

Casmalia Site Remediation

Sampling and Analysis Plan

Prepared for:

USEPA, Region 9
75 Hawthorne Street
San Francisco, CA 94105

Prepared by:

Casmalia Resources Site Steering Committee



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TABLE OF CONTENTS

1.0	Introduction	1-1
1.1	Objectives of the Study	1-1
1.2	Overview of Approach	1-3
1.2.1	Terrestrial Study Areas and Sampling	1-3
1.2.2	Aquatic Study Area and Sampling	1-4
1.2.3	Data Quality Objectives and COIs	1-4
1.3	Organization of the Sampling and Analysis Plan	1-5
2.0	Terrestrial Sampling	2-1
2.1	Overview and Sampling Locations	2-1
2.2	Plant Sampling Methods	2-1
2.3	Soil Invertebrate Sampling Methods	2-2
2.4	Small Mammal Sampling Methods	2-3
3.0	Aquatic Sampling	3-1
4.0	Handling and Analysis of Samples	4-1
4.1	Sample Analysis	4-1
4.1.1	Equipment Rinsate Blanks	4-1
4.1.2	Analytical Methods	4-1
4.1.3	Sample Containers and Preservatives	4-3
4.1.4	Sample Labeling, Packaging, and Shipment	4-3
4.1.5	Sample Documentation	4-3
4.1.6	Chain-of-Custody Records	4-4
4.2	Decontamination Procedures	4-4
4.3	Investigation-Derived Waste Management	4-4
4.4	Surveying and Photographs	4-5
4.5	Quality Assurance and Quality Control Measures	4-5
5.0	Schedule and Reporting	5-1
5.1	Field Supervision and Coordination with USEPA	5-1
6.0	References	6-1

LIST OF TABLES

<u>Table #</u>	<u>Description</u>
1	Data Quality Objectives for the Collection of Tissue Samples
2	Remedial Investigation Soil Chemical of Interest Concentrations
3	Method Reference, Sample Preservation, and Holding Time Requirements
4	Requested Analytical Parameters, Methods, and Detection Limits for Soil/Sediment and Biota Samples
5	Sample Analysis Matrix

LIST OF FIGURES

<u>Figure #</u>	<u>Description</u>
1	Site Location Map
2	Site Sampling Locations
3	Background Sampling Locations
4	Small Mammal Trapping and Terrestrial Invertebrate Sampling Area

LIST OF APPENDICES

APPENDIX A	Plant Tissue Sampling Standard Operating Procedure
APPENDIX B	Soil Invertebrate Tissue Sampling Standard Operating Procedure
APPENDIX C	Small Mammal Tissue Sampling Standard Operating Procedure
APPENDIX D	Composite Soil, Sediment, and Tissue Sampling Standard Operating Procedure
APPENDIX E	Aquatic Invertebrate Tissue Sampling Standard Operating Procedure
APPENDIX F	Field Sample Handling, Packaging, and Shipping Standard Operating Procedure
APPENDIX G	Field Sampling Equipment Decontamination Standard Operating Procedure

LIST OF ACRONYMS AND ABBREVIATIONS

ARCADIS	ARCADIS U.S., Inc.
ASTM	American Society for Testing and Materials
bgs	below ground surface
BSAF	biota-sediment bioaccumulation factor
COI	chemical of interest
CPEC	chemical of potential ecological concern
CSC	Casmalia Steering Committee
DDE	dichlorodiphenyldichloroethane
DDT	dichlorodiphenyltrichloroethane
DQO	data quality objective
ERA	ecological risk assessment
IDW	investigation-derived waste
PCB	polychlorinated biphenyl
PPE	personal protective equipment
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
Site	former Casmalia Hazardous Waste Facility
SOP	standard operating procedure
TEQ	toxicity equivalent
TOC	total organic carbon
TRV	toxicity reference value
USEPA	U.S. Environmental Protection Agency
WHO	World Health Organization

1.0 Introduction

This Final Sampling and Analysis Plan (SAP) was prepared by ARCADIS US, Inc. (ARCADIS), on behalf of the Casmalia Steering Committee (CSC) and documents the CSC's proposed plans for identifying and collecting additional data required to evaluate potential ecological risks at the former Casmalia Hazardous Waste Facility (Site) located in Casmalia, California (Figure 1).

As a follow up to our submittal of the Draft Remedial Investigation (RI) Report in April 2008 (CSC, 2008a), the CSC submitted a memorandum to the U.S. Environmental Protection Agency (USEPA) entitled *Next Steps for Ecological Risk Assessment* (Next Steps Memo [ARCADIS, 2008a]) for the Site on July 16, 2008. The CSC received comments on the Next Steps Memo from USEPA in a letter dated August 15, 2008. USEPA sent comments on the Draft RI Report to the CSC in a letter dated October 15, 2008. The CSC is currently in the process of responding to those comments. In a meeting with the CSC on October 21, 2008, USEPA discussed their comments on the next phase of the ecological risk assessment (ERA) with the CSC and discussed how to address any existing data gaps.

These discussions and subsequent communications (summarized in an email from Russell Mechem dated November 10, 2008) provide a framework for the scope of additional work required to complete the ERA. These next steps were initially outlined in a revised memorandum (revised Next Steps Memo [ARCADIS, 2008b]) dated November 26, 2008. Technical comments on the revised Next Steps Memo were received from USEPA on December 23, 2008. A Draft SAP incorporating the last set of comments received from USEPA on the revised Next Steps Memo and describing the approach and methodologies for collecting soil, sediment, plant, soil invertebrate, and small mammal samples from the Site and from a background location was submitted to USEPA on February 2, 2009. The CSC received comments on the Draft SAP from USEPA in a letter dated March 5, 2009. The CSC and USEPA discussed these comments and a path forward to finalizing the SAP on a teleconference call on March 13, 2009. This Final SAP incorporates comments received from USEPA last set of written comments (from March 5, 2009) and agreements made on the call on March 13, 2009.

Note that some of the comments on the revised Next Steps Memo in the USEPA memorandum dated December 23, 2008 are not addressed herein as they pertain to methodologies and approaches to be used in the next phase of the ERA. This SAP is specifically focused on field sampling methodologies and approach.

1.1 Objectives of the Study

As discussed in the Draft RI Report (CSC, 2008a), a Tier 2 assessment was proposed to further evaluate exposure pathways, ecological receptors, and chemicals of potential ecological concern (CPECs) for some of the unacceptable risks to ecological receptors at the Site. This further evaluation will include additional studies and evaluations designed to make the assessment more site-specific and less generic. Based on the CPECs that drive risk at the Site (identified as chemicals of interest [COIs]), site-specific tissue collection, especially from the areas where remedial activities are yet to be determined, would provide valuable information in refining risks. The ERA presented in the Draft RI Report used modeled/assumed bioaccumulation factors for uptake of chemicals into prey items, and such assumptions and

models are more uncertain in predicting site-specific bioaccumulation given differences in chemical form, exposure duration, and other site-specific factors. Measurement of tissue concentrations in organisms at this Site addresses these factors and reduces the uncertainty in the resulting risk estimates. Therefore, the primary objectives of this SAP are to:

- Design a sampling approach to address additional data needs based on previous investigations that will aid in refining risks to ecological receptors;
- Validate and refine exposure models by analyzing for COI concentrations in prey items most likely to be ingested by wildlife receptors;
- Develop relationships between soil/sediment and tissue concentrations for COIs;
- Soil and sediment data collected in accordance with the methods used for the RI will be incorporated in the soil and sediment dataset for the site (e.g., there are uncertainties associated with using composite soil data in the site dataset) and to further address site characterization, if warranted;
- Exclusion of CPECs or study areas for investigation in this SAP does not mean that they will not warrant further evaluation in the ERA.

The ERA presented in the Draft RI Report (CSC, 2008a) predicted that invertivorous birds and mammals were the most sensitive terrestrial species, and their risks were driven by exposure to chemicals in surface soil (0 to 0.5 foot below ground surface [bgs]). There were also some risks that were driven by herbivorous birds, carnivorous birds, and carnivorous mammals; however these risks, as represented by hazard quotients (HQs), were generally low in magnitude. The aquatic invertivorous bird (based on the killdeer) was generally predicted to be the most sensitive aquatic bird, exposed to chemicals in surface sediment. The risks to aquatic birds are similar with those for terrestrial birds when the ERA was conducted assuming the ponds would be drained. The pathway that generally contributed most to the risk estimate was food ingestion. Therefore, this SAP focuses on the collection of food/prey items from the Site. The ERA completed by the CSC (2008) also evaluated risks to plants and soil invertebrates for select chemicals at the Site. Some of the data proposed for collection may be useful in understanding exposure and/or risk in these receptors.

The CSC acknowledges that results of the ERA are in the draft stage and may change as USEPA comments on the Draft RI are incorporated. If changes to the ERA result in changes to the conclusions, further investigation may need to be conducted at that time, if warranted. However, based on the current results of the ERA and as shown in the bubble plots (CSC, 2008a)¹, additional sample collection is warranted for three study areas on Site:

Terrestrial Study Areas:

- Resource Conservation and Recovery Act (RCRA) Canyon/West Canyon Spray Area; and
- Former Ponds and Pad/Remaining On-Site Areas.

Aquatic Study Area:

- A-Series Ponds.

¹ The bubble plots utilized site-specific ecological screening levels that were developed by back-calculating from the ERA results.

The approach that will be used to collect biotic and abiotic samples from these study areas of the Site and a background location are introduced in the following section and described in detail in Sections 2.0 and 3.0.

1.2 Overview of Approach

Where appropriate, sample locations were selected based on a range of concentrations for the COIs identified in each terrestrial study area during the RI. Sample locations for the aquatic study area will be selected in the field and biased toward suitable foraging habitat for representative ecological receptors of concern such as dabbling ducks and shorebirds. As described in the revised Next Steps Memo (ARCADIS, 2008b), the following chemicals are considered COIs for the terrestrial and aquatic study areas:

1.2.1 Terrestrial Study Areas and Sampling

- RCRA Canyon/West Canyon Spray Area
 - Barium;
 - Cadmium;
 - Chromium;
 - Copper;
 - Lead; and
 - Zinc.

- Former Ponds and Pads/Remaining On-Site Areas
 - Total polychlorinated biphenyls (PCBs);
 - Dichlorodiphenyldichloroethane (DDE); and
 - Total dichlorodiphenyltrichloroethane (DDT).

A minimum of five composite soil and five composites² of each type of food/prey samples will be collected from the RCRA Canyon/West Canyon Spray Area (Figure 2). At each location, a specific number of subsamples will be composited and analyzed as one single sample representing that specific location (i.e., in this study area, there will be five unique data points for soil and five unique data points for each type of food/prey sample). The food/prey items from this study area include:

- Plants;
- Soil invertebrates; and
- Small mammals.

A minimum of seven soil composite and seven composites² of each type food/prey samples will also be collected from the Former Ponds and Pads/Remaining On-Site Areas (Figure 2). At each location, a specific number of subsamples will be composited and analyzed as one single sample representing that specific location (i.e., in this study area, there will be seven unique data points for soil and seven unique data points for each type of food/prey sample).. Although metals were not considered as COIs at the Former Ponds and Pads/Remaining On-Site Areas,

² Note that plant samples will consist of tissues from a single plant, where feasible.

if feasible (i.e., sufficient mass can be obtained), then metals will be analyzed from this study area. The food/prey items from this study area include:

- Plants; and
- Soil invertebrates.

The specific approaches that will be used to collect terrestrial samples from these two study areas are discussed further in Section 2.0. Plant, soil invertebrate, and small mammals samples will be collected using the methods outlined in Appendices A, B, and C, respectively. Soil samples will be collected using existing standard operating procedures (SOPs) developed for the RI and presented in Appendix A of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (CSC, 2004). Where appropriate, soil and tissue samples will be composited following the methods outlined in Appendix D. Additionally, five soil and five types of food/prey samples (i.e., plant, soil invertebrate, and small mammal) will be collected from the background location to assess incremental risk associated with exposure to COIs at the Site (Figure 3).

1.2.2 Aquatic Study Area and Sampling

- A-Series Pond
 - Selenium.

A minimum of five sediment and five food/prey samples will be collected from A-Series Pond (Figure 2), assuming such samples can be obtained. Please note that in the event the food/prey samples cannot be collected the CSC will not collect the sediment samples. The food/prey item from this study area includes:

- Aquatic invertebrate samples.

The specific approaches that will be used to collect aquatic samples from the A-Series Pond are discussed further in Section 2.0. Aquatic invertebrates will be collected using the methods outlined in Appendix E. Sediment samples will be collected according to existing SOPs developed for the RI and provided in Appendix A of the RI/FS Work Plan (CSC, 2004). The area immediately surrounding the Site is arid and the availability of suitable water bodies that are not related to agricultural activities are not readily available. Therefore, background sediment and aquatic invertebrate samples will not be collected.

1.2.3 Data Quality Objectives and COIs

Table 1 provides the data quality objectives (DQOs) supporting this SAP. The information generated regarding the potential for bioavailability will prove useful in supporting the remedial decisions to protect ecological receptors. The food/prey items that will be used to evaluate tissue residue concentrations will include plants, soil invertebrates, small mammals, and aquatic invertebrates.

In addition to the COIs described above, the revised Next Steps Memo (ARCADIS, 2008b) identified other risk drivers, including:

- Di-n-butyl phthalate in the RCRA Canyon Area

- Dioxin toxicity equivalent (TEQ) and Total TEQ (i.e., sum of PCB TEQ and dioxin TEQ) in the West Canyon Spray Area.

The CSC has re-evaluated these chemicals for the purpose of this SAP and, based on best professional judgment, we are no longer considering these as COIs. Di-n-butyl phthalate was not considered a COI in the RCRA Canyon Area because risk to terrestrial birds was based on the maximum concentration and, therefore, may not be reflective of actual risks. Additionally, di-n-butylphthalate was only detected in 2 out of 40 samples in the 0-2 ft interval in RCRA Canyon, so an adequate range of concentrations is not available to develop chemical-to-tissue relationships either as a regression or bioaccumulation factor. However, CSC acknowledges that the two detected samples in the 0-2 ft bgs depth interval were in close proximity and additional di-n-butylphthalate detects were found in deeper samples and therefore, could require further evaluation or potential hotspot analysis. Dioxin and Total TEQ risks to terrestrial mammals are not evaluated further because risks were based on maximum concentrations, which again may not be reflective of actual risks. Additionally, the Total TEQ concentrations (e.g. maximum detected concentration for total TEQ for mammals is 6.06 picogram per gram [pg/g]) are less than the background upper tolerance limit (UTL; based only on background data) of 13 pg/g for mammals and the ecological site-specific surface soil screening level (8.2 pg/g as shown in the bubble plots) in the West Canyon Spray Area.

USEPA has previously recommended that specific organ tissue samples be collected from small mammals to assess individual- and population-level risk to ecological receptors. A subsequent technical memorandum will be provided that describes the approach and results for developing organ-specific toxicity values.

1.3 Organization of the Sampling and Analysis Plan

The remainder of this SAP is organized as follows:

Section 2.0, Terrestrial Sampling – This section provides information on the proposed terrestrial sampling methodologies.

Section 3.0, Aquatic Sampling – This section provides information on the proposed aquatic sampling methodologies.

Section 4.0, Handling and Analysis of Samples – This section provides a summary of specific sampling handling and analytical procedures.

Section 5.0, Schedule and Reporting – This section provides a proposed/approximated schedule for implementation of field activities.

Section 6.0, References – This section lists the sources of information used to prepare this SAP.

Appendices A through G. – These appendices contain SOPs associated with plant, soil invertebrate, small mammal, and aquatic invertebrate tissue sampling using the methods proposed in Sections 2.0 and 3.0 of this SAP, as well as SOPs for sample handling, packing, and shipping and sampling equipment decontamination.

2.0 Terrestrial Sampling

2.1 Overview and Sampling Locations

As described previously, metals are COIs in the RCRA Canyon/West Canyon Spray Area and PCBs and organochlorine pesticides (DDE and Total DDT) are COIs in the Former Pond and Pads/Remaining On-Site Area (although metals are not considered COIs in the Former Pond and Pads/Remaining On-Site Area, samples collected from this area may be analyzed for metals if feasible). Proposed tissue sample locations were selected to target a range of concentrations in these study areas so that chemical-to-tissue relationships, either as regressions or as site-specific bioaccumulation factors, could be developed. Five locations were selected from the RCRA Canyon/West Canyon Spray Area for tissue sampling and seven locations were selected from the Former Ponds and Pads/Remaining On-Site Area that encompass existing COI concentrations over several orders of magnitude (Table 2). The seven selected locations from the Former Ponds and Pads/Remaining On-Site Area were selected because they are representative of concentrations both inside and outside of preliminary “hot spots” identified in the ERA (CSC, 2008a) and the Next Steps Memo (ARCADIS, 2008b).

Five background tissue sample locations were selected from existing background sample locations that were used in the RI (Figure 3). The background area was previously approved by USEPA for use in the RI and ERA. These locations were chosen because they provide good spatial coverage of the background area and provide a basis to assess incremental risk associated with exposure to COIs at the Site. Background tissue samples provide a basis for evaluating ambient risk that may exist from metals accumulated in tissue from background areas and provides a method to assess incremental risk for use in making risk management decisions. In addition, wildlife can actively regulate inorganics (e.g. essential nutrients) uptake which may not be related to concentrations in soil (especially if soil concentrations are low; uptake may increase if exposure is low). If high concentrations are observed in tissue when soil concentrations are low (such as in background), then it would provide information that uptake may not be due to contamination but maybe due to other physiological reasons. Additionally, the CSC will perform statistical tests to evaluate if background data population is different from Site data population. If the data populations are different, then they will be used separately to estimate uptake relations, but if the two populations are the same, they will be combined as used as one population to determine uptake.

The specific methods for collecting each tissue type are provided below.

2.2 Plant Sampling Methods

Five plant sample locations are proposed for the RCRA Canyon West/Canyon Spray Area, seven plant sample locations are proposed for the Former Ponds and Pads/Remaining On-Site Area (Figure 2), and five plant sample locations are proposed for the background area (Figure 3). A minimum of 15 to 55 grams of composite tissue (wet weight; dependent on analyte suite [Table 3]) will be collected at each sample location and material from a single plant (where feasible) will be collected to provide a representative sample of food concentrations in that specific sampling location. Plant tissue sampling will target leaves as seeds often do not provide sufficient mass for laboratory analysis,. The lowest field-identifiable taxon of tissue included in

the sample will be recorded. One replicate plant tissue sample will be collected from each study area. Plant sampling will be focused on those plants that are most likely to be ingested by small mammals and birds. The following hierarchy of plants will be used to collect tissue from the sample locations.

- Saltbush (*Atriplex sp.*)
- Coyote bush (*Baccharis pilularis*)
- Annual grasses (Family Poacea)

To the extent feasible, the same taxon of plant tissue will be collected at each location within a study area. The taxon selected for collection will be evaluated in the field based on the above hierarchy and depending on which taxon is present at all the proposed sample locations. Plants targeted for collection are based on species identified in the Final Biological Species and Habitat Survey (CSC, 2008b) as being present on-Site.

Each plant sampling location will be located within an approximately 10-foot radius area around each central soil sample location (i.e., existing RI sample location). Plant sampling will follow the methods described in Appendix A. A co-located surface soil (0 to 0.5 foot bgs) sample will be collected along with each plant tissue sample collected at the base of the plant. From each tissue sampling location, the tissue analytical value and the soil analytical value will be paired to develop regression equations to model bioaccumulation from soil-to-plant tissue. DQOs for plant tissue sampling are presented in Table 1.

2.3 Soil Invertebrate Sampling Methods

Five soil invertebrate sample locations are proposed for the RCRA Canyon West/Canyon Spray Area, seven soil invertebrate sample locations are proposed for the Former Ponds and Pads/Remaining On-Site Area (Figure 2), and five soil invertebrate sample locations are proposed for the background area (Figure 3). A minimum of 15 to 55 grams of composite tissue (wet weight; dependent on analyte suite [Table 3]) will be collected at each sample location and material from a single sample location will be composited to provide a representative sample of prey concentrations in that specific sampling location. Those organisms that are most directly associated with the soil such as grubs (coleopteran larvae) and earthworms will be targeted, as these organisms are expected to have the highest potential body burdens. However, the sampling will be “opportunistic” in that all soil invertebrates captured will be retained. The following hierarchy will be used to form composite tissue samples.

- Annelida (earthworms)
- Gastropoda (slugs and snails)
- Coleoptera (beetles)
- Orhoptera (grasshoppers and crickets)
- Composite invertebrate tissue sample of all other opportunistically collected invertebrates.

Tissue samples will be separated by organism type identified above, and the final samples submitted to the laboratory will preferentially consist of a single taxon of soil-associated invertebrates where sufficient sample mass can be achieved. Samples may consist of multiple organism types if sufficient sample mass for the preferred tissue types cannot be achieved. The

lowest field identifiable taxon of tissue and number and mass composing these taxa included in the sample will be recorded. If sufficient mass is available, one replicate sample will be collected from each study area.

Each soil invertebrate sampling location will encompass an area with an approximately 30-foot radius around each central soil sample location (i.e., existing RI sample location). Soil invertebrate samples will be collected by manual searches and/or cover boards following the methods described in B within the sampling area. Tissue collection will initially be conducted by digging soil pits and manually searching/handpicking. Pit trap and cover board methods will be used to collect additional mass, as necessary if manual searches do not provide sufficient mass.

In each soil invertebrate sampling area (representing a single location), field personnel will collect a total of nine soil sub-samples; one surface soil (0 to 0.5 foot bgs) sub-sample at the central soil sample location (based on the initially selected RI soil sample location) and two surface soil (0 to 0.5 foot bgs) sub-samples per quarter of the sampling area. These nine sub-samples will then be composited to represent one single location as outlined in Appendix D. Figure 4 depicts the invertebrate (and mammal – see below) tissue sampling area in relation to the central soil sample location.

Soil invertebrate tissue collected within each tissue sampling area will be composited for a single sample for laboratory analysis as outlined in Appendix D. Soil samples collected in the tissue sampling area will also be composited to obtain a single soil value to correspond to the composite soil invertebrate tissue sample. From each tissue sampling area, the composite tissue analytical value and the composite soil analytical value will be paired to develop regression equations to model bioaccumulation from soil-to-soil invertebrate tissue. DQOs for soil invertebrate tissue sampling are presented in Table 1.

2.4 Small Mammal Sampling Methods

Field personnel will collect small mammal tissue from five sample locations, preferentially targeting shrews (i.e., *Sorex spp.*), in the RCRA Canyon/West Canyon Spray Area (Figure 2) and small mammal tissue from five sample locations from the background area (Figure 3). If shrews are not present or not enough can be trapped (shrews are highly territorial with densities in the literature of just 1-2 per acre, which may limit the ability to collect enough tissue to complete all requested analyses of whole body and liver and kidney) in a practical timeframe, other small mammals such as mice and voles may be collected, with an emphasis on collecting invertivorous or at least omnivorous mammals. At each location, a specific number of individual subsamples (described below) will be composited and analyzed as one single sample representing that specific location. Composite samples will be composed of a single species of small mammal unless tissue mass limitations require compositing more than one species in a composite sample. A minimum 15 grams of composite tissue (wet weight; dependent on analyte suite [Table 3]) will be collected at each sample location. Depending on the type and size of mammals collected multiple mammals (up to 5) will need to be trapped at each location composited to provide enough tissue for analysis of organs (liver and kidneys) as well as the remainder of the tissues (to get whole body concentrations). The lowest field-identifiable taxon of tissue and the number of these taxa included in the sample will be recorded. If sufficient mass is available, one replicate sample will be collected from each study area.

Each small mammal tissue sampling location will encompass an area with an approximately 30-foot radius from each central soil sample location (i.e., existing RI sample location). Small mammal sampling will follow the methods described in Appendix C. A minimum of 20 live-capture small mammal traps will be set in each tissue sampling area, within a 30-foot radius of each central soil sample location to allow for the approximate shrew home range (i.e., approximately 0.25 acre) to encompass the central soil sample location. The number and type of traps may be modified in the field based on capture success (i.e., snap traps may be used if live traps do not result in trapping success). While pit fall traps may provide higher success rates for capture of shrews, this trapping methodology will not be used in this sampling event due to logistical constraints of installing numerous pit fall traps and it is not expected that shrews will provide sufficient mass for laboratory analysis. The soil samples collected for soil invertebrates (see Section 2.3 and Figure 4) will be used to develop uptake relationships for mammals; no additional co-located soil samples are necessary.

Small mammal tissue collected within each tissue sampling area will be shipped to the laboratory where they will dissect out the kidney and liver tissues. Specific tissue types (i.e., liver, kidney and carcass) will be composited from individuals collected at a single sample location and each tissue type will be analyzed separately in the laboratory. The weights of the three tissue types will be recorded separately so that a whole body tissue concentration can be calculated. Soil sub-samples collected in the tissue sampling area will be composited to obtain a single soil sample as outlined in Appendix D. From each tissue sampling area, the composite whole body tissue analytical value and the composite soil analytical values will be paired to help develop regression equations to model bioaccumulation from soil-to-small mammal tissue. Organ-specific data will be compared to organ-specific toxicity values. DQOs for small mammal tissue sampling are presented in Table 1.

3.0 Aquatic Sampling

As described previously, selenium is a COI in A-Series Pond. A minimum of five sample locations will be selected in the field based on available foraging habitat for dabbling ducks and shorebirds, two key receptor groups evaluated in the ERA (CSC, 2008a). Additionally, co-located sediment samples from the presumed biologically active layer (i.e., 0-0.5 feet below sediment surface) will be collected along with each aquatic invertebrate sample. Aquatic invertebrate tissue sampling will be accomplished primarily by using a D-ring net or kick net, as necessary, to sweep potential foraging habitat, including emergent and submergent vegetation as described in Appendix E. A D-ring net sweep will also be conducted across the water surface to collect water column aquatic invertebrates, if available. If D-ring and kick net collection methods do not result in sufficient mass for laboratory analysis, petite ponar and sieving methods will be used, as described in Appendix E. Sampling will be focused, to the degree possible, on organisms that are expected to be more closely associated with sediment as these organisms would potentially have the highest body burdens and would be the most appropriate to evaluate bioaccumulation into biota from sediment relationships. The lowest field-identifiable taxon of tissue included in the sample will be recorded. If sufficient mass is available, one replicate sample will be collected. Aquatic invertebrate samples will be composed of the following hierarchy of groupings, as necessitated by tissue mass limitations.

- Benthic and epi-benthic aquatic invertebrates
- Water column aquatic invertebrates
- Composite aquatic invertebrate tissue sample of all opportunistically collected aquatic invertebrates

The paired sediment and tissue data will be used to develop regression equations to model bioaccumulation from sediment-to-biota tissue. If enough mass is obtained, water column invertebrates will be analyzed separately and surface water monitoring data used to develop and water-to-biota relationship. DQOs for aquatic invertebrate tissue sampling are presented in Table 1.

As stated previously, a suitable background aquatic sampling area is not readily available in the vicinity of the site and, therefore, no aquatic background samples will be collected.

4.0 Handling and Analysis of Samples

4.1 Sample Analysis

Offsite analytical services for analyses will be provided by Pace Analytical Laboratories, a National Environmental Laboratory Accreditation Program accredited laboratory. All analyses will be conducted according to the USEPA methods listed in Section 4.1.2. Chilled soil and sediment and frozen tissue samples will be submitted to the laboratory for immediate analysis. All tissue samples will be homogenized prior to sampling. Small mammal samples will be irradiated prior to homogenization as a health and safety step to reduce the potential for exposure of laboratory staff to Hantavirus and organ tissues dissected out prior to analysis. Sample weights will also be recorded.

Field duplicates of tissue samples will not be collected; replicates will be collected (one per study area) where feasible. Equipment rinsate blanks will be collected and analyzed for all constituents for each analytical method described below in Section 4.1.2 when non-disposable equipment is utilized (i.e., for sediment samples). Matrix spike/matrix spike duplicates will be collected (for soil/sediment) and analyzed at a minimum frequency of 1 per 20 field samples.

4.1.1 Equipment Rinsate Blanks

Following the guidelines set forth in the Quality Assurance Project Plan (QAPP) provided in Appendix B of the RI/FS Work Plan (CSC, 2004) and the SOPs contained therein, equipment blanks will be collected to test for cross-contamination among batches. Equipment blanks will be collected following decontamination procedures (see Section 4.2) by carefully pouring distilled water over or through the recently cleaned equipment and collecting this directly into an appropriate sample container held over a bucket. At a minimum, one equipment blank will be collected per day. Equipment blanks will be analyzed using the same analytical methods used on the bulk sediment samples (Section 4.1.2).

4.1.2 Analytical Methods

The analytical methods for each matrix/tissue type are presented below. In the case of metals and organochlorine pesticides, only a subset of constituents in each analytical suite are considered COIs and will be evaluated as part of the risk evaluation. However, the entire analytical suite will be analyzed and results will be reported.

Based on the COIs identified at the Site, submitted soil samples will be analyzed for metals, 14 planar PCB congeners (World Health Organization [WHO] list), organochlorine pesticides, total organic carbon (TOC), and total solids by the following analytical methods (Table 4):

- Metals by SW846 6020³;
- WHO List of PCB Congeners by SW846 1668;

³ Selenium (Se) will be analyzed by Method 6020A. The previous method version did not list Se as a reportable analyte, but interference issues previously associated with this method have been eliminated and 6020A now lists Se.

- Organochlorine pesticides by SW846 8081;
- TOC by Walkley-Black method; and
- Total solids by ASTM D2216

Submitted sediment samples will be analyzed for metals, TOC, grain size, and total solids by the following analytical methods (Table 4):

- Metals by SW846 6020³;
- TOC by Walkley-Black method;
- Grain size by ASTM D4464/D422; and
- Total solids by ASTM D2216

Submitted plant tissue samples will be analyzed for metals, 14 planar PCB congeners (WHO list), organochlorine pesticides, and total solids by the following analytical methods (Table 4):

- Metals by SW846 6020³;
- WHO List of PCB Congeners by SW846 1668;
- Organochlorine pesticides by SW846 8081; and
- Total solids by ASTM D2974-87

Submitted soil invertebrate tissue samples will be analyzed for metals, 14 planar PCB congeners (WHO list), organochlorine pesticides, lipids and total solids by the following analytical methods parameters (Table 4):

- Metals by SW846 6020³;
- WHO List of PCB Congeners by SW846 1668;
- Organochlorine pesticides by SW846 8081; and
- Lipids by Pace Analytical SOP; and
- Total solids by ASTM D2974-87

Submitted small mammal tissue samples will be analyzed for metals, lipids, and total solids by the following analytical methods (Table 4):

- Metals by SW846 6020³;

- Lipids by Pace Analytical SOP; and
- Total solids by ASTM D2974-87

A summary of proposed sample counts per matrix and requested analyses is provided in Table 5.

4.1.3 Sample Containers and Preservatives

Soil and sediment samples will be transferred to clearly labeled wide-mouth jars. These will be provided by the laboratory immediately prior to the sampling event. The containers will be pre-cleaned and will not be rinsed prior to sample collection. Whole organism tissue samples will be transferred to zip-top bags for shipment to the laboratory (Table 3). Tissue samples will be frozen at the end of each field day until shipment to the laboratory. Soil and sediment samples will be maintained at 4° C at the end of the field day and during shipment.

4.1.4 Sample Labeling, Packaging, and Shipment

Sample labeling, packaging, and shipment will be conducted according to the guidelines in Appendix F.

To identify and manage samples obtained in the field, a sample label will be affixed to each sample container and secured with clear tape. To clearly associate a sample with a given sampling area and location, samples will be identified as follows: each sample name will start with the moniker RC, FPP, AS, or BK to indicate the sampling area from which the sample was collected (RC = RCRA Canyon/West Canyon Spray Area, FPP = Former Ponds, Pads/Remaining On-Site Areas, AS = A-Series Pond, or BK = background location). This moniker will be followed by a dash and a two-digit serial number corresponding to the location within the sampling area. This number will increase incrementally as more locations are sampled in the sampling area. The two-digit serial number will be followed by the moniker SO, SD, PL, SI, or SM indicating the soil matrix is either a soil (SO), sediment (SD), plant (PL), soil invertebrate (SI), or small mammal (SM). For example a small mammal sample collected from second tissue sample location in the RCRA Canyon/West Canyon Spray Area sampling area would be identified as RC-02SM.

Following collection and labeling, samples will be immediately placed in a sample cooler with ice for temporary storage. A temperature blank will be included in each cooler sent to the analytical laboratory so that a representative measurement of the temperature of the enclosed samples can be obtained by the laboratory without disturbing the actual samples. Samples will be shipped to the analytical laboratory within a day of sampling via overnight courier.

4.1.5 Sample Documentation

Field notes will document where, when, how, and from whom any vital project information was obtained. Entries will be complete and accurate enough to permit reconstruction of field activities. Each page of the field notes will be dated and signed by the individual making the entries, and the time of each entry will be noted in military time. All entries will be legible and written in indelible ink. Language will be factual, objective, and free of personal opinions or other terminology that might prove inappropriate. If an error is made, corrections will be made by

crossing a line through the error and entering the correct information. Corrections will be initialed. No entries will be obliterated or rendered unreadable.

4.1.6 Chain-of-Custody Records

Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory for quality assurance purposes. Chain-of-custody forms will be completed and maintained in accordance with Appendix F.

A self-adhesive custody seal will be placed across the lid of each sample container. The shipping containers in which samples are stored (usually sturdy picnic cooler or ice chest) will also be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

4.2 Decontamination Procedures

To reduce the likelihood of cross-contamination, all equipment that comes into contact with potentially contaminated soil, sediment, or water will be decontaminated according to Appendix G. Disposable equipment intended for one-time use will not be decontaminated, but will be packaged for appropriate disposal. As described in the QAPP (CSC, 2004 – Appendix B), decontamination will occur prior to and after each use of a piece of equipment. All sampling devices used will either be single-use and pre-cleaned or be decontaminated using the following procedures:

- Non-phosphate detergent and tap water wash using a brush if necessary;
- Tap water rinse; and
- Final deionized/distilled water rinse.

4.3 Investigation-Derived Waste Management

In the process of collecting environmental samples during the proposed field sampling program, different types of potentially contaminated investigation-derived waste (IDW) will be generated that includes the following:

- Used personal protective equipment (PPE);
- Disposable sampling equipment; and
- Decontamination fluids.

The USEPA's National Contingency Plan requires that management of IDW comply with all applicable or relevant and appropriate requirements to the extent practicable. The sampling plan will follow the Office of Solid Waste and Emergency Response Publication 9345.3-03FS, which provides the guidance for the management of IDW (USEPA, 1992). Other legal and practical considerations that may affect the handling of IDW will also be considered.

Listed below are the procedures that will be followed for handling the IDW:

- Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill.
- Decontamination water will be placed in 35-gallon or 55-gallon drums. The drums will be sealed and properly labeled so that they are watertight pending receipt of analytical results.
- Following receipt of analytical results from samples collected at the site, all liquid IDW (decontamination water) will be disposed of as appropriate based on the analytical results.

4.4 Surveying and Photographs

Northings and eastings will be surveyed for all sample locations following the completion of field activities using a handheld differential global positioning system (GPS) for capturing readings. Photographs will be taken and logged in the field to document findings.

4.5 Quality Assurance and Quality Control Measures

An integral part of the SAP is the quality assurance/quality control program, which contributes to the reliability and compatibility of all data generated during this investigation. The QAPP (CSC, 2004 – Appendix B) provides specific descriptions of the field and laboratory procedures to be employed for verifying and maintaining performance quality for collection of environmental samples and subsequent chemical analysis. Furthermore, the QAPP sets forth the policies, procedures, and activities for the identification and documentation of the precisions, accuracy, completeness, and representativeness of the data during the performance of this investigation (CSC, 2004 – Appendix B).

During the investigation, a variety of data will be collected. Each sample collected may be analyzed for several different chemicals depending on the rationale for sample collection. However, not all chemicals detected will be attributable to an onsite release, and it is possible that not all of the data will be of acceptable quality.

5.0 Schedule and Reporting

To comply with the recommended sampling period for tissue collection, the CSC anticipates field activities will be conducted during Spring 2009, and field events will target the month of April but starting no later than early May. It is estimated that the tissue sampling can be completed in two weeks and sampling will be limited to what can be collected within that time frame. The analysis and validation of the initial biotic and abiotic samples will take five and four weeks, respectively (nine weeks total).

5.1 Field Supervision and Coordination with USEPA

The CSC will notify USEPA at least one week before we begin any sampling so they may participate if they wish. The CSC will adhere to the requirements previously listed in the Sections 11 and A6.1 of the Final RI/FS Work Plan (CSC, 2004) regarding coordination with USEPA or its oversight contractor.

6.0 References

ARCADIS. 2008a. Next Steps for Ecological Risk Assessment. ARCADIS U.S., Inc. July.

ARCADIS. 2008b. Next Steps for Ecological Risk Assessment (Revised). ARCADIS U.S., Inc. November.

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

CSC. 2008a. Draft Remedial Investigation Report. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. April.

CSC. 2008b. Final Biological Species and Habitat Survey (BSHS) Report. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. November.

USEPA. 1992. Guide to Management of Investigation-Derived Wastes. OSWER Publication 9345.3-03FS. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. January.

TABLES

Table 1.
Data Quality Objectives for the Collection of Tissue Samples

State the Problem	Identify the Decisions	Inputs to the Decisions	Define Study Boundaries	Decision Rules	Specify Limits on Decision Errors	Optimize the Sampling Design
<p>Chemicals of interest (COI) including metals, polychlorinated biphenyls (PCBs), and organochlorine pesticides, have been shown to be potential risk drivers within areas of the Site where remedial activities are yet to be determined. These COIs may be present in various prey tissue at the former Casmalia Hazardous Waste Facility (the Site). COIs may be present in soil and sediment at the Site, but not all constituents are considered COIs in all media. Ecological receptors at the Site may be ingesting some of these COIs through their food items. Site-specific prey tissue data would provide food intake values for refining potential risks to ecological receptors and eliminate the need for modeling food intake.</p> <p>COIs and study areas include:</p> <p>RCRA Canyon/West Canyon Spray Area¹:</p> <ul style="list-style-type: none"> Barium, cadmium, chromium, copper, lead, and zinc <p>Former Ponds and Pads/Remaining On-Site Area:</p> <ul style="list-style-type: none"> Total PCBs, dichlorodiphenyldichloroethane (DDE), and total dichlorodiphenyltrichloroethane (DDT) <p>A-Series Pond:</p> <ul style="list-style-type: none"> Selenium. <p>A sampling program is proposed to:</p> <ul style="list-style-type: none"> Characterize COI concentrations in various on-site prey tissue (e.g., aboveground vegetation, soil invertebrates, small mammals, and aquatic invertebrates) to provide information to refine intake values for predicting risk to wildlife receptors; Characterize COI concentrations in various prey tissue (e.g., aboveground vegetation, soil invertebrates, and small mammals) collected from a background location to evaluate incremental risk to wildlife receptors; Additionally, this effort will provide qualitative data that documents the presence or absence of utilization by various receptor groups in different habitats and areas of the Site through identifying the level of effort required to collect prey tissue samples for analysis; and Provide information for the refined or Tier 2 Ecological Risk Assessment (ERA). 	<p>Principal Study Questions</p> <ul style="list-style-type: none"> What COIs are of concern and should be included for analysis in this study? Which COIs are present in aboveground vegetation parts and what is the relationship between soil and tissue concentrations? Which COIs are present in soil invertebrates and what is the relationship between soil and tissue concentrations? Which COIs are present in small mammals and what is the relationship between soil and tissue concentrations? Which COIs are present in aquatic invertebrates and what is the relationship between sediment (and possibly water) and tissue concentrations? Which COIs are present in small mammal liver and/or kidney tissues and are the levels above organ-specific toxicity values? What COIs are present in prey tissue collected at the background locations and what is the relationship between soil and tissue concentrations? <p>Decision Statement</p> <p>Evaluate whether the ingestion of the COI concentrations reported in the prey tissue contributes to the potential for unacceptable risks to terrestrial and aquatic wildlife receptors.</p>	<ul style="list-style-type: none"> Results of ERA presented in the Remedial Investigation Report (CSC, 2008) COI data from tissue (e.g., plants, soil invertebrates, small mammals, and aquatic invertebrates) and co-located media samples collected at the Site. Toxicity reference values for COIs, including organ-specific values. Exposure parameters, including ingestion rate, for surrogate wildlife species. Information on level of effort and methods to collect the various tissue samples. COI data from tissue (e.g., plants, soil invertebrates, and small mammals) samples collected at the background location. If action is the decision (see the Decision Statement), then data regarding COI uptake into prey tissue and data regarding receptor utilization of various areas are possible additional inputs to subsequent decisions. 	<p>Specific physical boundaries include:</p> <ul style="list-style-type: none"> Terrestrial and aquatic tissue sampling areas as described in Figure 2 Background area was approved by U.S. Environmental Protection Agency as identified in Figure 3. 	<ul style="list-style-type: none"> If risk assessment calculations, including the site-specific prey tissue intake variables, identify the potential for unacceptable risks to terrestrial or aquatic wildlife receptors, then protective soil and/or sediment concentrations will be back-calculated to identify areas of concern. If risk assessment calculations, including the site-specific prey tissue intake variables and kidney and liver concentrations, identify the potential for unacceptable risks to terrestrial or aquatic wildlife receptors, then data from the background area will be used to develop background risks to understand the incremental risk associated with site-related COIs. 	<p>Potential sources of decision errors include:</p> <ul style="list-style-type: none"> Uncertainties that measured concentrations of prey tissue at sampling locations are representative of actual ranges of concentrations at the site; Underestimating prey tissue concentrations by sampling non-impacted areas; Biasing prey tissue concentrations by sampling heavily impacted areas; Selection of non-comparative reference/background site for one or more of the prey tissue items; Uncertainties associated with compositing of tissue and soil samples; Lack of aquatic habitat in the background area; Analytical measurement errors; and Sample design errors. <p>Methods to control the decision errors are listed below.</p> <ul style="list-style-type: none"> Collect sufficient data in the various media to characterize COI concentrations. Use appropriate analytical methods to achieve required detection limits. Purposefully choose sampling locations to represent range of true prey tissue concentrations. 	<p>Identified in the main document, to which this table is attached.</p>

¹ Although metals were not considered as COIs at the Former Ponds and Pads/Remaining On-Site Areas, if feasible (i.e., sufficient mass can be obtained), then metals will be analyzed from this study area.

Table 2.
Remedial Investigation Soil Chemical of Interest Concentrations

RI Location ID	Sample Depth	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Selenium (mg/kg)	Zinc (mg/kg)	Total DDT (mg/kg)	Total PCBs (ug/kg)
RCRA Canyon/West Canyon Spray Area RI Sample Results for Proposed Tissue Sample Locations										
Background UTL	NA	174	3.2	47	19	11.9	3.3	104	NA	NA
Minimum Concentration	NA	29	0.48	19	8.3	7.7	0.7	31	0.0014	0.000045
Maximum Concentration	NA	12000	24	670	480	140	5.6	710	0.0115	0.012
RISSRC-03	0 - 0.5 ft	340	1.1	33	14	8.2	0.7	53	NA	NA
RISSSA-04	0 - 0.5 ft	77	0.48	42	14	10	1.2	45	NA	NA
RISSSA-06	0 - 0.5 ft	190	4.3	120	84	17	1.5	110	NA	55.3
RISBRC-06	0 - 0.5 ft	9700	4.1	53	42	110	1.3	430	NA	NA
RISBRC-05	0 - 0.5 ft	10000	24	470	320	130	1.4	710	0.0115	NA
Former Ponds and Pads/Remaining On-Site Areas RI Sample Results for Proposed Tissue Sample Locations										
Background UTL	NA	174	3.2	47	19	11.9	3.3	104	NA	NA
Minimum Concentration	NA	19	0.26	10	6.4	6	0.0082	20	0.00123	0
Maximum Concentration	NA	3800	7	160	59	120	1.9	160	0.36	2070
RISSON-40	0.5 - 1 ft	65	4.4	13	13	ND (9)	1.9	61	0.171	0.020
RISBON-09	0 - 0.5 ft	150	8.5	28	11	ND (8.4)	ND (1.1)	46	0.003	10.9
RISBON-41	0 - 0.5 ft	240	1.4	29	17	7.5	ND (1.2)	63	0.0085	2.52
RISBON-34	0 - 0.5 ft	150	0.96	24	15	ND (8.8)	ND (1.2)	52	0.018	22.4
RISBON-30	0 - 0.5 ft	990	0.92	38	27	9.7	ND (1.0)	75	0.036	70.0
RISBON-66	0 - 0.5 ft	250	1.6	25	19	11	ND (1.2)	60	0.14	20.7
RISSRS-13	0 - 0.5 ft	240	0.71	28	13	ND (9.3)	ND (1.2)	43	0.36	351
A-Series Ponds RI Sample Results ¹										
Background UTL	NA	174	3.2	47	19	11.9	3.3	104	NA	NA
Minimum Concentration	NA	0.24	0.85	14	15	5.09	1.3	41	0.00385	0.191
Maximum Concentration	NA	0	20.9	28	43.6	41	9.4	112	0.0208	0.191
RISESP-10	0 - 0.5 ft	76	0.85	20	19	9.7	ND (1.3)	66	0.00385	0.191
RISESP-12	0 - 0.5 ft	66	1.9	14	15	10	ND (1.4)	41	0.00396	NA
RISESP-13	0 - 0.5 ft	0	1.6	28	20	14	1.8	1.8	0.0097	NA
RISESP-11	0 - 0.5 ft	16	11	23	27	29	9.4	79	0.0208	NA

Indicates chemical of interest for a study area

DDT = dichlorodiphenyltrichloroethane

mg/kg = milligram(s) per kilogram

NA = Not Applicable/Not Analyzed

ND = Not Detected

PCBs = polychlorinated biphenyls

RCRA = Resource Conservation and Recovery Act

RI = Remedial Investigation

¹ Tissue samples will be preferentially collected from wildlife foraging habitat, which may not be necessarily be associated with an existing RI sample. Therefore, exact locations may be adjusted in the field.

**Table 3.
Method Reference, Sample Preservation, and Holding Time Requirements**

Parameter	Analytical Method	Sample Matrix	Sample Preparation Method	Sample Mass (g) or Containers	Preservative	Sample Holding Time
Metals ¹	EPA 6010B/6020	Tissue Soil/Sediment	EPA 3050B EPA 3050B	10 1-8 oz jar	Freeze Store at 4deg C	Frozen = 1 year, extracted = 40 days 6 months
Polychlorinated Biphenyls	EPA 1668	Tissue Soil/Sediment	EPA 3540 EPA 1668	25 1-16 oz jar	Freeze Store at -10deg C	Frozen = 1 year, extracted = 40 days prep/analysis = 6 months
Organochlorine Pesticides	EPA 8081	Tissue Soil/Sediment	EPA 3540	30 1-16 oz jar	Freeze Store at 4deg C	Frozen = 1 year, extracted = 40 days prep = 14 days, analysis = 40 days
Lipids	Pace SOP S-GB-L003.01	Tissue	Pace SOP S-GB-L003.01	NA ²	Freeze	Frozen = 1 year, extracted = 40 days
Percent Moisture	ASTM D2974-87	Tissue	ASTM D2974-87	5	Freeze	Frozen = 1 year, extracted = 40 days
Grain Size	ASTM D4464	Sediment	ASTM D422	1-8 oz jar ³	Store at 4deg C	Analysis = 28 days
Total Organic Carbon	Walkley-Black	Soil/Sediment	NA	1-8 oz jar ³	Store at 4deg C	Analysis = 28 days
Total Solids	ASTM D2216	Soil/Sediment	NA	1-8 oz jar ³	Store at 4deg C	Analysis = 28 days

NA = Not applicable

EPA = Environmental Protection Agency

SOP = Standard Operating Procedure

ASTM = American Society for Testing and Materials

¹ Selenium (Se) will be analyzed by Method 6020A. The previous method version did not list Se as a reportable analyte, but interference issues previously associated with this method have been eliminated

² Lipids will be analyzed as part of pesticide analysis

³ Grain size, total organic carbon, and total solids will be analyzed from the same 8 oz jar.

Table 4.
Requested Analytical Parameters, Methods, and Detection Limits for Soil/Sediment and Biota Samples

Analyte	CAS or IUPAC Number	Units	Lowest Ecological Screening Level ^{1,2}	Soil/Sediment		Biota	
				PQL ³	MDL ³	MDL ⁴	PRL ⁴
Metals (EPA 6020)							
Aluminum	7429-90-5	mg/kg	--	50		0.8729	25
Antimony	7440-36-0	mg/kg	2	1		0.05	0.1
Arsenic	7440-38-2	mg/kg	8.2	0.5		0.02	0.1
Barium	7440-39-3	mg/kg	500	1		0.0371	0.1
Beryllium	7440-41-7	mg/kg	10	0.1		0.0118	0.1
Boron	7440-42-8	mg/kg	--	--		0.25	0.5
Cadmium	7440-43-9	mg/kg	0.99	0.1		0.0068	0.1
Calcium	7440-70-2	mg/kg	--	100		36.4838	100
Chromium	7440-47-3	mg/kg	0.4	0.5	0.04	0.0405	0.1
Cobalt	7440-48-4	mg/kg	20	1		0.05	0.1
Copper	7440-50-8	mg/kg	31.6	2		0.0693	0.5
Iron	7439-89-6	mg/kg	--	50		3.3818	25
Lead	7439-92-1	mg/kg	35.8	7.5		0.0448	0.1
Magnesium	7439-95-4	mg/kg	--	50		39.7572	100
Manganese	7439-96-5	mg/kg	--	1		0.1329	0.5
Mercury	7439-97-6	mg/kg	0.1	0.02		0.0057	0.02
Molybdenum	7439-98-7	mg/kg	2	2		0.0167	1
Nickel	7440-02-0	mg/kg	20.9	3		0.0259	0.1
Potassium	7440-09-7	mg/kg	--	250		9.87561	100
Selenium	7782-49-2	mg/kg	1	1		0.0629	0.2
Silver	7440-22-4	mg/kg	1	0.7		0.025	0.05
Sodium	7440-23-5	mg/kg	--	50		38.4648	100
Strontium	7440-24-6	mg/kg	--	--		0.0316	0.1
Thallium	7440-28-0	mg/kg	1	0.2		0.0054	0.1
Tin	7440-31-5	mg/kg	50	25		0.2179	5
Titanium	7440-32-6	mg/kg	--	--		0.1495	0.5
Vanadium	7440-62-2	mg/kg	2	1		0.0668	0.2
Zinc	7440-66-6	mg/kg	50	2		0.8874	2
Organochlorine Pesticides (EPA 8081)							
2,4'-DDD	53-19-0	ug/kg	--	--		0.91	2.5
2,4'-DDE	3424-82-6	ug/kg	--	--		1.2	2.5
2,4'-DDT	789-02-6	ug/kg	--	--		1.2	2.5
4,4'-DDD	72-54-8	ug/kg	2	3.3	0.18	0.99	5
4,4'-DDE	72-55-9	ug/kg	2.2	3.3	0.13	1.3	5
4,4'-DDT	50-29-3	ug/kg	1	3.3	0.1	0.77	5
Aldrin	309-00-2	ug/kg	--	1.7		0.73	2.5
Chlordane (Technical)	57-74-9	ug/kg	--	--		23	50
Dieldrin	60-57-1	ug/kg	0.02	3.3	0.18	0.64	5
Endosulfan I	959-98-8	ug/kg	--	1.7		0.58	2.5
Endosulfan II	33213-65-9	ug/kg	--	3.3		0.98	5
Endosulfan sulfate	1031-07-8	ug/kg	--	3.3		1.6	5
Endrin	72-20-8	ug/kg	0.02	1.7	0.18	0.73	5
Endrin aldehyd	7421-93-4	ug/kg	--	6.6		2.9	5
Endrin ketone	53494-70-5	ug/kg	--	3.3		1.2	5
Heptachlor	76-44-8	ug/kg	--	1.7		0.72	2.5
Heptachlor epoxide	1024-57-3	ug/kg	4.7	1.7		0.77	2.5
Hexachlorobenzene	118-74-1	ug/kg	--	10		2.1	2.5
Methoxychlor	72-43-5	ug/kg	--	6.6		3.7	25
Mirex	2385-85-5	ug/kg	--	10		2	2.5
Oxychlordane	27304-13-8	ug/kg	--	--		0.91	2.5
Pentachloroanisole	1825-21-4	ug/kg	--	--		0.94	2.5
Toxaphene	8001-35-2	ug/kg	--	66		24	75
alpha-BHC	319-84-6	ug/kg	3.7	3.3		0.81	2.5
alpha-Chlordane	5103-71-9	ug/kg	0.5	3.3	19	0.54	2.5
beta-BHC	319-85-7	ug/kg	3.7	3.3		0.92	2.5
cis-Nonachlor	5103-73-1	ug/kg	--	--		0.65	2.5
delta-BHC	319-86-8	ug/kg	3.7	0.11		1	2.5
gamma-BHC (Lindane)	58-89-9	ug/kg	3.7	1.7		0.54	2.5
gamma-Chlordane	5103-74-2	ug/kg	0.5	3.3	19	1.5	2.5
trans-Nonachlor	39765-80-5	ug/kg	--	--		0.75	2.5

Table 4.
Requested Analytical Parameters, Methods, and Detection Limits for Soil/Sediment and Biota Samples

Analyte	CAS or IUPAC Number	Units	Lowest Ecological Screening Level ^{1,2}	Soil/Sediment		Biota	
				PQL ³	MDL ³	MDL ⁴	PRL ⁴
Polychlorinated Biphenyl Congeners (EPA 1668A)							
3,4,4',5-Tetrachlorobiphenyl	PCB-81	ng/kg	--	0.4		2.8	50
3,3',4,4'-Tetrachlorobiphenyl	PCB-77	ng/kg	--	0.4		5.4	50
2,3',4,4',5'-Pentachlorobiphenyl	PCB-123	ng/kg				6.4	50
2,3',4,4',5-Pentachlorobiphenyl	PCB-118	ng/kg	--	0.4		42.1	100
2,3,4,4',5-Pentachlorobiphenyl	PCB-114	ng/kg				4.3	50
2,3,3',4,4'-Pentachlorobiphenyl	PCB-105	ng/kg	--	0.4		19.2	50
3,3',4,4',5-Pentachlorobiphenyl	PCB-126	ng/kg	--	0.4		4.1	50
2,3',4,4',5,5'-Hexachlorobiphenyl	PCB-167	ng/kg				3.0	50
PCB-(156/157)	PCB-(156/157)	ng/kg	--	0.4		5.7	50
3,3',4,4',5,5'-Hexachlorobiphenyl	PCB-169	ng/kg	--	0.4		3.0	50
PCB-(180/193)	PCB-(180/193)	ng/kg	--	0.4		25.9	75
2,2',3,3',4,4',5-Heptachlorobiphenyl	PCB-170	ng/kg	--	0.4		12.5	50
2,3,3',4,4',5,6-Heptachlorobiphenyl	PCB-189	ng/kg				1.9	50

CAS = Chemical Abstract Service

EPA = Environmental Protection Agency

IUPAC = International Union of Pure and Applied Chemistry

MDL = Method Detection Limit

PQL = Practical Quantitation Limit

PRL = Practical Reporting Limit

-- = Value not available

mg/kg = milligrams per kilogram

ug/kg = micrograms per kilogram

ng/kg = nanograms per kilogram

¹ From Table 3-10 of the RI/FS Work Plan

² Screening Levels that are bolded are less than the PQL.

³ PQL and MDL information supplied by Sequoia Analytical Laboratory. MDL provided in PQL is greater than lowest screening level.

⁴ MDL and PRL for biota samples provided by Pace Analytical. Applicable limits at the time of analysis will be used

**Table 5.
Sample Analysis Matrix**

Study Areas/Samples	Metals¹	Total PCBs²	Organochlorine Pesticides¹	Lipids	TOC	Grain Size	Total Solids
RCRA Canyon/West Canyon Spray Area							
Soil ³	10	-	-	-	10	-	10
Plant	5	-	-	-	-	-	5
Soil Invertebrate	5	-	-	5	-	-	5
Small Mammal	5	-	-	5	-	-	5
Former Ponds and Pads/Remaining On-Site Area⁴							
Soil ³	-	14	14	-	14	-	14
Plant	-	7	7	-	-	-	7
Soil Invertebrate	-	7	7	7	-	-	7
Background							
Soil ³	10	-	10	-	10	-	10
Plant	5	-	5	-	-	-	5
Soil Invertebrate	5	-	5	5	-	-	5
Small Mammal	5	-	5	5	-	-	5
A-Series Pond							
Sediment	5	-	-	-	5	5	5
Aquatic Invertebrate ⁵	5	-	-	5	-	-	5
Totals	60	28	53	32	39	5	88

PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act

TOC = total organic carbon

¹ Entire analytical suite will be reported with analytical method is performed

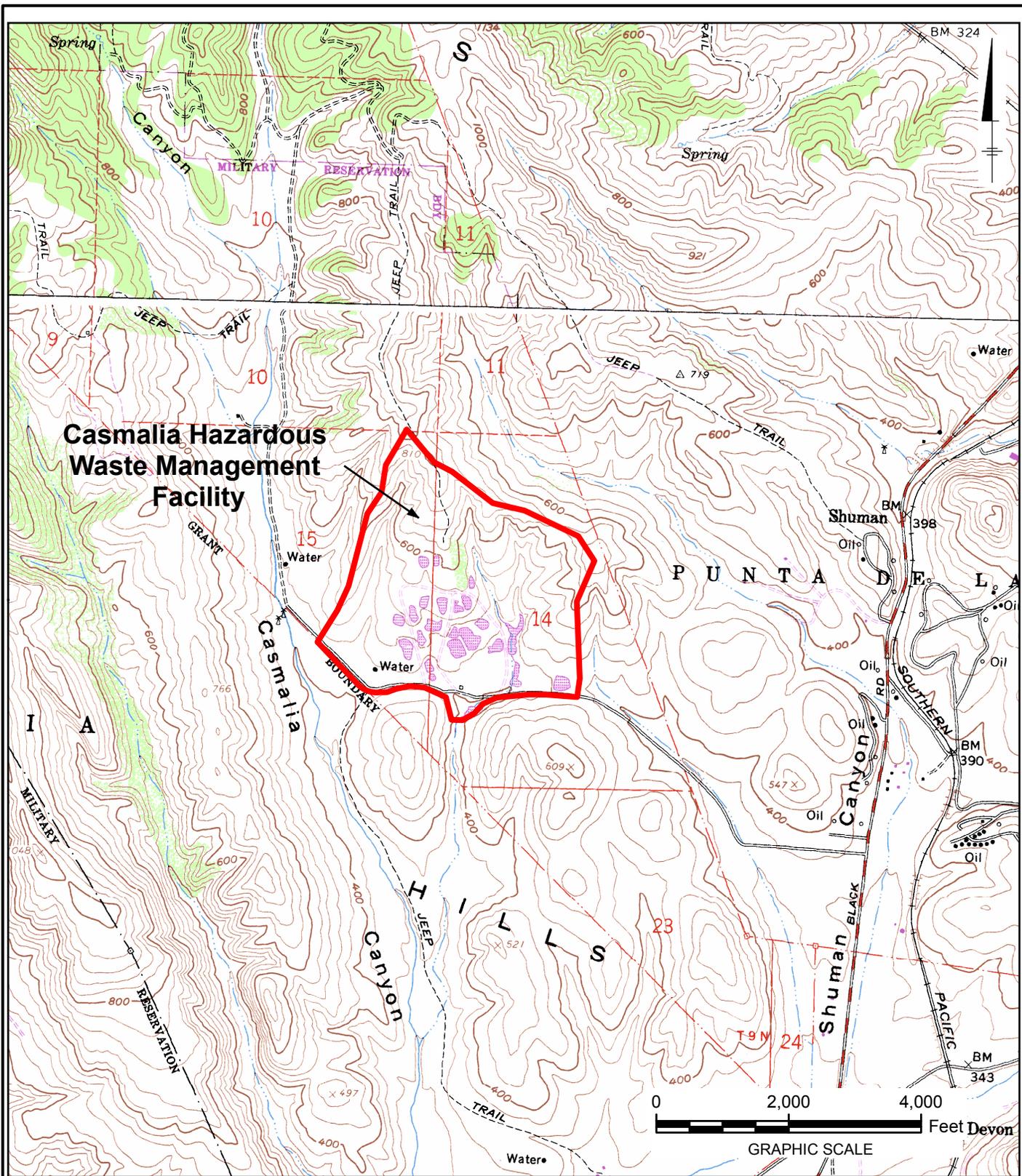
² WHO list of 14 PCB congeners

³ One composite soil sample will be collected per plant sample and one composite soil sample will be collected per invertebrate/small mammal sample

⁴ Metals will be added as an analyte if enough tissue is available.

⁵ Samples will be preferentially comprised of benthic/epi-benthic organisms; however, water column invertebrates will be collected if sufficient sample mass can be achieved.

FIGURES



LEGEND

LANDFILL BOUNDARY

CASMALIA STEERING COMMITTEE
 FORMER CASMALIA HAZARDOUS WASTE FACILITY,
 SANTA BARBARA COUNTY, CALIFORNIA
SAMPLING AND ANALYSIS PLAN

SITE LOCATION MAP

SOURCE:
 USGS TOPOGRAPHIC MAP, 1982.



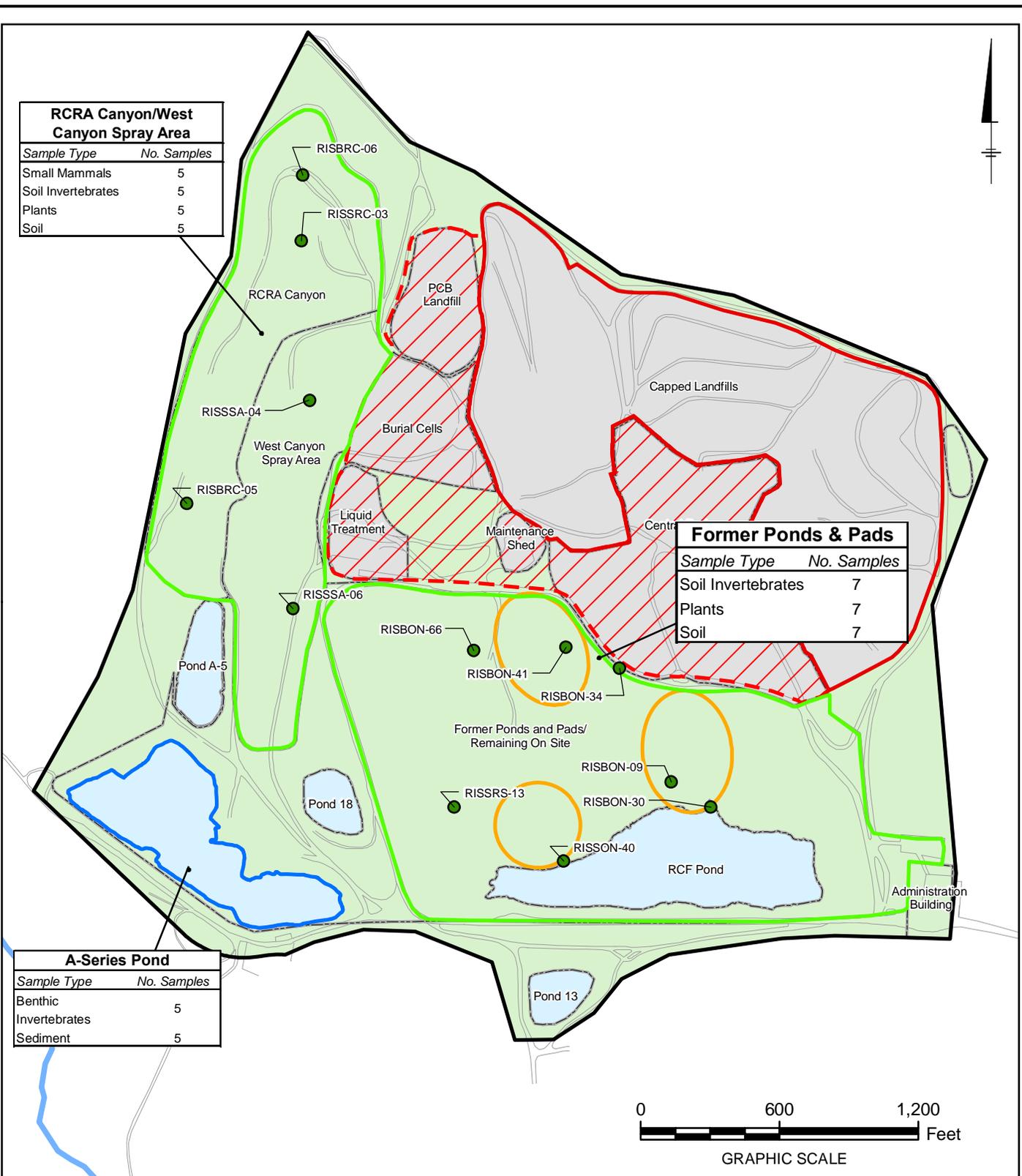
FIGURE
1

CITY: San Francisco DIV/GROUP: 85 DB: ME LD: PIC: PM: TM: TR:
 Project #: 1124.0001 task 1
 Q:\Casmalia\SamplingAnalysisPlan\Mxd\Fig 1 SiteLocationMap.mxd - 1/30/2009 @ 8:42:13 AM

RCRA Canyon/West Canyon Spray Area	
Sample Type	No. Samples
Small Mammals	5
Soil Invertebrates	5
Plants	5
Soil	5

Former Ponds & Pads	
Sample Type	No. Samples
Soil Invertebrates	7
Plants	7
Soil	7

A-Series Pond	
Sample Type	No. Samples
Benthic Invertebrates	5
Sediment	5



- LEGEND:**
- Proposed Prey Tissue Sample Location
 - Property Boundary
 - Existing Cap
 - Proposed Cap Extension
 - Preliminary Chemical of Interest Hotspots
 - Proposed Terrestrial Sampling Area Boundary
 - Proposed Aquatic Sampling Area Boundary

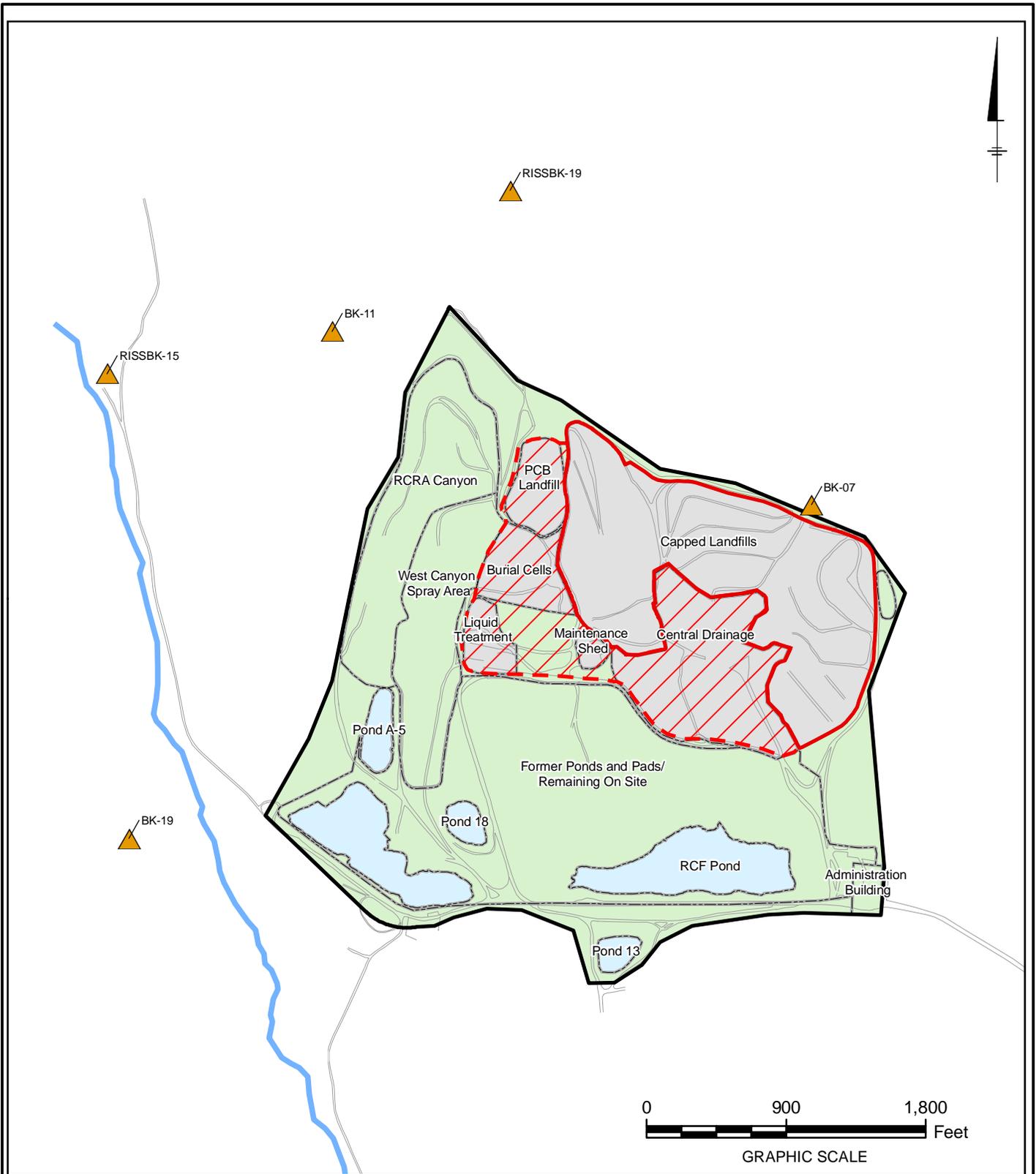
NOTE:
The A- series Pond Sampling locations will be determined in the field.

CASMALIA STEERING COMMITTEE
 FORMER CASMALIA HAZARDOUS WASTE FACILITY,
 SANTA BARBARA COUNTY, CALIFORNIA
**NEXT STEPS FOR THE ECOLOGICAL
 RISK ASSESSMENT MEMORANDUM**

SAMPLING AND ANALYSIS PLAN

FIGURE
2

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: TR:
 Project (Project #)
 Q:\Casmalia\Eco_Risk\MXD\SamplingAndAnalysisPlan.mxd - 1/20/2009 @ 4:01:51 PM



LEGEND:

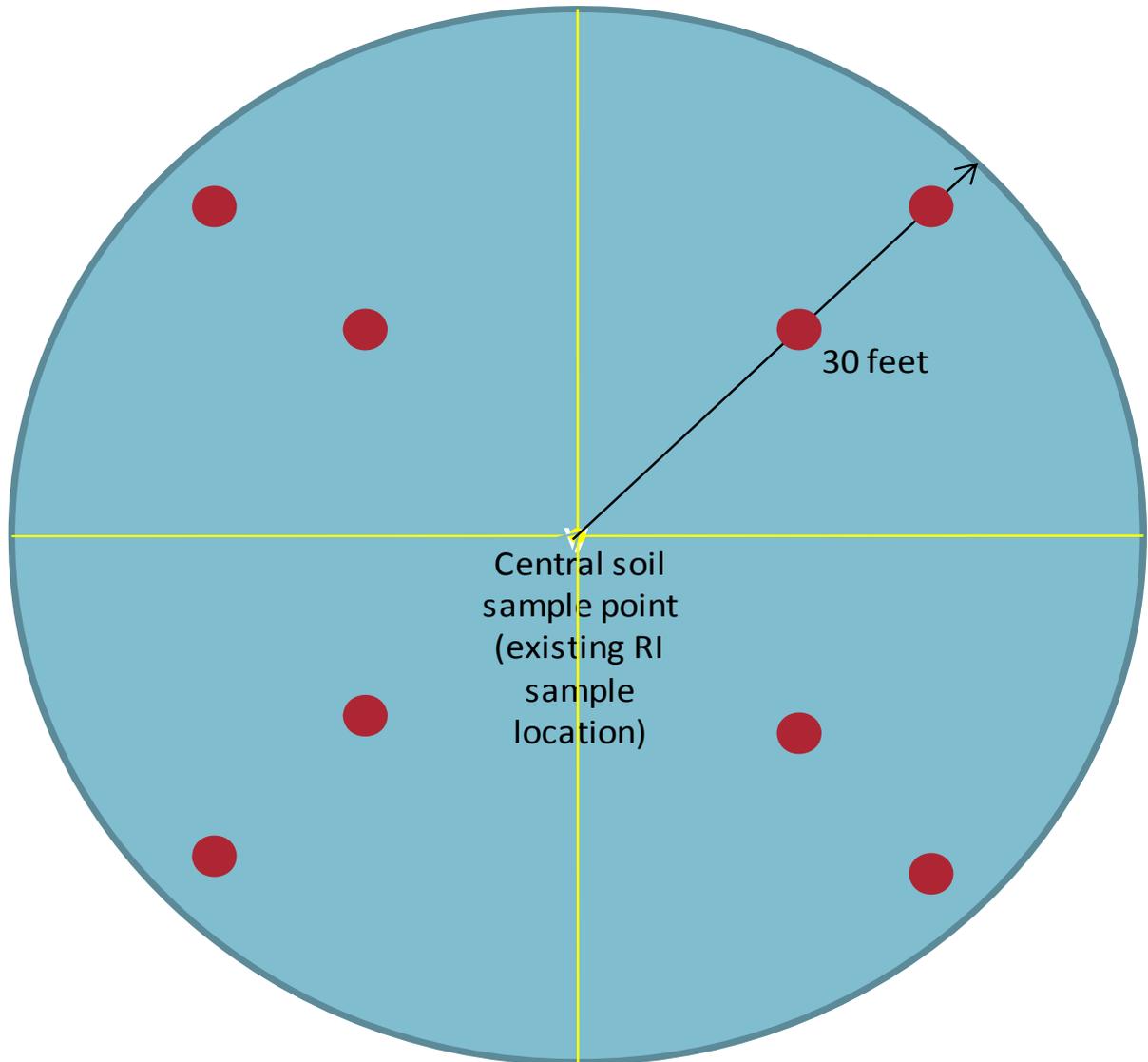
-  Background Sample Location
-  Existing Cap
-  Proposed Cap Extension
-  Property Boundary

CASMALIA STEERING COMMITTEE
 FORMER CASMALIA HAZARDOUS WASTE FACILITY,
 SANTA BARBARA COUNTY, CALIFORNIA
SAMPLING AND ANALYSIS PLAN

**PROPOSED BACKGROUND
 TISSUE SAMPLE LOCATIONS**



**FIGURE
 3**



LEGEND:

-  Small mammal and terrestrial invertebrate sampling area
-  Soil sub-sample location

NOTES:

- A minimum of 20 traps will be placed in the positioning area.

CASMALIA STEERING COMMITTEE FORMER CASMALIA HAZARDOUS WASTE FACILITY, CASMALIA, CALIFORNIA	
SAMPLING AND ANALYSIS PLAN	
SMALL MAMMAL TRAPPING AND TERRESTRIAL INVERTEBRATE SAMPLING AREA	
	ARCADIS
FIGURE 4	

APPENDICES

APPENDIX A

**PLANT TISSUE SAMPLING STANDARD OPERATING
PROCEDURE**

Plant Tissue Sampling

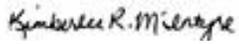
Rev. #: 02

Rev Date: March 17, 2009

Approval Signatures

Prepared by:  Date: 03/17/09

Reviewed by:  Date: 03/17/09
(Technical Expert)

Reviewed by:  Date: 03/23/09
(Editorial Reviewer)

Reviewed by:  Date: 03/25/09
(Quality Assurance Reviewer)

Reviewed by:  Date: 03/25/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the field sampling procedures for vegetation samples from terrestrial ecosystems for tissue analysis. This is a standard (i.e., typically applicable) operating procedure that may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project report. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the U.S. Environmental Protection Agency (USEPA) as soon as practicable and documented in the project report.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOP and possess the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

Equipment to be used during sample collection may include, but are not limited to the following:

- Health and Safety Plans
- Appropriate personal protective equipment (PPE)
- Nitrile gloves and work gloves
- Work permits
- Insect repellent
- Sunscreen
- Permanent markers
- Field data sheets

- Equipment decontamination supplies
- Appropriate sample containers, labels, and forms
- Appropriate cooler(s) with ice and shipping materials
- Spray bottles
- Stainless steel scissors or hand pruners
- Disposable sterilized sampling bags
- Photoionization detector (PID)
- Digital camera
- Hand-held differential global positioning system (GPS)
- Field logbook
- Portable digital scale.

IV. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Field-collected samples might potentially be in proximity to toxic plants (e.g., poison ivy, poison oak, and poison sumac) and, therefore, should be treated with caution to minimize exposure to workers. Vegetation sampling locations should avoid areas containing poisonous plants. Tecnu[®] will be provided to samplers and should be used promptly if inadvertent exposure to poisonous plants occurs or is believed to have occurred. Gloves, long sleeve shirts, and long pants will be worn to minimize the potential for exposure.

Care will be taken to avoid tripping hazards (vines, roots, tangled vegetation, etc.) and eye-level twigs and branches and the locations of these hazards will be communicated between samplers.

Sampling should not be done during hazardous weather conditions, including while lightning or other severe weather conditions are occurring.

Because the collection of plants requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

V. Procedure

Vegetation at each sample location will be inspected to assess vegetative portions available for sampling. Vegetation sampling areas will be limited to within 10 feet of the associated soil sample location. Field personnel will target leaves for collection. Field personnel will collect a single taxon of plant across all sample locations. The taxon selected for collection will be assessed in the field and will follow the hierarchy presented in the Sampling and Analysis Plan. General condition of plant material (e.g., new shoots or evidence of stress [wilting and chlorosis]) collected will also be recorded. Field personnel will weigh samples in the field to assess if sufficient plant material (i.e., 15 to 65 grams) has been collected. Where feasible, material from a single plant will be collected to provide a representative sample of food concentrations in that specific sampling location. The plant materials, lowest field-identifiable taxon, and weight will be recorded on the field data sheet/logbook.

Field personnel will use stainless steel scissors to cut leaves from plants at least 1 cm above the ground surface to avoid including soil particles in the sample. If field personnel must collect plant tissue from more than 10 feet from the selected soil sample location, such deviations will be noted in the field notes.

Field personnel will measure and record the total fresh weight of samples following collection and subsequently freeze samples for shipment to the analytical laboratory.

The field logbook will be used to record information such as observations made in the field and to note any deviations in sampling methodology that may be necessary to accommodate field conditions. Field personnel will record all relevant information in the field logbook and take supplementary photographs as needed to record field conditions.

Sampling equipment will be decontaminated for gross contamination (i.e., plant tissue residuals from sampling) using distilled water, non-phosphate detergent, and a stiff bristled brush between each sampling location. Sampling equipment will also be decontaminated with methanol and nitric acid followed by a distilled water wash. Gloves will be changed between each location.

Sampling materials and waste will be collected before leaving the sampling area.

VI. Waste Management

Rinse water, PPE, and other residual material generated during the equipment decontamination will be placed in appropriate containers. Containerized waste will be disposed of consistent with appropriate procedures.

VII. Data Recording and Management

Field sampling personnel will document field sampling events in the project field logbook to record all relevant information in a clear and concise format. As an alternative, a bound field notebook may be used at the discretion of field personnel to document field activities. The record of field sampling events will include:

- Project number, client, and site location
- Date
- Field sampling personnel
- Subcontractors
- Name and affiliation of all site visitors
- Field sampling equipment with serial numbers
- Weather

- Equipment calibration details
- Sample locations
- PID readings
- Tissue description and taxon identification
- Samples collected and analytical parameters
- Sample times
- Air monitoring readings
- Other miscellaneous observations.

VII. Quality Assurance

Equipment will be decontaminated for gross contamination prior to use on the site, between each sample location, and upon completion of the sampling program prior to leaving the site. Reusable equipment and associated tools, including shovels/trowels, sampling equipment, and other equipment or tools will be decontaminated.

Tissue samples do not allow for collection of blind duplicate samples. Sufficient mass of plant tissue will be collected at a frequency of 1 per 20 samples to perform matrix spike/matrix spike duplicate laboratory Quality Assurance/Quality Control (QA/QC) samples. Additional internal laboratory QA/QC samples will be conducted in accordance with the Quality Assurance Project Plan (CSC, 2004, Appendix B). One field blank sample will be collected each day to assess decontamination procedures and evaluate potential for cross-contamination between sample locations. As samples are not being collected for volatile organic compounds, no trip or field blank QA/QC samples are proposed.

IX. References

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

Plant Collection Field Data Sheet

Project Description:		Project Number:	
Location of Sampling Event:		Date (ddmmyy):	
Sampling Personnel:	Field Team Leader:	Time (hh:mm):	
Weather Conditions: Sunny <input type="checkbox"/> Partly Sunny <input type="checkbox"/> Cloudy <input type="checkbox"/> Raining <input type="checkbox"/> Calm <input type="checkbox"/> Slightly Windy <input type="checkbox"/> Windy <input type="checkbox"/> Gusting Winds <input type="checkbox"/>			
Ambient Air Temperature (°F): _____			
Composite Sample ID:		Person-minutes of sampling effort:	
Sub – sample ID	Sub-Sample description	Taxon in sub-sample	Weight of sub-sample (g)
Total Weight of Composite Sample:			
Notes/Comments:			

APPENDIX B

**SOIL INVERTEBRATE TISSUE SAMPLING STANDARD
OPERATING PROCEDURE**

Soil Invertebrate Tissue Sampling

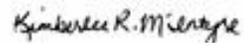
Rev. #: 02

Rev Date: March 17, 2009

Approval Signatures

Prepared by:  Date: 03/17/09

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Reviewed by:  Date: 03/25/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the field sampling procedures for soil invertebrate samples for tissue analysis. This is a standard (i.e., typically applicable) operating procedure that may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project report. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the U.S. Environmental Protection Agency (USEPA) as soon as practicable and documented in the project report.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. Field personnel will obtain the appropriate Scientific Collector's Permits from California Department of Fish and Game prior to performing field activities. In addition, ARCADIS field personnel will be versed in the relevant SOP and possess the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

Equipment to be used during sample collection may include, but are not limited to the following:

- Health and Safety Plans
- Appropriate personal protective equipment (PPE)
- Nitrile gloves and work gloves
- Work permits
- Scientific Collectors permit
- Insect repellent
- Sunscreen

- Permanent markers
- Field data sheets
- Equipment decontamination supplies
- Appropriate sample containers, labels, and forms
- Appropriate cooler(s) with ice and shipping materials
- Tweezers
- Spray bottles
- Hand spade
- Shovel
- 1-gallon cans
- Petroleum jelly
- Bait (e.g., rotting meat, apples, dried oats)
- Cotton or wool stuffing
- 2-foot square plywood coverboards
- Concrete blocks
- Disposable sterilized sampling bags
- Photoionization detector (PID)
- Digital camera
- Hand-held differential global positioning system (GPS)
- Field logbook

- Portable digital scale
- Plastic sheeting.

IV. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Caution should be used while using shovels or spades. Field teams should verify that when one sampler is using digging equipment, the other samplers should remain a safe distance away. Additionally, common injuries resulting from use of shovels and spades, such as strains and cuts, should be paid careful attention.

Debris such as metal scrap, bottles, and cans might be buried in the soil. Field crews should scan the collection area for debris, and remove it prior to digging. Crews should also be careful when sifting through soil to recover worms and grubs.

Sampling should not be done during hazardous weather conditions including while lightning or other severe weather conditions are occurring. Since the collection of soil invertebrates requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

V. Procedure

The field team leader will determine the field crew size by assessing the difficulty of obtaining invertebrates prior to collection. A minimum 2-person crew will be used for safety purposes and more people will be added to the crew, as evaluated by the field crew leader, to ensure safety and efficiency.

The field crew will evaluate sampling gear at the end of each day and start of each sampling day to ensure that equipment is functioning properly and in good condition. Equipment that is not functioning properly or is not in good condition will not be used until repaired. Equipment will be sharpened and decontaminated as needed.

The sampling crew will identify the sample location from sampling map. Site conditions will be documented and a brief description will be recorded in the field notebook. Soil invertebrate tissue samples will be targeted to bias collection of invertebrates with intimate contact with soil (e.g., earthworms and grubs) will follow the hierarchy presented in the Sampling and Analysis Plan. However, if sufficient mass of these grouping of invertebrates is not available then other groupings of invertebrates will be collected (e.g., beetles and grasshoppers). If sufficient mass is not available to collect a single taxon of invertebrate, then a composite of all opportunistically collected invertebrates will be selected to makeup the sample. To reflect this hierarchy of collection, field personnel will first attempt to hand collect soil invertebrates and perform pit-trap sampling if hand collection methods do not produce sufficient mass. Hand collection and pit-trap collection methods are described below.

Hand Collection Methods

Soil invertebrate tissue samples will be collected within a 30-foot radius of the selected representative soil samples. Field personnel will initially sift through leaf litter and turn over logs/debris to search for and collect soil invertebrates observed. Personnel will collect all soil invertebrates observed and will separate tissue types by appropriate taxon (e.g., Coleoptera and Annelida). Following initial searching and hand collection, field personnel, using shovels, will excavate one square foot of soil to a depth of approximately one foot below ground surface. Soil will be placed on plastic sheeting in a manner that keeps the removed soil as intact as possible. Field personnel will adjust the depth of digging to site-specific conditions to maximize the yield of earthworms and grubs. For example, if water is present in the hole, shallower excavations are advised. If soil invertebrates, specifically worms, are present at deeper depths subsequent excavations will be advised. During dry seasons, worms tend to be found under leaf packs and fallen logs, where the soil moisture is greatest.

Wearing nitrile gloves and using hand trowels, field personnel will sift through the soil to pick out worms, and grubs if abundant. Sampling will initially focus on earthworms, as, when

present, earthworms typically provide the largest proportion of easily collected mass. However, if sufficient mass is available, then other terrestrial invertebrates such as grubs (e.g., Coleopteran larvae) will be collected opportunistically and will be kept separate from earthworm samples. Due to their morphology, it is unlikely that grubs will be able to be field identified to a discernible taxon.

Collected soil invertebrates will be placed into a labeled sterile sampling bag. Soil excavation and picking will continue until the required mass (i.e., 15 to 55 grams) of soil invertebrates has been collected, unless reaching such mass is deemed unfeasible by field personnel. If hand collection methods do not result in sufficient mass for analytical testing, collected tissue will be frozen and additional tissue collection methods (e.g., pit-trap collection and coverboards) will be initiated.

If feasible, a single taxon of soil invertebrate will be separated and submitted for analysis. Samples will be weighed in the field to assess when sufficient mass has been achieved. The taxon and numbers of each taxon composing a sample will be recorded.

Pit-Trap Collection

If hand collection of invertebrates results in insufficient mass for laboratory analysis, field personnel will attempt to collect soil invertebrate tissue using pit-trap methods. Pit trap methods will be employed for a number of days, as agreed to with the appropriate regulatory agencies. Pit traps will be installed, as described below, within a 30-foot radius of the pre-selected soil sample location.

Field personnel will dig a hole sufficiently wide and deep for a 1-gallon can and place a 1-gallon can in the hole. The lip of the can top will be flush with the ground surface and free space around the edge of the can will be filled with soil that originated from the hole. Field personnel will then bait the pit trap cans with rotting meat, apples and dried oats. Additionally, field personnel will place cotton fluff in the can to serve as warming cover for non-target animals (e.g., small mammals) that may be caught overnight in pit-traps. Field personnel will cover pit trap locations with 2-foot square plywood coverboards placed flush to the ground. Coverboards will be weighted with concrete blocks to reduce disturbance by predatory mammals (e.g., fox and raccoon), as necessary

Field personnel will check pit-traps twice a day, once in the morning and once in the evening. Field personnel will collect invertebrates for tissue analysis and release any non-target animals observed in pit-traps. If sufficient mass, is available, taxonomic groupings of invertebrates (e.g., mollusca, coleoptera and orthoptera) will be separated. Field personnel will re-bait pit-traps, as necessary, and replace coverboards.

General Procedures

Field personnel will record sample designations, field observations, groupings of invertebrates included in the sample, and weights of sub-samples in the field logbook. If appropriate, photographs will be taken of representative specimens for proof of collection and summary reporting.

Invertebrate samples will be placed in a cooler in the field and frozen as soon as possible to prevent depuration. The laboratory will explicitly be instructed to analyze frozen samples to avoid loss of fluids during the thawing process.

The field logbook will be used to record information such as observations made in the field and to note deviations in sampling methodology that may be necessary to accommodate field conditions. Field personnel will record relevant information in the field logbook.

Shovels/hand trowels will be decontaminated for gross contamination (i.e., soil residuals from sampling) using distilled water, non-phosphate detergent, and a stiff bristled brush between each sampling location. Sampling equipment will also be decontaminated with methanol and nitric acid followed by a distilled water wash. Gloves (nitrile) will be changed between each location.

Sampling materials and waste will be collected before leaving the sampling area.

VI. Waste Management

Rinse water, PPE, and other residual material generated during the equipment decontamination will be placed in appropriate containers. Containerized waste will be disposed of consistent with appropriate procedures.

VII. Data Recording and Management

Field sampling personnel will document field sampling events in the project field logbook to record all relevant information in a clear and concise format. As an alternative, a bound field notebook may be used at the discretion of field personnel to document field activities. The record of field sampling events will include:

- Project number, client, and site location
- Date

- Field sampling personnel
- Subcontractors
- Name and affiliation of all site visitors
- Field sampling equipment with serial numbers
- Weather
- Equipment calibration details
- Sample locations
- PID readings
- Tissue description and taxon identification
- Samples collected and analytical parameters
- Sample times
- Air monitoring readings
- Other miscellaneous observations.

VIII. Quality Assurance

Equipment will be decontaminated for gross contamination prior to use on the site, between each sample location, and upon completion of the sampling program prior to leaving the site. Reusable equipment and associated tools, including shovels/trowels, sampling equipment, and other equipment or tools will be decontaminated.

Tissue samples do not allow for collection of blind duplicate samples. Sufficient mass of invertebrate tissue will be collected at a frequency of 1 per 20 samples to perform matrix spike/matrix spike duplicate laboratory Quality Assurance/Quality Control (QA/QC) samples. Additional internal laboratory QA/QC samples will be conducted in accordance with the Quality Assurance Project Plan (CSC, 2004, Appendix B). As samples are not being collected for volatile organic compounds and cross contamination of invertebrate tissue between sample locations is unexpected, no trip or field blank QA/QC samples are proposed.

IX. References

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

Soil Invertebrate Collection Field Data Sheet

Project Description:		Project Number:	
Location of Sampling Event:		Date (ddmmyy):	
Sampling Personnel:	Field Team Leader:	Time (hh:mm):	
Weather Conditions: Sunny <input type="checkbox"/> Partly Sunny <input type="checkbox"/> Cloudy <input type="checkbox"/> Raining <input type="checkbox"/> Calm <input type="checkbox"/> Slightly Windy <input type="checkbox"/> Windy <input type="checkbox"/> Gusting Winds <input type="checkbox"/>			
Ambient Air Temperature (°F): _____			
Composite Sample ID:		Person-minutes of sampling effort:	
Sub – sample ID	Sub-Sample description	Taxon in sub-sample	Weight of sub-sample (g)
Total Weight of Composite Sample:			
Notes/Comments:			

APPENDIX C

**SMALL MAMMAL TISSUE SAMPLING STANDARD
OPERATING PROCEDURE**

Small Mammals Tissue Sampling

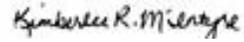
Rev. #: 02

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Approval Signatures

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(Editorial Reviewer)

Reviewed by:  Date: 03/25/09
(Quality Assurance Reviewer)

Reviewed by:  Date: 03/25/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the field sampling procedures for small mammal samples from terrestrial ecosystems for tissue analysis. This is a standard (i.e., typically applicable) operating procedure that may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project report. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the U.S. Environmental Protection Agency (USEPA) as soon as practicable and documented in the project report.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. Field personnel will obtain the appropriate Scientific Collector's Permits from California Department of Fish and Game prior to performing field activities. In addition, ARCADIS field personnel will be versed in the relevant SOP and possess the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

Equipment to be used during sample collection may include, but are not limited to the following:

- Health and Safety Plans
- Appropriate personal protective equipment (PPE)
- Nitrile gloves and work gloves
- Work permits
- Scientific Collectors permit
- Insect repellent
- Sunscreen
- Permanent markers

- Field data sheets
- Equipment decontamination supplies
- Appropriate sample containers, labels, and forms
- Surveyors tape or pin flags
- Sherman[®] live traps
- Bait (e.g., dried oats, peanut butter, bacon grease, and commercial shrew bait)
- Cotton or wool stuffing
- Plastic tub with lid of sufficient size to hold a live trap
- Plastic tubing
- Carbon dioxide gas tank with regulator
- Appropriate cooler(s) with ice and shipping materials
- Disposable sterilized sampling bags
- Digital camera
- Hand-held differential global positioning system (GPS)
- Field logbook
- Portable digital scale.

IV. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Sampling should not be done during hazardous weather conditions, including while lightning or other severe weather conditions are occurring. Since the collection of small mammals requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

V. Procedure

Selection of Small Mammal Sampling Areas

Areas for small mammal collection will be selected and mapped prior to conducting field collection activities. Specific position of trapping locations within the sampling area will be selected in the field, as described below. Trapping will target shrews as a first choice of small mammal. However, as shrews are often difficult to trap, mice will be selected as a secondary small mammal for collection.

Setting Small Mammals Traps

Field personnel will set ten traps within a 30-foot radius of the pre-selected representative soil sample location. Field personnel will set traps in areas with appropriate habitat (e.g., brush piles, fallen logs, and burrows) to maximize potential captures. Traps should be set along small mammal paths, indicated by features such as grass runways or scat, if such features are observed. Trap lines should be placed in areas that are out of sight of roads, sidewalks, paths, or other areas of human activity. Avoid areas frequented by livestock to prevent destruction or accidental tripping of traps.

After setting traps flush with the ground, field personnel will check sensitivity of trap release mechanism and bait the traps. Bait will be composed of commercial shrew bait or a mixture of dried oats, peanut butter, and bacon grease. Field personnel will place a small amount of cotton

or wool to provide warmth in the case that an animal is caught. For Sherman® traps, place small amount of bait in the back on the spring platform and depress trigger mechanism.

Traps should be set on the evening of the first day of trapping or should be closed immediately after placement and reopened and baited in the evening. Field personnel will mark trap locations with surveyors flagging or pin flags. If trapping success is limited after two days, traps will be deployed during daytime and additional small mammal species may be targeted.

Field personnel will check traps early each morning and collect small mammal captures, as described below. After checking traps, field personnel will close traps for the remainder of the day. Traps will be reopened and re-baited, if necessary, each evening.

Collecting Captured Small Mammals

Prior to handling traps, field personnel will don nitrile gloves and work gloves. Check each trap for evidence of capture or visitation. If a trap appears to have been visited but not sprung (e.g., contains urine, feces, or nesting material in or on the trap), place the trap in a double plastic bag to be washed with soap and water and checked for proper function. Replace the trap with a clean trap.

When a live trap is encountered with the door closed, lift the trap without shaking it. Standing with the trap held at arm's length, push the door open just enough to peer into the trap and confirm the presence of a captured rodent. If there is no capture and no evidence of visitation, check the adjustment of the trap and replace it in the trap line. If a non-target species has been captured, carefully release the animal at the site of capture and then reset the trap or place the trap in a bag for decontamination.

If the trap contains a target species, close the trap door. Field personnel will then place the trap in a plastic container connected to a carbon dioxide canister. Place a lid on the plastic container and slowly turn on the carbon dioxide regulator. Pay careful attention to the gas release rate, so as not to blow off the container lid. Allow the carbon dioxide to run for five minutes and shut off the regulator.

Remove the trap from the container and remove the trapped small mammal. Field personnel will then perform cervical dislocation of the animal by grasping the tail and the neck and pulling in separate directions.

Depending on trapping success, traps may be collected to place in a different location for the next evening or, if trap success was reasonable (10% or better), they may be left in the same location for additional nights. Additionally, traps may be set during the day if trapping success is limited during the night.

General Procedures

Field personnel will record sample designations, field observations, lowest field-identifiable taxon of mammals collected, and weights in the field logbook. If appropriate, photographs will be taken of representative specimens for proof of collection and summary reporting.

Small mammal samples will be placed in a cooler in the field and frozen as soon as possible. The laboratory will explicitly be instructed to analyze frozen samples to avoid loss of fluids during the thawing process.

The field logbook will be used to record information such as observations made in the field and to note any deviations in sampling methodology that may be necessary to accommodate field conditions. Field personnel will record all relevant information in the field logbook and take supplementary photographs as needed to record field conditions.

Sampling materials and waste will be collected before leaving the sampling area.

VI. Waste Management

Rinse water, PPE, and other residual material generated during the equipment decontamination will be placed in appropriate containers. Containerized waste will be disposed of consistent with appropriate procedures

VII. Data Recording and Management

Field sampling personnel will document field sampling events in the project field logbook to record all relevant information in a clear and concise format. As an alternative, a bound field notebook may be used at the discretion of field personnel to document field activities. The record of field sampling events will include:

- Project number, client, and site location
- Date
- Field sampling personnel
- Subcontractors
- Name and affiliation of all site visitors
- Field sampling equipment with serial numbers

- Weather
- Equipment calibration details
- Sample locations
- PID readings
- Tissue description and taxon identification
- Samples collected and analytical parameters
- Sample times
- Air monitoring readings
- Other miscellaneous observations.

VIII. Quality Assurance

Sampling equipment for small mammal collection only requires soap and water decontamination when traps have been visited.

Tissue samples do not allow for collection of blind duplicate samples. Sufficient mass of small mammal tissue will be collected at a frequency of 1 per 20 samples to perform matrix spike/matrix spike duplicate laboratory Quality Assurance/Quality Control (QA/QC) samples. Additional internal laboratory QA/QC samples will be conducted in accordance with the Quality Assurance Project Plan (CSC, 2004, Appendix B). As samples are not being collected for volatile organic compounds and cross contamination of small mammal tissue between sample locations is unexpected, no trip or field blank QA/QC samples are proposed.

IX. References

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

Small Mammal Collection Field Data Sheet

Project Description:		Project Number:	
Location of Sampling Event:		Date (ddmmyy):	
Sampling Personnel:	Field Team Leader:	Time (hh:mm):	
Weather Conditions: Sunny <input type="checkbox"/> Partly Sunny <input type="checkbox"/> Cloudy <input type="checkbox"/> Raining <input type="checkbox"/> Calm <input type="checkbox"/> Slightly Windy <input type="checkbox"/> Windy <input type="checkbox"/> Gusting Winds <input type="checkbox"/>			
Ambient Air Temperature (°F): _____			
Composite Sample ID:		Person-minutes of sampling effort:	
Sub – sample ID	Sub-Sample description	Taxon in sub-sample	Weight of sub-sample (g)
Total Weight of Composite Sample:			
Notes/Comments:			

APPENDIX D

**COMPOSITE SOIL, SEDIMENT, AND TISSUE SAMPLING STANDARD
OPERATING PROCEDURE**

Composite Soil, Sediment, and Tissue Sampling

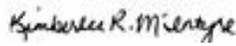
Rev. #: 00

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Approval Signatures

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Reviewed by:  Date: 03/24/09
(Technical Expert)

Reviewed by:  Date: 03/24/09
(Editorial Reviewer)

Reviewed by:  Date: 03/24/09
(Quality Assurance Reviewer)

Reviewed by:  Date: 03/24/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the field sampling procedures for compositing soil, sediment, plant, soil invertebrate, and small mammal samples for tissue analysis. This is a standard (i.e., typically applicable) operating procedure that may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project report. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the U.S. Environmental Protection Agency (USEPA) as soon as practicable and documented in the project report.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. Field personnel will obtain the appropriate Scientific Collector's Permits from California Department of Fish and Game prior to performing field activities. In addition, ARCADIS field personnel will be versed in the relevant SOP and possess the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

Equipment to be used during sample collection may include, but are not limited to the following:

- Health and Safety Plans
- Appropriate personal protective equipment (PPE)
- Nitrile gloves and work gloves
- Work permits
- Scientific Collectors permit
- Insect repellent
- Sunscreen
- Permanent markers
- Field data sheets

- Equipment decontamination supplies
- Appropriate sample containers, labels, and forms
- Appropriate cooler(s) with ice and shipping materials
- Tweezers
- Spray bottles
- Hand spade
- Shovel
- 1-gallon cans
- Stainless steel bowls and spoons
- Bait (e.g., rotting meat, apples, dried oats)
- Cotton or wool stuffing
- 2-foot square plywood coverboards
- Concrete blocks
- Disposable sterilized sampling bags
- Photoionization detector (PID)
- Digital camera
- Hand-held differential global positioning system (GPS)
- Field logbook
- Portable digital scale
- Plastic sheeting.

IV. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Caution should be used while using shovels or spades. Field teams should verify that when one sampler is using digging equipment, the other samplers should remain a safe distance away. Additionally, common injuries resulting from use of shovels and spades, such as strains and cuts, should be paid careful attention.

Debris such as metal scrap, bottles, and cans might be buried in the soil. Field crews should scan the collection area for debris, and remove it prior to digging. Crews should also be careful when sifting through soil.

Sampling should not be done during hazardous weather conditions including while lightning or other severe weather conditions are occurring. Since the collection of soil invertebrates requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

V. Procedure

The field team leader will determine the field crew size by assessing the difficulty of obtaining samples prior to collection. A minimum 2-person crew will be used for safety purposes and more people will be added to the crew, as evaluated by the field crew leader, to ensure safety and efficiency.

The field crew will evaluate sampling gear at the end of each day and start of each sampling day to ensure that equipment is functioning properly and in good condition. Equipment that is not functioning properly

or is not in good condition will not be used until repaired. Equipment will be sharpened and decontaminated as needed.

The sampling crew will identify the sample location from sampling map. Site conditions will be documented and a brief description will be recorded in the field notebook. For all tissue types, tissue samples will be targeted to follow the hierarchy presented in the Sampling and Analysis Plan. However, if sufficient mass of these grouping of preferred taxon is not available then other groupings of taxa will be collected, as necessary. If sufficient mass is not available to collect a single taxon, then a composite of all opportunistically collected taxa will be selected to makeup the sample. To reflect this hierarchy of collection, field personnel will first attempt to collect the preferred taxa.

Plant Tissue Composite Sample Methods

Plant tissue samples will be collected as described in the SAP and in Appendix A. The following hierarchy of plants will be used to collect tissue from the sample locations.

- Saltbush (*Atriplex sp.*)
- Coyote bush (*Baccharis pilularis*)
- Annual grasses (Family Poacea)

To the extent feasible, the same taxon of plant tissue will be collected at each location within a study area. The taxon selected for collection will be evaluated in the field based on the above hierarchy and depending on which taxon is present at all the proposed sample locations.

Each plant sampling location will be located as close as possible to the central soil sample location (i.e., existing RI sample location) and no more than approximately 10-foot radius area around each central soil sample location. Plant sampling will follow the methods described in Appendix A. A co-located surface soil (0 to 0.5 foot bgs) sub-sample will be collected along with each plant tissue sub-sample collected at the base of the plant. Each soil sub-sample will be placed in a stainless steel bowl until all four sub-samples have been collected. The four soil sub-samples will be homogenized in the field and then placed into appropriate laboratory containers for shipment to the laboratory. Soil sample containers will be maintained at 4° C in coolers with ice from the time of sample collection until shipment to the laboratory. Each plant sub-sample will be placed into a plastic bag until all four plant sub-samples have been collected. Once all four plant samples have been collected, the plant samples will be sealed in a plastic bag and shipped to the laboratory for homogenization and then analysis. Plant tissue samples will be maintained at 4° C while in the field and will be frozen as soon as possible for shipment to the laboratory. If sufficient mass is available, one replicate sample will be collected from each study area.

From each tissue sampling location, the composite tissue analytical value and the composite soil analytical value will be paired to develop regression equations to model bioaccumulation from soil-to-plant tissue.

Soil Invertebrate Tissue Composite Sample Methods

A minimum of 15 to 55 grams of composite tissue (wet weight; dependent on analyte suite) will be collected at each sample location and material from a single sample location will be composited to provide a representative sample of prey concentrations in that specific sampling location. Those organisms that are most directly associated with the soil such as earthworms will be targeted, as these organisms are expected to have the highest potential body burdens. However, the sampling will be “opportunistic” in that all soil invertebrates captured will be retained. The following hierarchy will be used to form composite tissue samples.

- Annelida (earthworms)
- Gastropoda (slugs and snails)
- Coleoptera (beetles)
- Orhoptera (grasshoppers and crickets)
- Composite invertebrate tissue sample of all other opportunistically collected invertebrates.

Tissue samples will be separated by organism type identified above, and the final samples submitted to the laboratory will preferentially consist of a single taxon of soil-associated invertebrates where sufficient sample mass can be achieved. Samples may consist of multiple organism types if sufficient sample mass for preferred single taxon of tissue type cannot be achieved. The lowest field identifiable taxon of tissue and number and mass composing these taxa included in the sample will be recorded. If sufficient mass is available, one replicate sample will be collected from each study area.

In each soil invertebrate sampling area (representing a single location), field personnel will collect a total of nine soil sub-samples; one surface soil (0 to 0.5 foot bgs) sub-sample at the central soil sample location (based on the initially selected RI soil sample location) and two surface soil (0 to 0.5 foot bgs) sub-samples per quarter of the sampling area (see Section 2.3 and Figure 4 of SAP). These nine sub-samples will be placed in a stainless steel bowl and then composited to represent one single location. If sufficient mass is available, one replicate sample will be collected from each study area.

Soil invertebrate tissue selected for collection, as described above, within each tissue sampling area will be composited for a single sample for laboratory analysis. Soil invertebrate samples will be stored at 4° C while in the field and will be frozen as soon as possible for sample compositing and subsequent shipment to the laboratory. Soil samples collected in the tissue sampling area will also be composited to obtain a single soil value to correspond to the composite soil invertebrate tissue sample. Soil sub-samples will be homogenized in a stainless steel bowl and transferred to appropriate laboratory containers for shipment to the laboratory. Soil samples will be maintained at 4° C while in the field and during shipment to the laboratory.

From each tissue sampling area, the composite tissue analytical value and the composite soil analytical value will be paired to develop regression equations to model bioaccumulation from soil-to-soil invertebrate tissue.

Small Mammal Tissue Composite Sample Methods

Each small mammal tissue sampling location will encompass an area with an approximately 30-foot radius from each central soil sample location (i.e., existing RI sample location). Small mammal sampling will follow the methods described in Appendix C. The soil samples collected for soil invertebrates (see Section 2.3 and Figure 4 of SAP) will be used to develop uptake relationships for mammals; no additional co-located soil samples are necessary.

Small mammals tissue will be kept at 4°C in the field and frozen as soon as possible to await sample composite and shipment to the laboratory. Small mammal tissue collected within each tissue sampling area will be shipped to the laboratory where they will dissect out the kidney and liver tissues. Specific tissue types (i.e., liver, kidney and carcass) will be composited from individuals collected at a single tissue sample area and each tissue type will be analyzed separately in the laboratory. The weights of the three tissue types will be recorded separately so that a whole body tissue concentration can be calculated. Soil sub-samples collected in the tissue sampling area will be composited to obtain a single soil sample. From each tissue sampling area, the composite whole body tissue analytical value and the composite soil analytical values will be paired to help develop regression equations to model bioaccumulation from soil-to-small mammal tissue. Organ-specific data will be compared to organ-specific toxicity values.

Aquatic Invertebrate Tissue Composite Sample Methods

As described in the SAP and Appendix E, aquatic invertebrate sampling will be focused, to the degree possible, on organisms that are expected to be more closely associated with sediment as these organisms would potentially have the highest body burdens and would be the most appropriate to evaluate bioaccumulation into biota from sediment relationships. The lowest field-identifiable taxon of tissue included in the sample will be recorded. If sufficient mass is available, one replicate sample will be collected. Aquatic invertebrate samples will be composed of the following hierarchy of groupings, as necessitated by tissue mass limitations.

- Benthic and epi-benthic aquatic invertebrates
- Water column aquatic invertebrates
- Composite aquatic invertebrate tissue sample of all opportunistically collected aquatic invertebrates

Benthic/epi-benthic aquatic invertebrates will be separated from water column aquatic invertebrates during sample collection. Once sample collection is complete, the mass of each grouping will be weighed and the group(s) that yield sufficient mass for analysis will be submitted to the laboratory. If sufficient mass cannot be achieved from a single grouping, then all opportunistically aquatic invertebrates will be combined to comprise a single sample, although this is the least preferred sample composition.

The paired sediment and tissue data will be used to develop regression equations to model bioaccumulation from sediment-to-biota tissue. If enough mass is obtained, water column invertebrates

will be analyzed separately and surface water monitoring data used to develop and water-to-biota relationship.

General Procedures

Field personnel will record sample designations, field observations, groupings of invertebrates included in the sample and weights of sub-samples in the field logbook.

Soil/sediment and tissue samples will be placed in a cooler in the field and tissue samples will be frozen as soon as possible to prevent depuration. Tissue grouping within a type (e.g., annelids for terrestrial invertebrate tissue) will be kept separately and added to daily until sufficient mass for analysis is achieved. If sufficient mass for analysis of a single grouping is not achieved during the sampling event, then multiple groupings will be composited to form a single sample and taxon and mass of each group included in the sample will be recorded. The laboratory will explicitly be instructed to analyze frozen samples to avoid loss of fluids during the thawing process.

The field logbook will be used to record information such as observations made in the field and to note deviations in sampling methodology that may be necessary to accommodate field conditions. Field personnel will record relevant information in the field logbook.

All equipment will be decontaminated for gross contamination (i.e., soil residuals from sampling) using distilled water, non-phosphate detergent, and a stiff bristled brush between each sampling location. Gloves (nitrile) will be changed between each location.

Sampling materials and waste will be collected before leaving the sampling area.

VI. Waste Management

Rinse water, PPE, and other residual material generated during the equipment decontamination will be placed in appropriate containers. Containerized waste will be disposed of consistent with appropriate procedures.

VII. Data Recording and Management

Field sampling personnel will document field sampling events in the project field logbook to record all relevant information in a clear and concise format. As an alternative, a bound field notebook may be used at the discretion of field personnel to document field activities. The record of field sampling events will include:

- Project number, client, and site location
- Date

- Field sampling personnel
- Subcontractors
- Name and affiliation of all site visitors
- Field sampling equipment with serial numbers
- Weather
- Equipment calibration details
- Sample locations
- PID readings
- Tissue description and taxon identification
- Samples collected and analytical parameters
- Sample times
- Air monitoring readings
- Other miscellaneous observations.

VIII. Quality Assurance

Equipment will be decontaminated for gross contamination prior to use on the site, between each sample location, and upon completion of the sampling program prior to leaving the site. Reusable equipment and associated tools, including shovels/trowels, sampling equipment, and other equipment or tools will be decontaminated.

Sufficient mass of soil/sediment and tissue will be collected at a frequency of 1 per 20 samples to perform matrix spike/matrix spike duplicate laboratory Quality Assurance/Quality Control (QA/QC) samples. Additional internal laboratory QA/QC samples will be conducted in accordance with the Quality Assurance Project Plan (CSC, 2004, Appendix B). As samples are not being collected for volatile organic compounds and cross contamination between sample locations is unexpected, no trip or field blank QA/QC samples are proposed.

IX. References

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

APPENDIX E

AQUATIC INVERTEBRATE TISSUE SAMPLING STANDARD OPERATING PROCEDURE

Aquatic Invertebrate Tissue Sampling

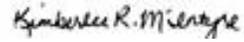
Rev. #: 02

Rev Date: March 17, 2009

Approval Signatures

Prepared by:  Date: 03/17/09

Reviewed by:  Date: 03/17/09
(Technical Expert)

Reviewed by:  Date: 03/23/09
(Editorial Reviewer)

Reviewed by:  Date: 03/25/09
(Quality Assurance Reviewer)

Reviewed by:  Date: 03/25/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the field sampling procedures for aquatic invertebrate samples for tissue analysis. This is a standard (i.e., typically applicable) operating procedure that may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project report. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the U.S. Environmental Protection Agency (USEPA) as soon as practicable and documented in the project report.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. Field personnel will obtain the appropriate Scientific Collector's Permits from California Department of Fish and Game prior to performing field activities. In addition, ARCADIS field personnel will be versed in the relevant SOP and possess the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

Equipment to be used during sample collection may include, but are not limited to the following:

- Health and Safety Plans
- Appropriate personal protective equipment (PPE)
- Personal flotation devices
- Chest waders
- Nitrile gloves and work gloves
- Work permits
- Scientific Collectors permit

- Insect repellent
- Sunscreen
- Permanent markers
- Field data sheets
- Equipment decontamination supplies
- Appropriate sample containers, labels, and forms
- Appropriate cooler(s) with ice and shipping materials
- Combined water quality meter
- Tweezers
- Spray bottles
- D-frame dip net, 500 μm mesh
- Standard kick net, 500 μm mesh
- Petite ponar dredge
- Standard U.S. no. 30 sieve screen
- Disposable sterilized sampling bags
- Photoionization detector (PID)
- Digital camera
- Hand-held differential global positioning system (GPS)
- Field logbook
- Portable digital scale

- Plastic sheeting.

IV. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Aquatic invertebrate tissue sampling will require work over/in water. Therefore, field personnel should be aware of hazards inherent to work over/in water (e.g., drowning, hypothermia, and electrocution). Field personnel working within six feet of water must wear personal flotation devices. If personnel are working in water more than waist deep, a shore watch should be used.

Sampling should not be done during hazardous weather conditions including while lightning or other severe weather conditions are occurring. Since the collection of soil invertebrates requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

V. Procedure

The field team leader will determine the field crew size by assessing the difficulty of obtaining invertebrates prior to collection. A minimum 2-person crew will be used for safety purposes and more people will be added to the crew, as evaluated by the field crew leader, to ensure safety and efficiency.

The field crew will evaluate sampling gear at the end of each day and start of each sampling day to ensure that equipment is functioning properly and in good condition. Equipment that is not functioning properly or is not in good condition will not be used until repaired. Aquatic invertebrate samples will be collected using a variety of different sampling techniques until sufficient mass is collected. Collection methods are described below.

D-Ring Net Collection Methods

The field crew will focus on shoreline areas of the aquatic habitat to target aquatic invertebrates that may be preyed on by wading birds and dabbling ducks. Aquatic invertebrate sampling areas will be within approximately 30 feet of preselected sediment sample locations. A composite of aquatic invertebrates located in this area will be collected. Water quality data (temperature, dissolved oxygen, pH, specific conductivity, turbidity, and water velocity) will be collected within 1 meter of the substrate surface, and will be collected prior to collection sediment samples. If sample locations are close together, this data will be recorded once for each general area.

Field personnel will disturb the sediment surface in front of the D-ring net and then pass the net through the disturbed area just above the sediment surface. Kicks from different locations in the substrate will be composited to form a single, homogenous sample from each sample location within the sample area. Field personnel will also sweep D-ring nets against coarse woody debris and through emergent vegetation and root mats to collect aquatic invertebrates.

Field personnel will also perform sweeps of the water column and water surface with D-ring nets to collect water column aquatic invertebrates, if available.

Collected invertebrates will be separated as water column or benthic/epi-benthic aquatic invertebrates, placed into sample containers, and the process will be repeated until sufficient mass is collected for laboratory analysis (i.e., 15 to 65 grams). Aquatic invertebrate samples will be frozen at the end of each day and when sufficient mass has been collected. Each sample will be labeled with sampling date and collection location, and the taxon of invertebrates collected will be recorded, to the extent possible, based on field identification.

Kick Net Collection Methods

If D-ring net collection methods result in insufficient mass for laboratory analysis, field personnel will attempt to collect aquatic invertebrate tissue using kick net methods.

Kick net methods are similar to D-ring net methods. However the procedure will require three personnel. One field personnel will disturb pond sediment in front of the kick net. Two trailing field personnel will then pass the kick net through the disturbed area just over the sediment

surface. Field personnel will then remove the net from the water and hand pick aquatic invertebrates collected.

Collected invertebrates will be placed into sample containers, and the process will be repeated until sufficient mass is collected for laboratory analysis (i.e., 15 to 65 grams). Aquatic invertebrate samples will be frozen at the end of each day and when sufficient mass has been collected. Each sample will be labeled with sampling date and collection location, and the taxon of invertebrates collected will be recorded, to the extent possible, based on field identification.

Petite Ponar Dredge Collection Methods

If D-ring and kick net collection methods result in insufficient mass for laboratory analysis, field personnel will attempt to collect aquatic invertebrate tissue using petite ponar dredge methods.

Field personnel will take sediment samples from the top 6 inches of sediment in the sampling area using a petite ponar dredge. Sediment will then be sieved through a standard U.S. no. 30 mesh. Aquatic invertebrates collected during sieving will be placed in sample containers, and the process will be repeated until sufficient mass is collected for laboratory analysis (i.e., 15 to 65 grams). Aquatic invertebrate samples will be frozen at the end of each day and when sufficient mass has been collected. Each sample will be labeled with sampling date and collection location, and the taxon of invertebrates collected will be recorded, to the extent possible, based on field identification.

General Procedures

Field personnel will record sample designations, field observations, groupings of invertebrates included in the sample, and weights of sub-samples in the field logbook. If appropriate, photographs will be taken of representative specimens for proof of collection and summary reporting.

Invertebrate samples will be placed in a cooler in the field and frozen as soon as possible to prevent depuration. The laboratory will explicitly be instructed to analyze frozen samples to avoid loss of fluids during the thawing process.

The field logbook will be used to record information such as observations made in the field and to note deviations in sampling methodology that may be necessary to accommodate field conditions. Field personnel will record relevant information in the field logbook.

D-ring nets, kick nets, and petite ponar dredge samplers will be decontaminated for gross contamination (i.e., soil residuals from sampling) using distilled water, non-phosphate

detergent, and a stiff bristled brush between each sampling location. Sampling equipment will also be decontaminated with methanol and nitric acid followed by a distilled water wash. Gloves will be changed between each location.

Sampling materials and waste will be collected before leaving the sampling area.

VI. Waste Management

Rinse water, PPE, and other residual material generated during the equipment decontamination will be placed in appropriate containers. Containerized waste will be disposed of consistent with appropriate procedures.

VII. Data Recording and Management

Field sampling personnel will document field sampling events in the project field logbook to record all relevant information in a clear and concise format. As an alternative, a bound field notebook may be used at the discretion of field personnel to document field activities. The record of field sampling events will include:

- Project number, client, and site location
- Date
- Field sampling personnel
- Subcontractors
- Name and affiliation of all site visitors
- Field sampling equipment with serial numbers
- Weather
- Equipment calibration details
- Sample locations
- PID readings
- Tissue description and taxon identification

- Samples collected and analytical parameters
- Sample times
- Air monitoring readings
- Other miscellaneous observations.

VIII. Quality Assurance

Equipment will be decontaminated for gross contamination prior to use on the site, between each sample location, and upon completion of the sampling program prior to leaving the site. Reusable equipment and associated tools, including D-ring nets, kick nets, and petite ponar dredge samplers will be decontaminated.

Tissue samples do not allow for collection of blind duplicate samples. Sufficient mass of invertebrate tissue will be collected at a frequency of 1 per 20 samples to perform matrix spike/matrix spike duplicate laboratory Quality Assurance/Quality Control (QA/QC) samples. Additional internal laboratory QA/QC samples will be conducted in accordance with the Quality Assurance Project Plan (CSC, 2004, Appendix B). As samples are not being collected for volatile organic compounds and cross contamination of invertebrate tissue between sample locations is unexpected, no trip or field blank QA/QC samples are proposed.

IX. References

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

Aquatic Invertebrate Collection Field Data Sheet

Project Description:		Project Number:	
Location of Sampling Event:		Date (ddmmyy):	
Sampling Personnel:	Field Team Leader:	Time (hh:mm):	
Weather Conditions: Sunny <input type="checkbox"/> Partly Sunny <input type="checkbox"/> Cloudy <input type="checkbox"/> Raining <input type="checkbox"/> Calm <input type="checkbox"/> Slightly Windy <input type="checkbox"/> Windy <input type="checkbox"/> Gusting Winds <input type="checkbox"/>			
Ambient Air Temperature (°F): _____			
Composite Sample ID:		Person-minutes of sampling effort:	
Sub – sample ID	Sub-Sample description	Taxon in sub-sample	Weight of sub-sample (g)
Total Weight of Composite Sample:			
Notes/Comments:			

APPENDIX F

FIELD SAMPLE HANDLING, PACKAGING, AND SHIPPING STANDARD OPERATING PROCEDURE

Chain-of-Custody, Handling, Packing, and Shipping

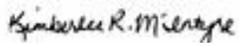
Rev. #: 2

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Approval Signatures

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Reviewed by:  Date: 02/02/09
(Technical Expert)

Reviewed by:  Date: 02/02/09
(Editorial Reviewer)

Reviewed by:  Date: 02/02/09
(Quality Assurance Reviewer)

Reviewed by:  Date: 02/02/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the chain-of-custody, handling, packing, and shipping procedures for the delivery of samples that are protected from cross-contamination, tampering, mis-identification, and breakage, and are maintained in a controlled environment from the time of collection until receipt by the analytical laboratory.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training, including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, will be available during chain-of-custody, handling, packing, and shipping procedures:

- Health and Safety Plans
- Permanent markers
- Polyethylene bags (resealable-type)
- Clear packing tape, strapping tape, duct tape
- Custody seal evidence tape
- Appropriate sample containers, labels, and chain-of-custody forms
- Large (30- to 40-gallon) insulated coolers
- Ice
- Cushioning and absorbent material (i.e., vermiculite)
- Thermometer

- Field notebook.

IV. Cautions

If methanol preservation is used in soil samples, shipping containers must not exceed 500 milliliters (mL) total volume of methanol and must be labeled **“This package conforms to 49 CFR 173.4.”**

V. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Sampling should not be done during hazardous weather conditions including while lightning or other severe weather conditions are occurring. Since the collection of soil invertebrates requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

V. Procedure

Chain-of-Custody

1. Prior to collecting samples, complete the chain-of-custody record (Attachment 1 or laboratory equivalent) header information by filling in the project number, project name,

and the name(s) of the sampling technician(s). Please note it is important that chain-of-custody information is printed legibly using indelible ink.

2. After sample collection, enter the individual sample information by filling in the following chain-of-custody fields:
 - a. STA. NO. Indicates the station number or location that the sample was collected from. Appropriate values for this field include well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30).
 - b. Date. Indicates the date the sample was collected. The date format to be followed should be mm/dd/yyyy (e.g., 03/07/2005).
 - c. Time. Indicates the time the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.
 - d. Comp. This field should be marked with an "X" if the sample was collected as a composite.
 - e. Grab. This field should be marked with an "X" if the sample was collected as an individual grab sample.
 - f. Station Location. This field should represent the complete sample name; although in some instances, it may be similar to the "STA. NO." field. An example of a complete sample name is "SB-3 (0.5-1.0)," where the 0.5-1.0 represents the depth interval in feet from where the sample was collected. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain-of-custody form. Sample names may also use the abbreviations "MS/MSD," "FB," "TB," and "DUP" as prefixes or suffixes to indicate that the sample is a matrix spike/matrix spike duplicate, field blank, trip blank, or field duplicate, respectively.
 - g. Number of Containers. This field represents the number of containers collected at the sampling location to be submitted for analysis.
 - h. Analytical Parameters. The analytical parameters that the samples are being analyzed for should be written legibly on the diagonal lines to the right of the "number of containers" column. As much detail as possible should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering "PCBs" or "Method 8082." Multiple methods and/or analytical parameters may be combined

for each column (e.g., PCBs/VOCs/SVOCs or 8082/8260/8270). These columns should also be used to present project-specific parameter lists (e.g., Appendix IX+3 target analyte list or MADEP SW-846). Quality assurance/quality control (QA/QC) information may also be entered in a separate column for each parameter (e.g., PCBs - MS/MSD) to identify a sample that the laboratory is to use for a specific QA/QC requirement. Each sample that requires a particular parameter analysis will be identified by placing an “X” in the appropriate analytical parameter column.

- i. Remarks. The remarks field should be used to communicate special analytical requirements to the laboratory. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG). Reporting requirements that should be specified in the remarks column include: 1) turnaround time; 2) contact and address where data reports should be sent; 3) name of laboratory project manager; and 4) type of sample preservation used.
 - j. Relinquished By. This field should contain the signature of the sampling technician who relinquished custody of the samples to the shipping courier or the analytical laboratory.
 - k. Date. Indicates the date the samples were relinquished. The date format should be mm/dd/yyyy (e.g., 03/07/2005).
 - l. Time. Indicates the time the samples were relinquished. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.
 - m. Received By. This field should contain the signature of the sample courier or laboratory representative who received the samples from the sampling technician.
3. Complete as many chain-of-custody forms as necessary to properly document the collection and transfer of the samples to the analytical laboratory.
 4. Upon completing the chain-of-custody forms, forward two copies to the analytical laboratory and retain one copy for the field records.

Handling

1. After completing the sample collection procedures, record the following information in the field notebook with indelible ink:

- Project number and site name
 - Sample identification code and other sample identification information, if appropriate
 - Sampling method
 - Date
 - Name of sampler(s)
 - Time
 - Location (project reference)
 - Any comments.
2. Fill in sample label with the following information in indelible ink:
- Sample type (e.g., surface water)
 - Project number and site name
 - Sample identification code and other sample identification information, if applicable
 - Analysis required
 - Date
 - Time sampled
 - Initials of sampling personnel
 - Sample type (composite or discrete)
 - Tissue preparation procedure (biota; e.g., fillets, whole body), if applicable
 - Preservative added, if applicable.
3. Cover the label with clear packing tape to secure the label onto the container.
4. Check the caps on the sample containers to seal them tightly.

5. Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
6. Place a signed custody seal label over the cap such that the cap cannot be removed without breaking the custody seal. Alternatively, if shipping several containers in a cooler, custody seal evidence tape may be placed on the shipping container as described below.

Packing

1. Using duct tape, secure the outside and inside of the drain plug at the bottom of the cooler being used for sample transport.
2. Place each container or package in individual polyethylene bags (resealable-type) and seal. If a cooler temperature blank is supplied by the laboratory, it should be packaged following the same procedures as the samples. If the laboratory did not include a temperature blank, do not add one since the sample temperature will be determined by the laboratory using a calibrated infrared thermometer.
3. Place 1 to 2 inches of cushioning material (i.e., vermiculite) at the bottom of the cooler.
4. Place the sealed sample containers upright in the cooler.
5. Package ice or blue ice in small resealable-type plastic bags and place loosely in the cooler. Do not pack ice so tightly that it may prevent the addition of sufficient cushioning material. Samples placed on ice will be cooled to and maintained at a temperature of approximately 4°C.
6. Fill the remaining space in the cooler with cushioning/absorbent material. The cooler must be securely packed and cushioned in an upright position and be surrounded by a sorbent material capable of absorbing spills from leaks or breakage of sample containers. (Note: to comply with 49 CFR 173.4, filled cooler must not exceed 64 pounds).
7. Place the completed chain-of-custody record(s) in a large resealable-type bag and tape the bag to the inside of the cooler lid.
8. Close the lid of the cooler and fasten with packing tape.
9. Wrap strapping tape around both ends of the cooler.
10. Mark the cooler on the outside with the following information: shipping address, return address, "Fragile, Handle with Care" labels on the top and on one side, and arrows indicating "This Side Up" on two adjacent sides.

11. Place custody seal evidence tape over front right and back left of the cooler lid and cover with clear plastic tape.

Note: Procedure numbers 2, 3, 5, and 6 may be modified in cases where laboratories provide customized shipping coolers. These coolers are designed so the sample bottles and ice packs fit snugly within preformed styrofoam cushioning and insulating packing material.

Shipping

1. All samples will be delivered by an express carrier within 48 hours of sample collection. Alternatively, a laboratory courier may be used for sample pickup. If parameters with short holding times are being analyzed (e.g., VOCs [EnCore™ Sampler], nitrate, ortho-phosphate [dissolved], and BOD), sampling personnel will take precautions so that the maximum holding times for these parameters will not be exceeded.
2. The following chain-of-custody procedures will apply to sample shipping:
 - Relinquish the sample containers to the laboratory via express carrier or laboratory courier. The signed and dated forms should be included in the cooler. The express carrier will not be required to sign the chain-of-custody forms.
 - When the samples are received by the laboratory, laboratory personnel will complete the chain-of-custody by recording the date and time of receipt of samples, measuring and recording the internal temperature of the shipping container, and checking the sample identification numbers on the containers to ensure they correspond with the chain-of-custody forms.

VI. Waste Management

Not applicable.

VII. Data Recording and Management

Copies of chain-of-custody forms will be maintained in the project file.

VIII. Quality Assurance

Chain-of-custody forms will be filled out in accordance with the Quality Assurance Project Plan (QAPP) (CSC, 2004, Appendix B). A copy of the completed chain-of-custody form forwarded with the samples to the laboratory will be sent to the Project Manager for review.

Subsequent chain-of-custody form submissions to the Project Manager will be at the Project Manager's discretion.

IX. References

CSC. 2004. Casmalia Site Remediation RI/FS Work Plan. Casmalia Hazardous Waste Facility, Casmalia, California. Casmalia Steering Committee. June.

APPENDIX G

FIELD SAMPLING EQUIPMENT DECONTAMINATION STANDARD OPERATING PROCEDURE

Field Equipment Cleaning/Decontamination

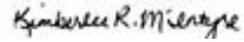
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Approval Signatures

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(Technical Expert)

Reviewed by:  Date: 02/02/09
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Reviewed by:  Date: 02/02/09
(Quality Assurance Reviewer)

Reviewed by:  Date: 02/02/09
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) outlines the cleaning/decontamination procedure to be used for non-disposable field sampling equipment that may come in contact with environmental samples. This equipment may include, but is not limited to, shovels, spoons, bowls, bottles, auger sample barrels/liners, well construction materials, well screens, non-disposable tubing, water pumps, etc.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training, including 40-hour HAZWOPER training, Loss Prevention System (LPS) training, and site-specific health and safety training. Field personnel will also have site supervisor training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired fieldwork.

III. Equipment List

Equipment to be used during sample collection may include, but are not limited to the following:

- Health and Safety Plans
- Distilled water;
- Non-phosphate soap (Alconox or equivalent);
- Rinse collection plastic containers;
- Brushes;
- Aluminum foil;
- Garbage bags;
- Spray bottles;
- Paper towels.

IV. Cautions

Rinse equipment thoroughly and allow the equipment to dry before re-use and storage.

V. Health and Safety Considerations

Emergency information and emergency response procedures will be relayed to all field sampling personnel in the site-specific health and safety plan and during daily safety meetings. The means to summon local response agencies such as on-site emergency response personnel, police, fire, and ambulance will be reviewed in the daily safety meeting.

Appropriate PPE will be worn by field personnel within the designated work area.

Air monitoring may be required during sampling activities as required in the Health and Safety Plan.

Sampling should not be done during hazardous weather conditions including while lightning or other severe weather conditions are occurring. Since the collection of soil invertebrates requires outdoor work, samplers should be aware of plants that cause allergic reactions (i.e., poison ivy), organisms that sting (i.e., bees and wasps) and organisms that bite (i.e., ticks, snakes, and mosquitoes). Sampling will not occur in a specific location if there is a significant concern or likelihood that an encounter with a snake, poisonous plant, or stinging insect will occur in that location. The location of the sampling will be moved and the rationale noted in the field logbook.

The site-specific health and safety plan will be reviewed prior to sampling. Daily tailgate safety meetings will be conducted prior to the start of field sampling activities and after lunch. The job safety analysis (JSA) form for each task must be reviewed each morning of the sampling effort before sampling to identify further site-specific hazards, precautions, and safety procedures and edited each morning to reflect lessons learned the previous day.

VI. Procedure

1. Follow health and safety procedures specified in the Health and Safety Plan.
2. Cleaning of reusable sampling equipment (e.g., scoops, mixing bowls, spatulas, etc.) will follow the decontamination procedures presented below:
 - Non-phosphate detergent and distilled water wash;
 - Distilled water rinse;

- Allow to air dry and wrap in aluminum foil;
- Remove PPE per Health and Safety Plan.

Cleaning Procedures for Large Equipment (if applicable)

1. Follow health and safety procedures specified in the Health and Safety Plan .
2. Wash all large equipment with a high pressure water wash, using a brush as deemed necessary to remove any particles.

VII. Waste Management

Water generated during cleaning and decontamination procedures will be collected and contained onsite in appropriate containers for future disposal.

VIII. Data Recording and Management

Equipment cleaning and decontamination will be noted in the field notebook. Containers with decontamination fluids will be labeled.

IX. Quality Assurance

Equipment blanks will be used in association with this SOP. The need for equipment blanks will depend on the data quality objectives.

X. References

Not applicable.