class will be ground-truthed and modified, if necessary, before performing transect sampling. An initial qualitative assessment of the suitability of potential habitats will be made using available site data and observations or evidence of past or present wildlife use, and will be noted. Final maps accurately describing the boundaries of each patch of each vegetation cover type will be generated subsequent to the field sampling. The total area of each vegetation cover type, as well as the area of each individual patch, will be calculated using GIS software (ESRI ArcGIS 2007), and will be used in the SLERA.

3.3 TRANSECT SAMPLING FOR VEGETATION AND WILDLIFE

Within each of the landcover types identified on ortho-quads and verified in the field, transect sampling will be used to collect all data required to describe plant communities and to assess the quality of habitat for various wildlife that may use the area. For an investigative study, a subset of the total area of each vegetative-cover type will be sampled, with the number of transects corresponding to the fraction of the total pit lake area represented by the cumulative area of the patch type. For example, if there are three vegetation categories (densely vegetated, sparsely vegetated, and barren) with total (cumulative within the pit lake area) coverages of 20, 50, and 30 percent, respectively; then the densely vegetated habitats would be surveyed using two transects, the sparsely vegetated areas would be surveyed with five transects, and the barren areas with three transects. The total number of transects will be determined on the basis of vegetation patch size, total area of each patch and of each cover type, and other factors. If a comparative study of vegetation and wildlife habitat is required, sample sizes for site and reference area transects will be determined by a power analysis to ensure adequate statistical power to detect differences in transect parameters (α and β will both be set to 0.1).

In both investigative or comparative surveys, parameters measured or recorded using transects will include vegetative characteristics and physical habitat parameters to support the wildlife habitat assessment. Transects will be placed parallel to each other to the greatest extent possible, and will be sufficiently long to include as much of the individual patch as possible. Transect starting points within each patch will be selected randomly using a 200 m by 200m grid and a sequence of randomly generated numbers.

3.3.1 Vegetation Sampling

Sampling will be designed to measure or calculate the following aspects of vegetation cover and composition:

- Species present
- Percent canopy cover
- Percent basal cover
- Percent litter cover
- Percent herbaceous cover
- Percent bare earth
- Percent senescent cover
- Percent cover by species (species composition)
- Percent canopy cover greater than 1.5 m in height
- Percent canopy cover less than 1.5 m in height
- Percent invasive species.

The preceding metrics will be measured on the site by the line intercept transect method (Pellant et al. 1999). This method was chosen for its accuracy and efficiency in quantifying vegetation cover in shrub habitats (Herrick et al. 2005). An appropriate length for each transect will be determined during the remote sensing analyses described above; transect lengths will be chosen to ensure adequate percent land area coverage for each representative land cover type.

3.3.2 Terrestrial Wildlife Habitat Sampling

Selection of the HEP method to characterize upland habitats requires that species of interest be identified, because the method can only be applied on the basis of species-specific habitat preferences. Also, the SLERA will select species that are representative of potential exposure pathways and feeding guilds as receptors for the risk analysis. Therefore, only a subset of the possible range of wildlife that may use the pit lake area can be addressed specifically by the wildlife habitat assessment.

Terrestrial wildlife species will be selected by the following criteria:

- Their use of representative local land cover types
- Their suitability as surrogates for other wildlife species
- The availability of an HSI model for the species.

A preliminary list of terrestrial wildlife potentially fulfilling these requirements includes the mule deer, red-tailed hawk, western meadowlark, Brewer's sparrow, and chukar. Methods for evaluating the habitat suitability for other terrestrial species likely to inhabit the Yerington Pit Lake, but for which HSI models are not available, will be considered. These species include black-tailed jackrabbits, other small herbivorous mammals, coyotes, kit fox, California quail, pigeons, and ravens. At a minimum, the suitability of pit lake habitat for these animals will be evaluated through a comparison of site observations to these species' habitat requirements; these results will then be coded in an evaluation matrix.

Standard HEPs involve measuring and combining key aspects of each species' habitat and comparing them to an optimum value or suitability index (SI); this SI serves as a theoretical reference habitat. Each comparison yields a dimensionless number between 0 (unsuitable) and 1 (optimal) for each measured habitat and species, or an HSI. The relative value of the HSI on this arbitrary scale represents the capacity of the study area to meet the habitat requirements of an evaluated species.

Terrestrial wildlife habitat surveys will focus on the vegetated portions of the site, and will be conducted along the same transect lines used for the vegetation survey within the vegetated areas. Barren and constructed portions of the site will be considered unsuitable for wildlife habitat *a priori*, and wildlife habitat assessment of these areas will not be performed. Requisite metrics for selected wildlife species' HSI models will be collected along each transect, or will be computed from data generated by the vegetation survey, as follows:

- Measured parameters
  - Distance from forage sites to perch sites (for meadowlark)
  - Distance from forage sites to exposed rocky areas (for chukar)
  - Herbaceous plant height
  - Average height of shrubs (for Brewer's sparrow)
  - Number of woody stems greater than 1 meter tall (for red-tailed hawk)
  - Number of trees greater than 50 cm diameter at breast height
- Parameters calculated from results of the vegetation survey
  - Percent herbaceous canopy cover

- Percent herbaceous canopy cover consisting of grass
- Percent shrub canopy cover
- Percent shrub canopy cover less than 1.5 m high
- Percent preferred forage canopy cover less than 1.5 m high (for mule deer)
- Percent canopy closure of overstory trees (for red-tailed hawk)

These metrics will allow calculation of HSIs for selected species in those portions of the pit lake area that have vegetative cover. These HSIs will then be weighted by the proportion of available terrestrial habitat over the proportion of total habitat to provide terrestrial HSIs for the entire pit lake.

For wildlife species of interest without HSI models, we will record the presence and quantity (percent) of important life factors in an evaluation matrix. These factors include food (e.g., appropriate forage plants or signs of prey), cover (e.g., vegetation or accessible buildings), and evidence of use (e.g., scat, tracks, remains). We will rate these parameters on a 5-point scale, with 0 representing absence of a resource and 5 representing presence of resources of high quality and quantity.

3.4 STATISTICAL EVALUATIONS OF VEGETATION AND WILDLIFE HABITAT

The final number of transect samples necessary for robust HSI calculations will depend on how many land cover types are delineated, the total area of each, and the variability of the habitat sampled metrics. Running means of wildlife habitat metrics will be calculated for each transect while field sampling, and the means of every five transects will be averaged. If the means of each group of five transects vary by more than 10 percent at the conclusion of the vegetation survey, additional randomly assigned transects will be sampled until variation is reduced or 30 transects have been conducted. Random quadrat measurements of riparian and littoral vegetation will be taken until the variability of means between quadrants is less than 20 percent or 15 quadrants have been measured.

Qualitative habitat evaluation matrices will be created for those species for which HSI models are unavailable. Each evaluation matrix row (representing a species) will be summed to create a habitat suitability value between 0 and 15. Habitat suitability from 0 to 5 will be considered "poor," from 6 to 10 "adequate," and from 11 to 15 "good." This process will allow us to consider a broader variety of species in the habitat evaluation than by HEP alone.

4 AQUATIC AREAS ASSESSMENT

The aquatic areas assessment will synthesize information on pit lake limnology, describe macroinvertebrate communities, determine whether fish are present in the pit lake, and evaluate the riparian/littoral areas in terms of their ability to support bird life. The objectives of the aquatic areas assessment is to generally describe the ecological condition of the pit lake for the purposes of supporting the SLERA and making informed site-management decisions for conducting a BERA.

The aquatic areas assessment will use existing information on the pit lake to describe the limnology of the lake, including the depth of the thermal layers during different seasons, the timing of lake turnover, trophic status and other parameters that define the physical and chemical habitat conditions. The macroinvertebrate community will be described, and the presence of fish in the lake will be investigated. The extent of vegetated habitat around the lake perimeter, including both uplands and littoral areas, will be documented and evaluated for its attractiveness and value to waterbirds. Mammals are assumed to not use the lake extensively, except possibly as a source of drinking water.

Results of these investigations will be used to identify the types of food webs that may be present in the pit lake and will guide the selection of receptors, inform any revisions to the conceptual site model, and if needed, support identification of assessment and measurement endpoints for the BERA.

4.1 LIMNOLOGICAL ASSESSMENT

Limnological characteristics provide an important framework for judging habitat conditions for aquatic plant, macroinvertebrates, and potentially fish that reside in the pit lake (Section 2.2 above). Limnological assessment of the Yerington Pit Lake is described in Section 5.1.4 of the RI pit lake work plan. Pit lake water quality data will be monitored for temperature (seasonal stratification/mixing), dissolved oxygen, conductivity, pH, total dissolved solids, sulfate, chloride, dissolved organic carbon, nutrients (nitrate, ammonia, phosphorus), chlorophyll-a, total and dissolved metals and radiochemicals in the central portion of the lake (limnetic and profundal zones) and in two locations in the littoral zone near the discharges of the east and west high wall seeps. Additional limnological sampling for these parameters is proposed for other locations in the littoral zone of the pit lake coincidental with the aquatic wildlife, aquatic macroinvertebrate, and fish/presence assessments described below (Figure 3-1 and Sections 4.3, 4.4, and 4.5). The water quality data will be used to characterize limnetic and littoral habitat conditions associated with proposed sample times and locations. Water samples in the littoral zone will be collected using a peristaltic pump, and transported to the laboratory using standard chain of custody procedures as described in the QAPP (Section 6) of the RI pit lake work plan.

Conventional nutrient and chlorophyll-a analyses will be used to confirm the pit lake's low productivity, oligotrophic status. The dissolved and total metals analyses will be used for comparisons with screening level values as described in Appendix B-2. If needed, pH, water hardness, the free metal ion concentrations, potential dissolved organic carbon complexation, and potential cationic competition (K^+, Na^+, Ca^{++}, Mg^{++}) will be used to judge bioavailability of trace metals to understand how site specific conditions may affect or mitigate their potential toxicity (USEPA 2007a,b).

4.2 SEDIMENT ASSESSMENT

Sediment sampling by gravity cores at four littoral (<30 ft depth) locations around the perimeter of the lake is proposed in Section 5.1.5 of the RI pit lake work plan. These samples will be used for analysis of grain size, selected cations (iron, calcium, copper and selenium), and sequential extraction techniques to determine element mobility.

To evaluate the potential risks to human health and the environment, including benthic community and wildlife receptors, additional sediment sampling is proposed for other locations in the littoral zone of the pit lake coincidental with the aquatic wildlife, aquatic macroinvertebrate and fish/presence assessments described herein (Figure 3-1 and Sections 4.3, 4.4, and 4.5). Surface sediments to a depth of approximately 10 cm (4 in) will be collected using an Ekman grab sampler and transported to the laboratory using standard chain-of-custody procedures as described in the QAPP (Section 6) of the RI pit lake work plan. All surface sediment samples will be analyzed for conventional analytes (total organic carbon, acid volatile sulfides, ammonia, grain size) and total metals by EPA Method SW846-6000/7000 Series.

The sediment conventional data will be used to characterize benthic habitat conditions. The total metals analyses will be used for comparisons with screening level values as described in Appendix B-2. If needed, the AVS-SEM data will be used to judge bioavailability of the divalent cation trace metals to understand how site specific conditions may affect or mitigate their potential toxicity to benthic organisms (USEPA 2007b).

4.3 MACROINVERTEBRATE ASSESSMENT

The objective of the macroinvertebrate survey is to qualitatively characterize the macroinvertebrate communities that use aquatic habitat created by the Yerington Pit Lake. The macroinvertebrate survey will expand upon the sampling described by Wiemeyer et al. (2004) to include barren and vegetated areas in the benthic and pelagic[4] habitats by sampling invertebrates from littoral sediments and substrates and from limnetic waters. A stratified

[4] Pelagic refers to water column habitat anywhere within the lake. It consists of littoral (shallow nearshore water at the margins of the lake and to the depth light penetration that can support rooted vegetation), limnetic (open water to the depth of light penetration), and profundal (open water below the limnetic zone to the lake bottom) zones.

random sampling design will be used to sample several habitat types. Sampling will be performed using transects that will be located on bathymetrically distinct benches or shallow slopes within the littoral zone and in the limnetic zone. Proposed sampling areas within the littoral zone of the pit lake are shown in Figure 3-1. These locations are preliminary and may be relocated pursuant to field verification of such factors as local bathymetry, areas of emergent vegetation, and inflows of seeps and springs.

4.3.1 Sampling Methods

Sampling in each of the aquatic habitats within the pit lake will be designed to describe the diversity and abundance of macroinvertebrates present at the site. To achieve a best estimate of macroinvertebrate diversity and abundances, several sampling methods appropriate to each habitat could be used (Table 4-1).

The littoral zone of the pit lake will likely contain the greatest diversity and abundance of emergent macroinvertebrates in both the benthic and pelagic habitats, especially in the presence of vegetation. The limnetic waters of the pit lake may contain some macroinvertebrate species on the surface of the water, at depth, or in benthic areas bordering the littoral zone. To sample sediment-dwelling macroinvertebrates, an Ekman or another substrate specific grab sampling technique will be used. To sample the macroinvertebrates that might be using the limnetic zones, aquatic light traps will be used to attract organisms to the passive sampling equipment. To address each of these habitats, both general and habitat-specific sampling techniques will be used, as described below.

4.3.1.1 General Sampling

Floating emergence traps are passive sampling devices that collect aquatic insects as they emerge from the water in their transition from the larval to adult stage. These traps can be used to sample emerging macroinvertebrates from both benthic and pelagic habitats (Merritt et al. 2008). Emerging adult insects are of interest since they will be prey for insectivorous vertebrates at the pit lake.

Wilding or Stovepipe samplers are essentially large metal pipes that when lowered through the water column and into the substrate will simultaneously collect invertebrates from benthic and pelagic habitats depending on the water depth. Wilding samplers may also be limited by a hard or coarse substrate, but not by vegetation.

Within the macrophyte zone, D-frame aquatic net sampling will collect larval macroinvertebrates most effectively from the water column and water surface when vegetation is present (Gerritsen et al. 1998). Both sessile and motile invertebrates will be collected as the dip net is swept through aquatic vegetation.

4.3.1.2 Benthic Specific

Grab samplers are various metal spring loaded boxes that are lowered to the substrate and then closed to collect sediment containing larval macroinvertebrates from the benthic habitat. Ekman samplers will provide a good representation of invertebrates using the upper layers of the sediment in the lake, and are the most widely used grab sampling techniques for lakes reported in recent scientific literature (Merritt et al. 2008). However, the presence of vegetation will limit the efficiency of an Ekman sampler, as will a coarse substrate. Additional benthic grab sampling options appropriate to major substrate types beyond the macrophyte zone are provided in the EPA Lake and Reservoir Bioassessment and Biocriteria guidance document (USEPA 1998) and are included in Table 4-2.

4.3.2 Sampling Frequency

The EPA Lake and Reservoir Bioassessment and Biocriteria guidance document (USEPA 1998) recommends sampling benthos in August, when the environment is most stressful, and potentially in early spring prior to adult emergence. Our goal is to qualitatively characterize diversity and abundance of macroinvertebrates, and therefore both of these sampling times are appropriate. Some aquatic macroinvertebrates overwinter as eggs, some as larvae, and some as pupae, but taxonomic keys describe only larval and adult characteristics. Therefore, sampling at two seasonal periods during each sample window is necessary to obtain identifiable stages of all taxa present.

The collection of emergent adults from the surface of the water using floating emergence traps will also provide species richness and diversity data. These data will provide a confirmation of the identity of collected macroinvertebrate larvae, in addition to a temporal characterization of adult emergence patterns that will be important in determining exposure to aerial insectivores. This sampling method, however, is temporally sensitive, and depending upon the timing and duration of deployment, may under- or overrepresent some macroinvertebrate populations. The potential to miss an emergence event supports the argument for continuous deployment, at least though one production cycle. However, the potential for the collection receptacle to fill and subsequently bias a sample necessitates frequent (biweekly) monitoring. Following the first sampling window, a degree day model will allow for a general prediction of subsequent emergence events, potentially reducing the sampling effort in the second and third sampling windows. Degree day models use cumulative daily mean temperature (e.g. 10 days at a mean temperature of 10°C = 100 degree days) to predict development since most aquatic invertebrate life cycles are under general thermal control.

The numbers of emergence traps, level of effort to be used with D-nets in characterizing macroinvertebrate communities, and number of sediment grab samples in each habitat will be defined in the SAP.

4.3.3 Tissue for Trace Metal Analysis

Wiemeyer et al. (2004) identified selenium, aluminum, chromium, and copper as chemicals of interest for birds that may be exposed via consumption of aquatic vegetation or macroinvertebrates. Screening level values (SLVs) that account for this exposure pathway have been developed for water and sediments for application in the SLERA (Appendix B-2). If the wildlife SLVs are exceeded in the SLERA, aquatic plant and invertebrate tissue sampling for trace metals may be needed to support a BERA. However, benthic macroinvertebrates that are collected for characterization of species richness and abundance are subjected to sample preservation techniques that may be incompatible with tissue analyses. Consequently, macroinvertebrate samples collected for abundance and taxonomic analysis as described above cannot be archived for subsequent tissue analysis.

If macroinvertebrate tissue analyses are needed to support development of the BERA, they will be collected in a later phase of the remedial investigation. Methods for sample location, processing, and analysis will be provided as an addendum to the Sampling and Analysis Plan. In general, sampling for macroinvertebrate taxa for tissue trace metal analysis will depend on the results from the invertebrate richness and diversity survey described above, to reflect the habitats used by the resident and emergent species. Representative samples of macroinvertebrates will then be collected from each habitat using active sampling techniques to avoid the use of preservatives that may alter the detection of trace metals in tissue.

4.3.4 Data Evaluation

Three informative parameters of benthic community structure that may be obtained from quantitative grab samples are standing crop (biomass or numbers), species richness, and species composition (USEPA 1990). The calculated means for each of these parameters can be compared between the habitats at each ramp, between ramps, or between the Yerington Pit Lake and a suitable reference site using an analysis of variance.

Standing crop will be expressed as the number of individuals per square meter sampled using Wilding, grab, or D-frame sampling devices. Emergence and light trap counts will not be included in the standing crop counts since the area sampled cannot be easily quantified. Species richness is a measure of the number of distinct taxa identified in a sample, based on the lowest practical level of identification (usually family or genus). We will not composite our replicate samples from each habitat to allow the richness mean and variability to be calculated for each sampling area.

Species composition as a parameter of environmental quality is based on the generally observed trend that relatively undisturbed habitats support communities with a high number of species, with none of the species present in overwhelming abundance. The Shannon-Weaver mean diversity (d) is a measure of species composition and is affected by both richness of species and

by the distribution of individuals among the species. The Shannon-Weaver mean diversity (d) can be useful metric for making comparisons among sites and is calculated according to the formula:

$$d = C/N\ (N \log_{10} N - \Sigma n_i \log_{10} n_i)$$

where C = 3.321, N = the total number of individuals, and n_i = the total number of individuals in the ith species (USEPA 1990).

Alpha diversity (α-diversity) is the biodiversity within a particular area, community or ecosystem and will also be a useful metric of the macroinvertebrate community. Alpha diversity will be measured by counting the number of macroinvertebrate taxa collected within the Yerington Pit Lake. Additionally, following the first sample window we will use α-diversity to evaluate the number of samples that we collect at each of the littoral bench sites. By plotting sample number against cumulative α-diversity and evaluating the slope of the line, we can determine the number of samples required to most efficiently collect as many taxa as is reasonable to characterize the emergent macroinvertebrate community.

4.4 FISH PRESENCE/ABSENCE SURVEY

It is unknown whether fish are present in the pit lake. While the lake is currently isolated from surface waters, it was formerly connected to the Walker River, at which time fish may have migrated to the lake and formed reproducing populations. The objective of the fish sampling is to determine whether or not fish are present in the pit lake and to identify any species that are present. This information is important to refining the conceptual site model in the SLERA and will further support the study design for a BERA if needed. Methods that will be applied will generate a qualitative description of the species in the lake if any are found.

All fish sampling equipment types are limited, and can produce only a partial profile of the overall fish community. Multiple methods are often employed when it is necessary to characterize the full community. Methods and sampling equipment are typically selected on the basis of the target fish species' life histories and habitat use patterns. Because the fish species, if any, that occupy the pit lake are unknown, general fish sampling equipment will be employed (fish traps and gill nets).

4.4.1 Sampling Areas and Methods

One or two general fish habitat types are expected in the pit lake, open water and vegetated areas, with the latter containing submerged and/or emergent vegetation. Within the open water areas, fish may be found in at least two habitat strata: profundal waters consisting of the lake's hypolimnion and constituting the deepest unvegetated portion of the pit lake, and shallower unvegetated limnetic waters at the surface of the lake. Each of these fish habitat types has

different characteristics of interest to fish, and many fish move between them, often in diurnal patterns, to find food and spawning substrate.

Fish traps will be baited and deployed within littoral habitats and along the lake perimeter where vegetation may not yet have become established. Proposed sampling areas within the littoral zone are shown in Figure 3-1. These locations are preliminary and may be relocated pursuant to field verification of such factors as local bathymetry, areas of emergent vegetation, and inflows of seeps and springs. If any fish are present in the lake, smaller fish would be expected because the lake is oligotrophic, and because juveniles tend to be smaller. Also, littoral zones are used by smaller fish as cover from predators. For these reasons, trapping will be initially conducted with minnow traps, which have a relatively small opening. If minnow traps are successful in capturing fish, deployment of larger traps will be considered.

In the open water habitats, variable mesh gill nets will be deployed at three depths in the limnetic and shallow profundal zones. Proposed sampling areas are shown in Figure 3-1. These locations are preliminary and may be relocated pursuant to field verification of such factors as local bathymetry and depth of the thermocline if one is present. Monofilament gill nets are invisible to fish and capture fish by entanglement. Gill nets consisting of several panels, each with a different mesh size, are often used in research and are called experimental gill nets. Experimental gillnets are about 1.5 to 2 meters deep and contain panels with 13-, 25-, 38-, 52-, 76-, and 102-mm mesh sizes. Using this type of net results in nonselective sampling and can produce a catch of multiple species or multiple size classes within a species.

All live captured fish will be held in ambient water, and individuals anaesthetized with carbon dioxide will be identified to species; their total lengths measured (tip of the closed mouth to the extreme tip of the caudal fin); weighed; and examined for external abnormalities such as visible skin disorders, eroded fins, or parasites.

4.4.2 Sampling Frequency

Fish traps and gill nets will be deployed during the same sampling events as the macroinvertebrate sampling is conducted. Both methods will include overnight deployment, since fish are often more active at night and may move between habitat types according to diurnal patterns. The specific depths, numbers, and locations of traps and nets will be provided in the SAP, but sampling will be designed to either identify most species that use the pit lake or allow for a high level of confidence in a conclusion that no fish are present in the event that none are captured.

Because gill netting often results in death of the fish, if the initial deployments result in captures, net density may be reduced to avoid adversely impacting the fish populations. Fish captured in traps will be released alive, unless they are archived for chemical analysis.

4.4.3 Tissue Sampling

Ultimately, a specific set of analyses of fish tissue for metals or other chemical residues may be needed to support the BERA, the parameters of which are not yet defined. For example, if it is determined that aquatic birds use the pit lake and that a risk assessment should consider risk to aquatic birds, the size of fish consumed by the bird species of interest should be sampled. Since the BERA is not scoped, these decisions are not possible. Nevertheless, a subsample of any fish that are captured will be identified to species, their individual length measured, wrapped in plastic, given a unique identifier and preserved on ice for shipment to a laboratory for archiving. Archived fish can later be analyzed for metals and other chemical residues, if needed to support decisions to conduct a BERA.

4.4.4 Data Evaluation

Results of the trapping and gill netting provide descriptive information on the ecological condition of the pit lake and will help define the types of ecological receptors and potential exposure pathways to be addressed by the SLERA. Sampling will not be conducted for the purposes of quantitative comparisons, nor will it be sufficiently intensive to quantitatively characterize the fish community.

4.5 AQUATIC WILDLIFE HABITAT ASSESSMENT

Obligate aquatic mammals (e.g., otters, muskrats, beaver) that are dependent on aquatic systems are highly unlikely to be actively using the pit lake because it is in relatively early stages of lake succession, has limited access, and low habitat potential to sustain such populations. Consequently, obligate aquatic mammals are not addressed in this document. However, terrestrial mammals (e.g., mule deer) common to the Great Basin desert are assumed to use the pit lake for drinking water. The pit lake also attracts birds which may rest or forage on the lake or the shoreline. Consequently, the objective of the aquatic wildlife habitat assessment is to qualify the pit lake in terms of its ability to attract and support aquatic birds.

4.5.1 Sampling Areas and Methods

To evaluate habitat for wildlife species that use aquatic habit, littoral habitats will be sampled for characteristics that can be measured remotely or determined from historical data, or field sampled. Examples of characteristics that may be determined remotely or derived from historical data include the following:

- Area of wetland/riparian corridor
- Recreational and/or watercraft use of habitat
- Water regime/level fluctuations

- Prevailing wind direction and wave heights

Examples of habitat characteristics to be measured directly include the following:

- Presence of small fish (see Section 4.4)
- Plant species composition of vegetated habitats
- Area in which emergent vegetation occurs
- Water levels around emergent vegetation
- Presence of suitable nesting cavities/vegetation

Sampling efforts will meet the requirements of each HSI model available for aquatic birds that may be expected at the pit lake; many of these requirements are qualitative (e.g., presence or absence of emergent vegetation at a water depth of less than 1 meter), while others are quantitative (e.g., estimated area of emergent vegetation, edge index). Due to the apparently small size of available riparian and littoral habitat at the pit lake, qualitative measurements will reflect a survey of the entirety of these habitats to the extent practicable. Quantitative measurements will be derived from on site inspection, during which the dimensions of a patch of vegetation can be estimated with a tape measure.

4.5.2 Data Evaluation

The combination of quantitative and qualitative measurements will allow calculation of HSIs for selected species in riparian and shoreline portions of the Yerington Pit Lake. These HSIs will then be weighted by the proportion of available riparian and shoreline habitats over the proportion of total habitat to provide aquatic wildlife HSIs for the entire pit lake.

For wildlife species of interest without HSI models, we will record the presence and quantity (percent) of important life factors in an evaluation matrix. These factors include food (e.g., appropriate forage plants or signs of prey), cover (e.g., vegetation or accessible buildings), and evidence of use (e.g., scat, tracks, remains). We will rate these parameters on a 5-point scale, with 0 representing absence of a resource and 5 representing presence of resources of high quality and quantity.

5 HEALTH AND SAFETY

A site-specific health and safety plan (SHSP) will be developed for the upland and aquatic sampling fieldwork at the site. The SHSP identifies, evaluates, and prescribes control measures for health and safety hazards and describes emergency response procedures and personnel training requirements for fieldwork at the Site. The SHSP will comply with both Federal Occupational Health and Safety Administration (OSHA) regulations (29 CFR 1910.120) and State of Nevada OSHA regulations (NRS Chapter 618). The SHSP will include the following sections:

- Introduction
- Chemical and hazard evaluation
- Physical hazard evaluation
- Over-water safety procedures
- Personal protective equipment (PPE) and safety equipment requirements
- Air monitoring
- Health and safety training and medical surveillance requirements
- Emergency planning
- Work zone definitions
- Decontamination procedures
- Task-specific safety procedures
- Vehicle safety, spill containment, and shipping instructions.

A copy of the SHSP must be in the custody of the field crew during all field activities. All individuals performing fieldwork must read, understand, and comply with the SHSP before undertaking field activities. Once the information in the SHSP has been read and understood, the individual must sign the Site Health and Safety Acknowledgment Form provided as part of this plan. The signed form will be maintained at the project site and will become part of the project file after completion of the work.

A brief description of some key elements of the SHSP is presented below. Additional details are presented in the SHSP.

5.1 TRAINING REQUIREMENTS

All consultants and contractors will receive site-specific safety training that will be covered at the pre-entry briefing. Records of pre-entry briefing will be maintained at the project site and

will become part of the project file after completion of the work. Site-specific training will include the following:

- Site background
- Persons responsible for site safety
- Site-specific health and safety hazards
- Use of PPE
- Work practices
- Engineering controls
- Major tasks
- Decontamination procedures
- Emergency response.

In addition to the site-specific training, personnel are required to have appropriate health and safety training that is outlined in the SHSP. Training requirements include, but are not limited to, OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) 40 hr training and annual 8 hr refresher courses, OSHA 8 hr supervisor training, first aid/CPR training, boat safety training, and enrollment in a medical surveillance program.

5.2 PERSONAL PROTECTIVE EQUIPMENT

The minimum PPE for the field activities described in this work plan includes the following:

- Safety glasses
- Steel-toed boots
- Nitrile or leather gloves
- Traffic safety vest.

Additional PPE may be required depending on the task including, but not limited to, hard hats, personal floatation devices, hearing protection, fall protection, respirators, and chemical protective suits. The need for additional PPE will be evaluated in the SHSP by Integral's corporate health and safety officer (CHSO), project manager, and the site safety and health officer (SSHO). PPE requirements are provided in the SHSP.

5.3 PRELIMINARY HAZARD EVALUATION

A comprehensive hazard evaluation will be completed for all field tasks required by this work plan prior to initiating field work. The hazard evaluation will be reviewed by Integral's CHSO, project manager, and the SSHO. A preliminary hazard evaluation is presented in Table 5-1.

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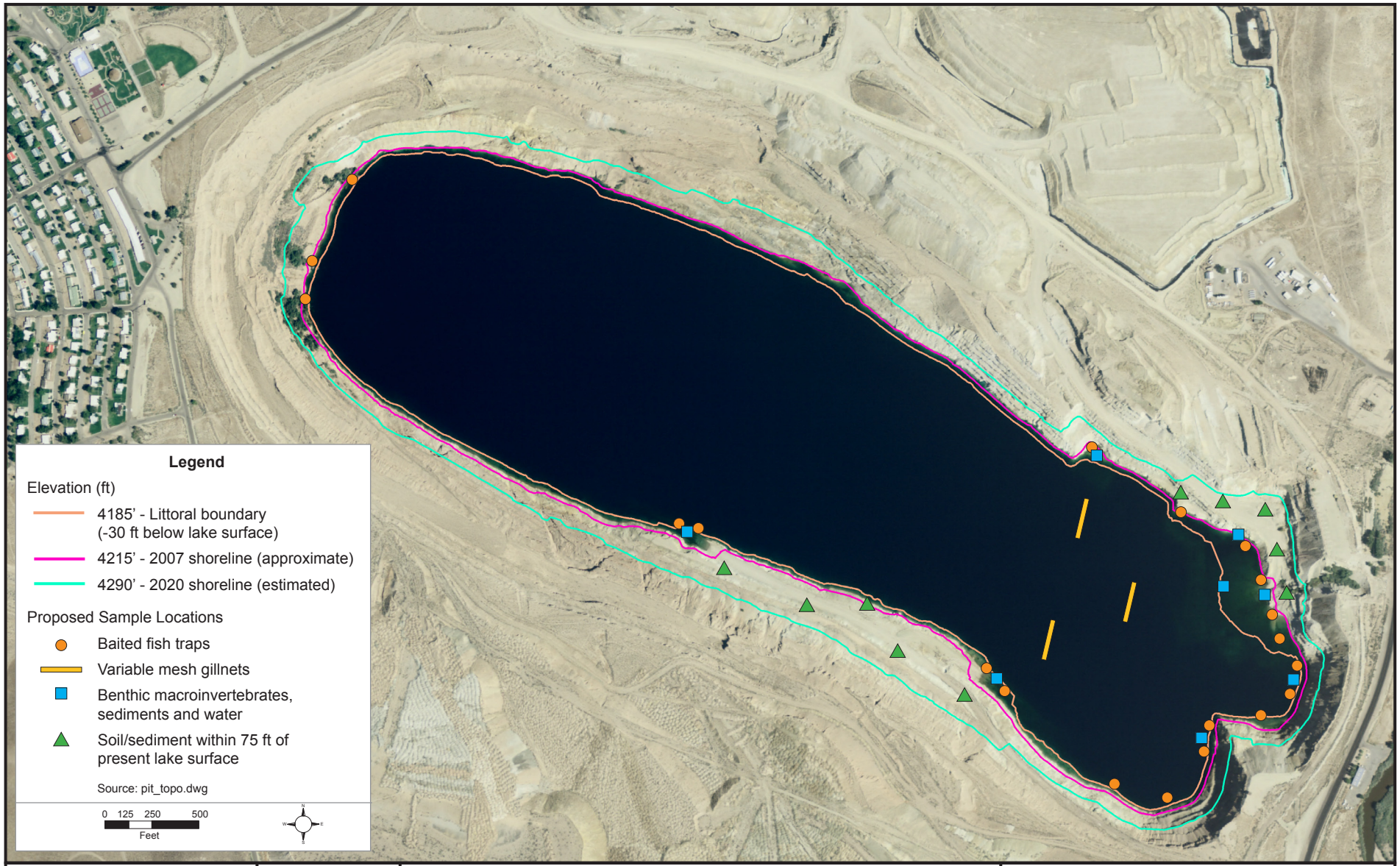
FIGURES



integral consulting inc.

BROWN AND CALDWELL

Date: November 2007

Atlantic Richfield Company

Project Number: 132034

Remedial Investigation Work Plan for Yerington Pit Lake (Operable Unit)

Figure 3-1

Proposed sampling locations for soils, sediments, water, aquatic macroinvertebrates and fish presence/ absence in the Yerington Pit Lake and basin.

TABLES

Table 2-1. Summary of Water Chemistry and Water Quality Values for the Yerington Pit Lake (September 1998)

Chemical	Units	N	Minimum	Maximum	Mean	SD	LCL	UCL	HQmax-cmc	HQmax-ccc
Ba	mg/L	3	0.032	0.034	0.033	0.001	0.030	0.036		
Cr	mg/L	3	0.010	0.018	0.012	0.005	0.000	0.024	0.01	0.1
Cu	mg/L	3	0.011	0.061	0.041	0.026	-0.025	0.107	1.7	2.8
Fe	mg/L	2	0.003	0.004	0.003	0.001	-0.004	0.011		
Mn	mg/L	2	0.021	0.034	0.028	0.009	-0.055	0.110		
Mo	mg/L	3	0.048	0.050	0.049	0.001	0.047	0.051		
Ni	mg/L	3	0.008	0.012	0.010	0.002	0.006	0.015	0.01	0.1
Sb	mg/L	3	0.007	0.008	0.008	0.000	0.007	0.008		
Se	mg/L	3	0.120	0.120	0.120	0.000	0.120	0.120	6.0	24.0
Sr	mg/L	3	0.400	0.400	0.400	0.000	0.400	0.400		
V	mg/L	3	0.005	0.007	0.006	0.001	0.002	0.009		

Source: Hershey (2007)

All sample results are for filtered samples and are expressed as the dissolved constituent

HQmax-cmc = Maximum concentration divided by the acute (CMC) water quality criterion

HQmax-ccc = Maximum concentration divided by the chronic (CCC) water quality criterion

Table 2-2. Summary of Water Chemistry and Water Quality Values for the Yerington Pit Lake (1998-1999)

Chemical	Units	N	Minimum	Maximum	Average	SD	LCL	UCL	HQcmc	HQccc
Ba	mg/L	30	0.027	0.047	0.035	0.007	0.033	0.038		
Ca	mg/L	30	69	88	81.1	5.2	79.2	83.0		
Cl	mg/L	30	29	39	34.6	3.1	33.4	35.8		
Cu	mg/L	17	0.011	0.064	0.048	0.012	0.042	0.054	1.8	3.0
F	mg/L	30	0.7	1.5	1.0	0.2	0.9	1.1		
Fe	mg/L	3	0.014	0.049	0.030	0.018	-0.013	0.074		
Hg	mg/L	6	0.001	0.002	0.001	0.000	0.001	0.002	1.4	2.6
K	mg/L	30	4	6	4.8	0.5	4.6	5.0		
Li	mg/L	30	0.018	0.043	0.027	0.007	0.024	0.030		
Mg	mg/L	30	14	18	14.9	1.3	14.4	15.3		
Mn	mg/L	14	0.010	0.022	0.018	0.004	0.015	0.020		
Na	mg/L	30	61	83	72.8	6.3	70.4	75.2		
Sb	mg/L	20	0.006	0.008	0.008	0.001	0.007	0.008		
Se	mg/L	20	0.089	0.103	0.094	0.003	0.093	0.096	5.2	20.6
Sr	mg/L	30	0.57	0.99	0.8	0.1	0.8	0.9		
Tl	mg/L	0	0	0						
pH		29	6.2	8.6	7.8	0.5	7.6	8.0		

Source: Jewell (1999)

All sample results are for filtered samples and are expressed as the dissolved constituent.

HQmax-cmc = Maximum concentration divided by the acute (CMC) water quality criterion.

HQmax-ccc = Maximum concentration divided by the chronic (CCC) water quality criterion.

Table 2-3. Screening Level Values for Wildlife Drinking Water and Freshwater Aquatic Life

			Avian SLVs			Mammalian SLVs			Aquatic Life Criteria		
Symbol	Chemical	Units	NOAEL[a]	LOAEL	Notes	NOAEL	LOAEL	Notes	CMC	CCC	Notes
Al	Aluminum	mg/L	471	--	b	4	45	e	--	--	
Sb	Antimony	mg/L	--	--		0.29	2.90	e	--	--	
As	Arsenic	mg/L	22	55	b	0.29	2.92	e	--	--	
Ba	Barium	mg/L	--	--		23	--	e	--	--	
Be	Beryllium	mg/L	3.77	--	c	3	--	e	--	--	
Bi	Bismuth	mg/L	--	--		--	--		--	--	
B	Boron	mg/L	124	430	b	120	401	e	--	--	
Cd	Cadmium	mg/L	6.23	86	b	4.13	41	e	0.005	0.0005	g
Ca	Calcium	mg/L	--	--		--	--		--	--	
Cl	Chloride	mg/L	--	--		--	--		--	--	
Cr	Chromium, Total	mg/L	4.30	21	b,d	11,725	--	e	1.317	0.171	b,g,i
Co	Cobalt	mg/L	--	--		--	--		--	--	
Cu	Copper	mg/L	202	265	b	65	86	e	0.035	0.021	g
F	Fluoride	mg/L	34	138	b	175	294	e	--	--	
Ga	Gallium	mg/L	--	--		--	--		--	--	
Fe	Iron	mg/L	--	--		--	--		--	--	
Pb	Lead	mg/L	4.86	49	b	34	343	e	0.193	0.0075	g
Li	Lithium	mg/L	--	--		--	--		--	--	
Mg	Magnesium	mg/L	--	--		--	--		--	--	
Mn	Manganese	mg/L	4,284	--	b	377	1,217	e	--	--	
Hg	Mercury	mg/L	1.93	3.87	b	--	--		0.001	0.001	
Mo	Molybdenum	mg/L	15	152	b	0.60	6.03	e	--	--	
Ni	Nickel	mg/L	333	460	b	171	343	e	1.112	0.124	g
K	Potassium	mg/L	--	--		--	--		--	--	
Sc	Scandium	mg/L	--	--		--	--		--	--	
Se	Selenium	mg/L	2.15	4.30	b	0.86	1.41	e	0.020	0.005	h
Si	Silicon	mg/L	--	--		--	--		--	--	
Ag	Silver	mg/L	--	--		--	--		0.019	--	g
Na	Sodium	mg/L	--	--		--	--		--	--	

Table 2-3. Screening Level Values for Wildlife Drinking Water and Freshwater Aquatic Life

			Avian SLVs			Mammalian SLVs			Aquatic Life Criteria		
Symbol	Chemical	Units	NOAEL[a]	LOAEL	Notes	NOAEL	LOAEL	Notes	CMC	CCC	Notes
Sr	Strontium	mg/L	1,127	--	e	--	--		--	--	
Th	Thallium	mg/L	0.03	0.32	e	0.03	0.32	e	--	--	
Sn	Tin	mg/L	29	73	b	54	81	e	--	--	
Ti	Titanium	mg/L	--	--		--	--		--	--	
U	Uranium	mg/L	69	--		7.00	14	e	--	--	
V	Vanadium	mg/L	49	--	b	0.84	8.35	e	--	--	
Zn	Zinc	mg/L	62	563	b	685	1,371	e	0.279	0.281	g

a No-observed-adverse-effect level (NOAEL) and lowest-observed-adverse effect level (LOAEL).
b The most sensitive avian receptor is the Rough-wing Swallow unless otherwise noted.
c River otter. No data were available for birds
d Based on Cr+3
e White-tail deer.
f Depleted metallic uranium.
g The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 278 mg/L and is calculated according to the procedures provided in by EPA (2006).
h EPA's (2006) recommended water quality criterion for selenium is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor (0.996- CMC or 0.922- CCC) that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.
i AWQC expressed for Cr III.
Source: Avian values (Sample et al. 1996); Aquatic Life Criteria (EPA 2006).

Reference:
Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife:1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 43 pp. + appendices.
US EPA. 2006c. National Recommended Water Quality Criteria. U.S. Environmental Protection Agency, Office of Water, Washington DC. 25 pp.

Table 4-1. Sampling Methods Specific to Each Habitat Type at the Yerington Pit Lake

Zone	Habitat	Vegetation	Sampling Type	Frequency
Littoral	Sediment	Present	Wilding Sampler	Spring, late summer
		Absent	Wilding Sampler or grab	Spring, late summer
	Water Column	Present	D-frame net	Spring, late summer
		Absent	Floating Emergence trap	Bi-weekly spring-fall
Limnetic	Sediment	Absent	Ekman or other grab	Spring, late summer
	Water Column	Absent	Floating Emergence trap, Aquatic Light trap	Bi-weekly spring through fall

Table 4-2. EPA Recommended Sampling Devices for Major Substrate Types beyond the Macrophyte Zone

Substrate	Sampling Device
Rocks, gravel	Diver operated[a] dome sampler
Sand	Peterson, Van Veen grabs
Mud	Ponar, Ekman grabs
Clay	Peterson, Van Veen grabs

[a]Deployment of diver operated devices is not recommended for the SLERA because the additional health-and-safety burden and costs are not proportional to the goals of a SLERA and are more appropriate to the level of detail and effort required in a BERA if warranted.

Table 5-1. Preliminary Hazard Evaluation Summary

Field Activities	Potential Hazards
Terrestrial vegetation sampling and reconnaissance	Falling hazard when working near the top of a pit wall
	Pit highwall hazards (including rock fall, wall failure, unprotected fall hazards)
	Slips, trips, and falls
	Plant/animal hazards (e.g., spiders, ticks, snakes)
	Adverse weather conditions (may create slippery conditions, etc.)
Soil sampling	Falling hazard when working near the top of a pit wall
	Pit highwall hazards
	Slips, trips, and falls, and heavy lifting (e.g., sample coolers with soil jars)
	Plant/animal hazards (e.g., spiders, ticks, snakes)
	Adverse weather conditions (may create slippery conditions, etc.)
Pit Lake surface water sampling	Exposure to sample bottle preservatives (acids)
	Drowning, heat and/or cold stress (hypothermia if clothes get wet), adverse weather conditions may cause high waves
	Slips, trips, falls, and heavy lifting (e.g., sample coolers and equipment) on the boat
	Pit highwall hazards (if working near shore)
Pit Lake sediment sampling	Falling objects (e.g., sediment samplers on a tripod)
	Drowning, heat and/or cold stress, adverse weather conditions
	Slips, trips, falls, and heavy lifting (e.g., sample coolers and equipment) on the boat
	Pit highwall hazards (if working near shore)
Pit Lake macroinvertebrate and fish sampling	Personnel getting tangled in gill netting material or other sampling devices
	Drowning, heat and/or cold stress, adverse weather conditions
	Slips, trips, falls, and heavy lifting (e.g., sample coolers and equipment) on the boat
	Pit highwall hazards (if near shore)