SALTON SEA ECOSYSTEM RESTORATION PLAN

Sampling and Analysis Plan for Data Collection

April 2005

Table of Contents

Items **Page**

Table

Items **Page**

Figure

Items **Page**

SAMPLING AND ANALYSIS PLAN FOR DATA COLLECTION

1.0 INTRODUCTION

The California Resources Agency is preparing a Salton Sea Ecosystem Restoration Plan and accompanying Programmatic Environmental Impact Report (PEIR) in compliance with legislation enacted in 2003. Selenium is known to be present in sediments and biota in the Salton Sea, and a State health advisory has been issued for human consumption of fish from the Salton Sea and the tributary rivers. Selenium also has been found at elevated levels in fish from the Lower Colorado River, but recent data are not available. Other concerns have been raised regarding possible exposures to constituents of potential concern (COPCs) via inhalation of contaminants and dust from exposed or disturbed sediments or soils. From an air quality or inhalation perspective, only limited information is available to support assessment of the significance of selenium, arsenic, and other COPCs in sediment/soil in the Salton Sea vicinity.

This Sampling and Analysis Plan (SAP) is intended to document field and laboratory analytical and QA/QC procedures for the additional sampling and testing of environmental media in and around the Salton Sea. It also includes information regarding the health and safety concerns for the field activities associated with this sampling. The additional sampling and analyses are being conducted to fill short-term data gaps that have been identified as important for evaluating potential human and ecological risks under current conditions and under different proposed ecosystem restoration alternatives.

Environmental media include samples of sediment, surface soils, and aquatic biota in the Salton Sea and surrounding areas. Sediment samples will be sought from archived and from new collection areas within the Salton Sea. Surface soils will be collected from the areas immediately surrounding the Salton Sea. Additional aquatic biota sampling also will be conducted within the Salton Sea and in the Lower Colorado River in cooperation with staff from San Diego State University Salton Sea Ecosystem Research Group (SSERG). Fish sampling in the Salton Sea will be completed in collaboration with personnel from the California Department of Fish and Game (DFG) and will only be done by personnel who possess the required sampling permits. The proposed sampling is limited in scope and area and all necessary precautions will be taken to avoid and minimize inadvertent impacts to individual desert pupfish that may be found in some sampling areas.

1.1 Background

Selenium and arsenic concentrations in biota and fish from the Salton Sea are known to be elevated, but analyses have been limited to relatively few individuals, and the available data may not be representative of current conditions. Similarly, the data available for selenium and arsenic in fish from the Lower Colorado River are limited, but they indicate that selenium concentrations in some fish are similar to those found in fish in the Salton Sea. The California Office of Environmental Health Hazard Assessment (OEHHA) and the DFG have expressed interest in updating the health advisory for consumption of fish from the Salton Sea, and having current information on selenium and arsenic in fish from the Lower Colorado River would provide perspective for the information about fish in the Salton Sea.

Under some of the future restoration alternatives being considered for the Salton Sea, currently wet or flooded areas could become dry and exposed and thereby become sources of windblown dust. An improved understanding of constituents contained within near-shore sediments and soils is critical for determining the potential health impacts that could arise from human exposure to airborne, fugitive dust. The data for sediment/soil will be used to assess potential air quality or human health impacts under current and potential future conditions.

1.2 General Objectives

In preparation for developing the Salton Sea Ecosystem Restoration Plan, a process was initiated to review existing information and to identify any data gaps that limit the ability to assess the potential impacts of various ecosystem restoration alternatives. As the data gaps were revealed, additional sampling and analyses of environmental media were recommended. The purpose of this SAP document is to provide details on the proposed field and analytical methods that will be used to generate data for the upcoming evaluation of ecosystem restoration alternatives. To meet that goal, this SAP describes project objectives, summarizes currently proposed sampling efforts for different environmental media, and describes overall project QA/QC procedures for field and laboratory methods that will help ensure that the data generated by the sampling and analysis tasks are of sufficient quality for their proposed use in evaluating various ecosystem management alternatives for the Salton Sea.

To address data gaps that have been identified for the Salton Sea Ecosystem Restoration Plan, a focused sampling and analysis program has been developed. The objectives of this sampling and analysis effort will be to (1) characterize levels of selenium in different biota (including macroalgae, zooplankton, aquatic invertebrates, and pileworms) from the Salton Sea where previous sampling may be limited or dated; (2) characterize levels of selenium and arsenic in fish from the Salton Sea and Lower Colorado River; (3) characterize levels of inorganic and organic COPCs in fillets of “catchable-sized” fish from the Salton Sea to support a re-examination of the fish consumption advisory by OEHHA staff; (4) measure concentrations of selenium, arsenic, and other COPCs in sediment/soil samples from near-shore portions of the Salton Sea; and (5) support bench-scale tests for Salton Sea sediments to characterize selenium release under different water quality conditions and to estimate biooaccumulation in aquatic invertebrates.

The data for biota will be used to assess risks associated with consumption of food items by ecological receptors higher in the food webs (such as fish and birds). The data for fish will be used to assess risks associated with consumption of fish by humans and fish-eating birds (such as pelicans). The COPC data for sediments and soils will be used to assess the potential for human health impacts via dust inhalation or other exposure pathways. The purpose of the bench-scale testing for the Salton Sea sediments will be to develop data about selenium release characteristics under different water quality conditions and to estimate toxicity and bioaccumulation characteristics. Protocols for bench-scale testing of sediments are being developed under separate cover. This SAP is intended to support the bench-scale tests by providing QA/QC details for the analyses of samples (i.e., water, sediment, and biota) that result from the tests. The 5-day selenium release tests will require analyses for total selenium in water (Day 1 through Day 4) and selenium species analysis for water samples on Day 5. At the end of the test, sediment samples from intact cores will be homogenized and analyzed for total selenium, total organic carbon (TOC), and particle size distribution. The bioaccumulation test will require total selenium, TOC, and particle size distribution analyses for 2 composite sediment samples (north and south basins) and for individual test chamber sediments. Total selenium analyses will also be completed for test organisms (Nereis and Lumbriculus worms) and for final overlying water for each of the test chambers.The analytical data generated by the proposed sampling and analysis activities will be subjected to a third-party review.

A Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) were prepared in anticipation of the Salton Sea sampling of water, sediment, and food-chain biota that was to begin in mid-March 2005 with SSERG staff. This current SAP incorporates the elements of the original SAP (CH2M HILL, 2005a). It also includes the other types of sampling and analyses that have been incorporated into the program since that time. In this sense, this SAP is intended to cover the sampling and analysis activities that will support the ecological and human health risk assessments that will become part of the Salton Sea Restoration Plan.

Avoidance measures will be taken to avoid inadvertent “take” of the federally listed desert pupfish during the fish sampling, including the choice of depth and location of sampling and net configurations. All fish

sampling will be completed in cooperation with DFG personnel and by qualified personnel with current sampling permits. If desert pupfish are identified in seines, they will be released immediately unharmed into the water.

2.0 PROPOSED ENVIRONMENTAL SAMPLES

2.1 Media and Parameters to Be Sampled

Four types of environmental media will be sampled and analyzed, including water, sediment, soil, and biota. The analytical parameters to be measured are summarized here but are described in more detail in the Field Sampling Plan (FSP) and Quality assurance Project Plan (QAPP), included as attachments to this SAP. Water samples will be collected from the Salton Sea at locations that correspond to sediment and biota samples. Sediment samples may come either from archived samples that are deemed suitable for analysis or from new sample locations in the Salton Sea. Biota samples will be obtained, as available, in a focused sampling event in the Salton Sea and in the Lower Colorado River in the spring of 2005 by personnel from DFG, SSERG, and CH2M HILL. Additional sediments from the Salton Sea will also be collected during the biota sampling events. These sediments will be subjected to bench-scale testing to characterize selenium release characteristics under different water quality conditions that could occur under proposed restoration alternatives. Bench-scale sediment testing also will assess uptake of selenium by aquatic invertebrates.

Water samples will be collected at different depths along proposed transects located in the northern and southern parts of the Salton Sea (Figure 1). The in-field water parameters to be measured will include conductivity, temperature, dissolved oxygen (DO), pH, and water depth. The water samples will then be analyzed for total and dissolved selenium, inorganic selenium, organic selenium, selenate, and selenite. The sediment samples will be submitted for total selenium analysis. Sample splits from a subset of the sediments will be sent to a separate laboratory for the following analyses: individual metals, semivolatile organic compounds (SVOCs), organochlorine pesticides, polychlorinated biphenyls (PCBs), TOC, and particle size distribution. If biota are not found during the spring sampling event, sediment chemistry, as listed above, will still be determined for a number samples, but would not be considered as splits. Near-shore surface soils will also be submitted for the same analytical suite as the sediment sample splits noted above.

Food/prey items to be sampled, as available, will include macroalgae, zooplankton, aquatic invertebrates and small fish. These samples will be analyzed for total selenium. Larger fish that are of sufficient size to yield fillets (if available) will be analyzed for total selenium and arsenic in the fillets. Non-fillet portions of these larger fish will be analyzed separately so that whole-body tissue concentrations can be calculated. To allow comparison to Salton Sea fish tissue concentrations, fish samples will also be collected from three locations in the Lower Colorado River and analyzed for total selenium and arsenic.

Portions of the fish fillets collected in the Salton Sea will be sent to a separate laboratory for the suite of analyses that was identified in the OEHHA protocol for use in supporting their re-examination of the fish consumption advisory. This will entail analysis of individual fillets for selenium, arsenic (total and inorganic), cadmium, and mercury. The fillets will then be composited for organic analyses to include pesticides and PCBs. The moisture content will be determined for all biota samples (where sufficient sample exists) to enable conversions between dry-weight and wet-weight selenium concentrations.

The status of archived sediment samples will be assessed through coordination with staff of the U.S. Geological Survey (USGS) Salton Sea Science Office (SSSO) and Agrarian Research, Inc. Those samples have been previously analyzed to determine TOC and particle size distribution. Suitable archived sediment samples will be submitted for analysis for individual metals. The objective will be to choose up to 40 archived sediment samples from areas where metals data are lacking and from dispersed locations around the Salton Sea. Approximately 10 QA/QC samples (field duplicates, matrix spike/matrix spike duplicates [MS/MSDs]) will also be identified from the same samples for laboratory analyses.

2.2 Sampling Approaches

This SAP describes a range of sampling activities intended to support different aspects of the Salton Sea Ecosystem Restoration Plan. Some of the sampling results will be used to address data gaps that were considered important for being able to evaluate different restoration alternatives being considered for the Salton Sea. Those results will be obtained by sampling to evaluate the potential ecological and human health effects from selenium that could arise under different alternatives. They also include developing baseline information that can be used to assess the potential for human health impacts from inhalation of fugitive dust or other exposure pathways to exposed sediments and near-shore soils. Sediment and water samples from the Salton Sea will also be used in bench-scale tests to characterize selenium release characteristics under different water quality conditions and to estimate bioaccumulation by benthic invertebrates. Table A-1 in the FSP provides an overall summary of the proposed samples and analyses.

2.2.1 Sampling of Food-Chain Biota and Associated Water and Sediment in the Salton Sea

Sampling of food-chain biota is intended to fill data gaps for selenium concentrations in historical sampling and to provide data on current conditions in the Salton Sea. Wherever sufficient biota samples are found, co-located sediment or water (as appropriate for the kind of biota) samples will also be collected in order to permit correlation and modeling of the selenium food-chain pathways. Proposed sampling locations were chosen based on the experience of persons familiar with biota sampling in the Salton Sea and are shown on Figure 1. A summary of the proposed samples is provided in Table A-1 of the FSP, with the understanding that conditions within the Salton Sea may preclude collecting the total number of samples that are planned.

As field conditions permit, food-chain biota will be sampled as close as possible to the designated sampling station. Target sample size for each type of "food item" is 2 grams (g) wet weight or more, but the samplers will obtain adequate material for reliable analysis of selenium content. Up to three composite samples by type will be analyzed for each station and event, when feasible (as described in Appendix A). Dietary items will be identified to the lowest practical taxonomic level, and will be analyzed for total selenium (dry weight, with a reporting limit of 0.5 milligrams per kilogram [mg/kg]) and moisture content. The sampling documentation will also note any deviations from the sampling regime and notable field conditions.

Water grab samples will be collected from the top 3 meters of the water column using an integrated tube sampler and analyzed by a qualified laboratory facility for total recoverable selenium (reporting limit of 0.15 μg/L) as well as dissolved selenium, selenate, selenite, and organic selenium (reporting limit of 0.1 μg/L for each fraction). Field water quality parameters will include station water depth, conductivity, temperature, DO, and pH. Water samples will be collected where plankton are sampled.

A ponar dredge will be used to collect grab samples of sediment. Up to 30 sediment samples will be collected and analyzed wherever sufficient biota samples are collected. Samples will be composited in the laboratory and analyzed for total selenium with a reporting limit of 0.5 mg/kg by the same laboratory that will be used for the biota samples. Field splits of these sediment samples (or original samples if biota sampling is unsuccessful) will be sent to a separate laboratory for a more complete characterization suite for metals, particle size, and TOC. Roughly half of the sediment samples will also be characterized for organic constituents that could include SVOCs, pesticides, and PCBs. A large composite sample of sediment will also be developed from the various locations for use in bench-scale testing to characterize selenium release under various water quality conditions and to measure potential selenium bioaccumulation in aquatic invertebrates.

These data will be used in the ecological risk assessment for selenium and to provide site-specific inputs to a model to predict selenium cycling between abiotic media (water and sediments) and biota in the

Salton Sea. Given the time frame for this project, all of this sampling will be completed between mid-March and the end of April 2005.

2.2.2 Fish Sampling to Assess Human Consumption Pathways

In addition to the ecological food-chain fish sampling in the Salton Sea, there will be an effort to collect fish of larger size (8 inches or greater) from which fillet samples can be taken. The purpose for this sampling is to characterize the current conditions in the Salton Sea with respect to potential pathways for selenium and arsenic to cause human health risks because of the food ingestion pathway. These data will be used in a human health risk assessment for selenium and arsenic in the Salton Sea.

In order to provide a relevant comparison of selenium and arsenic concentrations in fish in the Salton Sea, and to compare with historic data, three locations will be sampled on the Lower Colorado River. These locations would represent fish tissue conditions before the Colorado River water passes through agricultural areas in the Imperial and Coachella Valleys before entering the Salton Sea. The three locations also correspond to prior sampling locations under the National Contaminant Biomonitoring Program (Lake Havasu, Lake Mead, and Imperial Reservoir, and/or the Colorado River at Yuma, Arizona) so that potential qualitative information on contaminant trends might be developed. The fish species to be sampled on the Lower Colorado River will be focused on previously sampled species in the river such as carp, bass, and/or catfish, as well as tilapia, depending on availability.

Provided that fish of adequate size are found in the Salton Sea during the spring 2005 or summer 2005 season, some of the fillet samples will also be analyzed to yield data in support of the OEHHA independent reconsideration of the existing fish consumption advisory for the Salton Sea. These samples will be collected and processed in accordance with U.S. Environmental Protection Agency (USEPA) guidance (USEPA, 2000a) and with a protocol provided by OEHHA staff (included as Attachment A of the FSP). The data required for the evaluation of the fish advisory include a more comprehensive list of inorganic and organic constituents as detailed in the FSP and QAPP.

2.2.3 Sediment Sampling to Characterize Conditions in the Salton Sea

In order to develop a better spatial characterization of sediments around the Salton Sea, especially in shallow, near-shore areas, additional sediment samples will be analyzed. Some of these sediment samples will be taken from archived sediments and some will be collected from new sample locations around the Salton Sea as described in the following sub-sections.

Archived Sediment Samples

Originally, the archived sediment samples were collected by Agrarian Research, Inc. for the USGS SSSO along numerous transects around the Salton Sea at various depths (including shoreline (0, 5, 10, and 15 feet) and the positions were recorded by Global Positioning System (GPS). These samples were then analyzed for TOC and for particle size. In late 2004 and early 2005, approximately 200 of these archived samples were analyzed for total selenium.

An additional 50 samples from the archived sediments will be analyzed to further characterize the near-shore sediments for constituents that could be important for air quality and other human health exposure pathways. These samples will be identified for areas that may not have been well characterized (such as the southern river deltas) and around the remaining perimeter of the Salton Sea. Up to 40 sample locations will be chosen along with up to 10 QA/QC samples (field duplicates and MS/MSDs). These samples will be analyzed for metals. The archived sediment samples will not be analyzed for organic compounds, TOC, or particle size.

A composite sample from the remaining archived sediments will be developed so it can be subjected to wind tunnel testing as part of a fine-fraction study. This composite will be sent to MRI in Kansas City,

KS for independent testing in a high-volume cyclone/impactor system to determine the emission rate of $PM_{2.5}$ and PM_{10} particles.

New Sediment Samples

Similar to the archived sediment samples, new sediment samples will be collected and analyzed to support an assessment of the potential risks to human health that could result from inhalation of fugitive dust or other exposure pathways. Approximately 50 new sediment samples will be collected from 40 sample locations along with up to 10 QA/QC samples (field duplicates and MS/MSDs) in April 2005. Some of these could be collected as field splits during the biota/sediment sampling described in Section 2.4.1. The remainder will be collected from near-shore sampling by boat or by wading into shallow water areas in early April 2005.

These sediment samples will be submitted for metals, TOC, and particle size analysis. Half of these new sediment samples will be analyzed for organic constituents that could include semi-volatile organic compounds, organochlorine pesticides, and PCBs.

2.2.4 Near-Shore Soil Sampling to Characterize Conditions Around the Salton Sea

Similar to the archived and new sediment samples described above, near-shore surface (0 to 6 inches) soil samples will be collected and analyzed to support an assessment of the potential risks to human health that could result from inhalation of fugitive dust or other exposure pathways. These samples will be collected from areas that had been recently flooded but are now exposed. To the degree practical, the soil sample locations will be chosen near the other sediment/biota transects discussed in Section 2.4.1 (shown on Figure 1).

Approximately 50 surficial soil samples will be collected from 40 locations along with up to 10 QA/QC samples (field duplicates and MS/MSDs) in early April 2005. These samples will be submitted for metals, TOC, and particle size analysis. Half of these surface soil samples will be analyzed for organic constituents that could include semi-volatile organic compounds, organochlorine pesticides, and PCBs.

A composite sample from the different soil sample locations will be developed so it can be subjected to wind tunnel testing as part of a fine-fraction study. This composite will be sent to MRI in Kansas City, KS for independent testing in a high-volume cyclone/impactor system to determine the emission rate of $PM_{2.5}$ and PM_{10} particles.

2.3 Sampling Program Duration

As described, the proposed sampling will be completed by April 30, 2005 with analyses and data validation to be completed by June 30, 2005. The only exception to his would be if there are inadequate fish of sufficient size collected for the OEHHA evaluation of the Salton Sea fish consumption advisory. In that case, another attempt to collect those fish would be made during the summer months of 2005. The anticipated date for laboratory analyses and data validation would then be September 30, 2005.

3.0 REPORTING AND DELIVERABLES

A brief technical memorandum will be prepared summarizing the sampling and analyses results for the media described in Section 2.0. This memorandum will describe the sampling methodology and any deviations from this SAP. It will also provide a table to summarize the analytical results and data validation. Interpretation of the significance of the data will occur in the ecological and human health risk assessments in which the data are used.

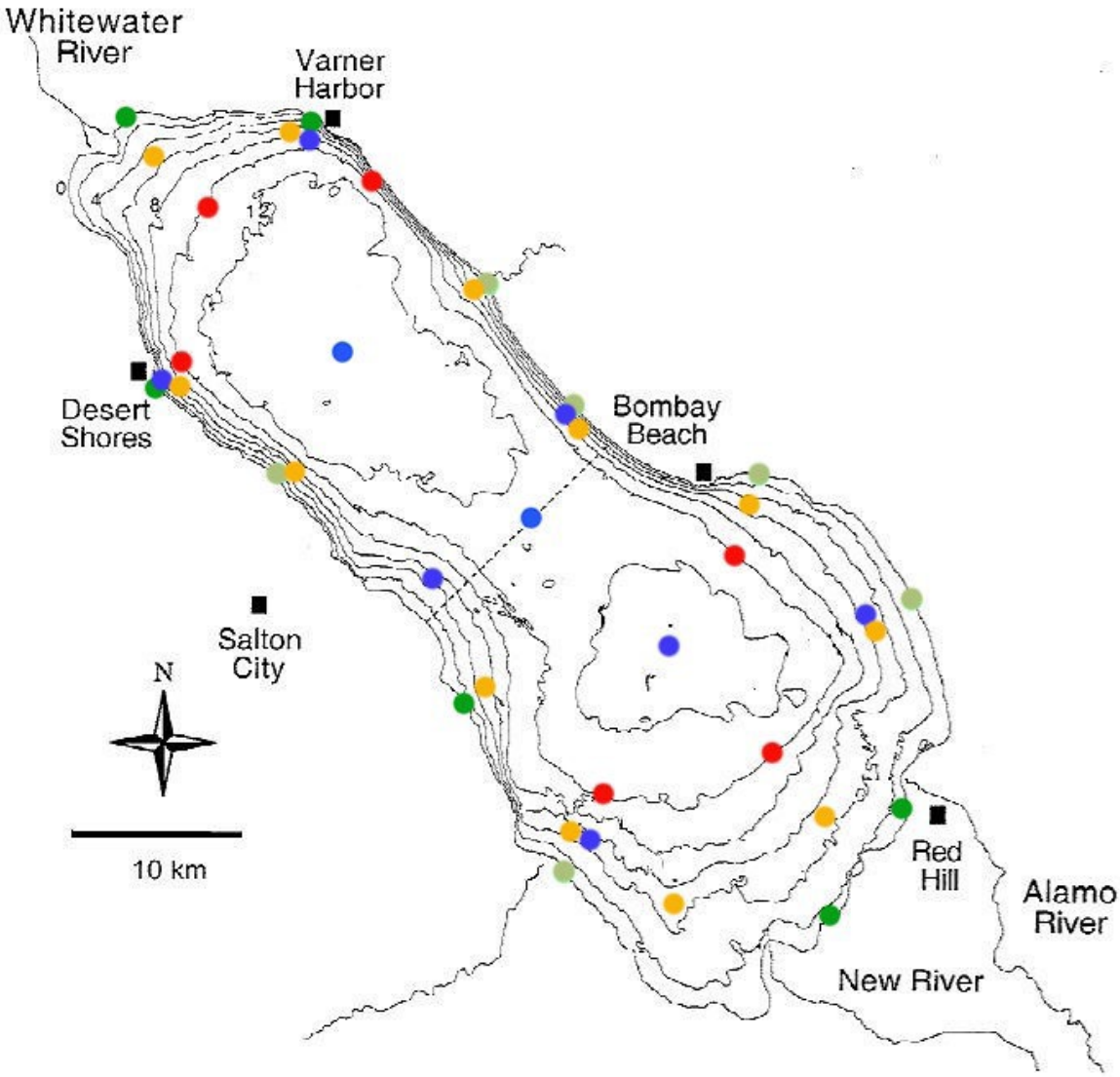

Figure 1
Potential Sampling Locations

Green = Shoreline macroalgae, invertebrate, sediment/water sites, Blue = Zooplankton and water stations, Red = deeper (10 m) pileworm and sediment/water sites, Orange = shallower (5 m) pileworm and sediment/water sites. Six fish sites (< 2 m deep) will be chosen to match successful invertebrate collection sites.

Meeting deliverable deadlines will be critical in the course of this project. The brief technical memorandum will be produced within 14 days of the receipt of the final data validation reports and is expected to be complete by the end of June 2005.

4.0 PROJECT ORGANIZATION AND MANAGEMENT

This section describes the framework for managing the work effort and work products.

4.1 Project Schedule

The schedule is critical to the success of this project. Table 1 shows the schedule for meeting the project milestones.

Table 1
Salton Sea Sampling Efforts in 2005 to Support Ecological and Human Health Risk Assessments

Date	Description
March 14, 2005	Begin sampling for water, sediment, and biota on the Salton Sea
April 1 to April 5, 2005	Sampling of soils and near-shore sediments from around Salton Sea
April 4 to April 15, 2005*	Sampling for fish in Salton Sea and Lower Colorado River
April 30, 2005	Cutoff date for all samples to be delivered to laboratories
May 31, 2005	Cutoff date for all laboratory results to be completed
June 30, 2005	Cutoff date for completion of third-party laboratory data validation

Note:

* If not enough samples of fish of "catchable-size" are caught to support the OEHHA re-examination of the Salton Sea fish advisory, a separate fish sampling effort may be planned together with DFG staff during the summer months of 2005.

4.2 Project Team

The project team will include staff from the DWR, CH2M HILL, USGS SSSO, DFG, and the SSERG. CH2M HILL, on behalf of the California Resources Agency, will manage the data collection effort and all deliverables.

4.3 Health and Safety

A project-specific health and safety plan (HSP) that complies with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 and all other applicable OSHA regulations is provided in Appendix C. CH2M HILL staff will be responsible for the enforcement of the HSP.

4.4 Data Quality Objectives and Quality Assurance/Quality Control

CH2M HILL is responsible for implementing a Quality Assurance/Quality Control (QA/QC) program on this project equaling or exceeding the approach provided in Appendix B. Data quality objectives (DQOs) and the QA/QC requirements are briefly described in this section.

4.4.1 Data Quality Objectives

As previously described, the proposed sampling and analysis activities will yield data that will be used as inputs for assessing potential ecological risks from selenium and human health risks from selenium and arsenic from consumption of fish in the Salton Sea. The data will also be used as inputs for modeling the selenium cycling dynamics that could be anticipated under different restoration scenarios. Additionally, data will be used to assess the potential for human heath impacts due to exposure to near-shore sediments

and soils (from inhalation of fugitive dust and other exposure pathways). Because of the anticipated use of these data, it is important that adequate steps be taken to assure that the data are of the highest possible quality.

The DQO process is a systematic planning process for data collection that has been described as part of USEPA's Total Quality Management activities (USEPA 2000b). The DQO process represents an effort to balance the need to minimize the cost and time of data collection with the need to collect data of sufficient quality and quantity to support defensible decision-making. The results of the DQO process are a series of statements (agreed-upon positions) leading to potential management decisions relative to the significance of selenium in various environmental media. The DQOs for the proposed analyses for COPC concentrations at the Salton Sea are presented in the following subsections.

Step 1: State the Problem

Elevated selenium concentrations may adversely affect fish and wildlife residing in the Salton Sea. In addition, selenium and arsenic may pose a human health risk from consumption of fish caught in the Salton Sea. The potential for human health impacts from fugitive dust and from other exposure pathways to sediment and soil is currently unknown. This work plan describes the sampling that will be conducted to fill some of the data gaps as identified in the *Draft Selenium at the Salton Sea and Summary of Data Gaps* report (CH2M HILL 2005b). It also described preliminary data that will be collected to assess the potential for human health impacts from constituents in near-shore sediments and soils from fugitive dust or other exposure pathways. In addition, it describes the data that will be collected to support an independent re-examination of the Salton Sea fish consumption advisory.

Step 2: Identify the Decision

The results of the biota, water and sediment sampling and analysis program will yield data that will be combined with previously existing data for use in an assessment of ecological risks associated with selenium in the Salton Sea. The selenium data for various abiotic (e.g., water and sediment) and biotic (e.g., algae, aquatic invertebrates, and fish) media will be compared to literature-derived benchmark values to assess the potential for risks to target ecological receptors. The potential for ecological risk will also be assessed by modeling selenium concentrations in various media that represent dietary components for higher-order wildlife receptors, such as birds.

The multi-level samples from various media and biota will be used to further the knowledge of the food web-selenium relationships at the Salton Sea. This information will be used as inputs for modeling selenium cycling in the Salton Sea and the modeling will be used to assess selenium conditions for various restoration alternatives being considered under the ecosystem restoration plan.

If fish are caught during the proposed sampling event in the Salton Sea that are large enough to yield fillets, selenium and arsenic levels will also be measured and this information will be used in a human health risk assessment for the fish consumption pathway. The human health risk assessment will be based upon the concentrations of these two constituents and estimates of fish consumption rates. As previously discussed, portions of these fillet samples will be used by OEHHA staff in an independent re-examination of the Salton Sea fish consumption advisory and the decision of whether to modify or lift the advisory.

The data on COPC concentrations in archived and new sediment and surface soil samples will be used to gauge the potential for human health impacts from fugitive dust and other exposure pathways. The decision from these data will be to determine if more focused analyses are required to complete a human health risk assessment for these pathways.

Step 3: Identify Inputs Affecting the Decisions

Inputs that will be used in the decision making include the results of the ecological and human health risk assessments that will be based in part on newly collected and existing analytical results. For the proposed sampling and analysis activities, inputs will include selenium concentrations in water, sediment, and biota (e.g., algae, zooplankton, pileworms, other aquatic invertebrates, and fish). Selenium species will be characterized for the water samples.

The human health risk assessment for the fish consumption pathway will use the data from the total selenium and arsenic concentrations in fish fillets. For the Salton Sea fish advisory, individual fish fillet samples (skin off) will be used to determine concentrations of total selenium, cadmium, mercury, and arsenic (plus organic arsenic). Composites of these fillet samples will also be analyzed for organochlorine pesticides and PCBs (with congeners).

The concentrations of various inorganic (metals) and organic constituents in near-shore sediments and soils will be used to determine if these media have the potential to increase risks for human health from fugitive dust or from other exposure pathways.

Step 4: Define the Boundaries of the Study

Biota, water, and sediment samples will be opportunistically collected from up to 12 shore-zone sites and 3 mid-lake areas within the Salton Sea. Spatial boundaries of this project include both the northern and southern mid-lake areas as well as selected shore-zone, shallow locations. It will not include sampling within tributary waterways. Abiotic and biotic media will be sampled, according to their availability, at pre-determined sampling stations (Figure 1). Environmental media to be sampled include surface water, sediment (top 10 cm), dietary biota (including macroalgae, zooplankton, and benthic invertebrates), and fish.

Human health assessments will be limited to fish of adequate size caught within the Salton Sea. Fish caught within the Lower Colorado River will be used only to provide a comparison to fish in the Salton Sea and to assess constituent trends over time.

Near-shore sediments and surface soils will be collected from the perimeter of the Salton Sea in order to characterize general conditions. The spatial distribution of these samples will allow a comparison anticipated conditions under different restoration alternatives that could expose sediments in different part of the Salton Sea.

Step 5: Develop Decision Rules

Because the proposed biota, water, and sediment sampling is being conducted to address identified data gaps in the existing data set within a limited time period, future additional sampling is not being considered as part of this program. The determinations of ecological and human health risks will help to characterize the current conditions in the Salton Sea. The modeling efforts to characterize selenium cycling, if possible, will be used to assess the impacts of various restoration alternative being considered for the Salton Sea. The impacts of different alternatives on selenium exposures would represent a single factor in the screening of the various restoration alternatives.

Independent of the Salton Sea Ecosystem Restoration Plan, the human health risk assessment information will be used by regulatory personnel at OEHHA to re-examine the existing fish consumption advisory for selenium in Salton Sea fish.

While no additional near-shore sediment or soil sampling is planned that would be part of this assessment of restoration alternatives for the Salton Sea, it is possible that preliminary data may indicate that potential human health risks do exist. The preliminary assessment would be used to determine if additional, focused sampling is among the recommendations for resource trustees.

Step 6: Specify Limits of Uncertainty

Uncertainties as a result of field sampling and laboratory analysis will be minimized by the procedures outlined in the FSP and in the QAPP for this program. The uncertainty associated with the data generated from these activities will be discussed in detail as part of the ecological and human health risk assessments that make use of the water, sediment, biota and fish tissue data. Similarly, the uncertainty associated with modeling of selenium cycling that is based on these data along with historic data will also be characterize. The uncertainty associated with modeling assumptions will also be explained in these documents.

The preliminary assessments of the potential for increase risks due to human exposure pathways to near-shore sediments and surface soils will also provide details on the uncertainty associated with the data and assumptions used in the assessment.

The assessments of the uncertainty of the data collected as part of these efforts will be based, in part, upon the results of the data validation process that is being proposed as part of this work plan.

Step 7: Optimize the Design for Obtaining Data

Various aspects of sampling and analysis were discussed at a February 14, 2005, interagency meeting. That meeting included people who had considerable experience with, and knowledge of, sampling in the Salton Sea. The proposed sampling locations were chosen, in part, based on direct input from these meeting participants. This FSP directly incorporates elements of the SDSU sampling plan that was submitted to CH2M HILL (*Proposed Salton Sea Sampling Regime – Spring 2005*, and revised February 21, 2005). Other input from the interagency meeting was also incorporated into this FSP to optimize the sampling design.

4.4.2 Field Sampling

Field sampling will be performed by CH2M HILL staff with assistance of personnel from the DFG and SSERG. All work will be performed in accordance with the FSP in Appendix A. CH2M HILL will be responsible for ensuring that their employees are trained and qualified to perform the sampling activities required for this project.

4.4.3 Laboratory Services

CH2M HILL is responsible for conducting, or subcontracting, all laboratory services and/or analyses noted in this work plan. The laboratories that have been chosen to complete this work are based on previous project experiences or laboratory-specific experience with particular types of analyses. Biota and sediment analyses for total selenium and arsenic will be completed by LET Analytical, Inc. (LET) of Columbia, MO. Water analyses for selenium and selenium species will be completed by Brooks Rand LLC (Brooks Rand) of Seattle, WA. Sediment and soil characterization for potential air quality and human health exposure constituents will be competed by Columbia Analytical Services, Inc. (CAS) of Redding, CA. Fish fillet tissue data will be completed by Applied Sciences Laboratory, Inc. (ASL) of Corvallis, OR.

Third-party data validation services will be provided by EcoChem, Inc. of Seattle, WA. CH2M HILL will be responsible for coordinating sample processing and analytical work and for ensuring that analyses and deliverables meet the required project milestones.

5.0 REFERENCES

CH2M HILL. 2005a. Draft Scope of Work and Field Sampling Plan, Salton Sea Biota and Sediment Sampling. March 18.

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APPENDIX A
Field Sampling Plan

Table of Contents

Items **Page**

List of Tables

Items **Page**

Figure

Items **Page**

Attachment

Items

APPENDIX A:
FIELD SAMPLING PLAN

A1.0 INTRODUCTION

This field sampling plan (FSP) outlines the conceptual approach and general methods for performing sampling of biotic and abiotic media to support the Salton Sea Ecosystem Restoration Plan. One objective of this sampling is to address data gaps that were identified in the *Draft Selenium at the Salton Sea and Summary of Data Gaps* (CH2M HILL 2005). Another objective is to provide more current data as inputs for a proposed model to predict selenium cycling in the Salton Sea that can be used to evaluate the selenium effects of different restoration alternatives. A third objective is to provide baseline information on constituent concentrations in near-shore sediments and soils that can be used to assess if there are potential human health impacts from exposed areas under certain restoration alternatives from inhalation of fugitive dust or other exposure pathways. A final objective is to provide data to the California EPA Office of Environmental Health Hazard Assessment (OEHHA) that will allow them to re-examine the fish consumption advisory for the Salton Sea.

Monitoring will include sampling of water, sediment, fish, and food-chain items from various locations in the Salton Sea. Near-shore sediments will be collected from locations around the Salton Sea and from upland areas around its perimeter. Sampling within the Salton Sea will be completed by CH2M HILL staff in cooperation with personnel from the California Department of Fish and Game (DFG) and the San Diego State University Salton Sea Ecosystem Research Group (SSERG). Fish samples will also be collected for comparison at three locations within the Lower Colorado River.

A1.1 Site Selection

Sites for sampling sediment, water, and various biota within the Salton Sea were chosen to characterize both the northern and southern mid-lake areas, as well as selected shore-zone, shallow locations. The previous experience of DFG and SSERG personnel for Salton Sea sediment and biota sampling was used to develop a stratified sampling design that was determined to be an efficient approach for filling the identified data gaps. Recent analyses of sediment samples collected by Agrarian Research, Inc. for the USGS were incorporated into the sampling design to identify locations of shore-zone sites that represented high and low ranges of sediment selenium in both the north and south basins.

Samples will be collected, as available, from up to 12 shore-zone sites and 3 mid-lake areas as shown on Figure A-1. The sampling sites were divided equally between the northern and southern portions of the Salton Sea. The 3 mid-lake areas will be used to characterize the deeper-water areas and are considered to be representative of exposure conditions for plankton for most of the area within the two main basins.

Grouped, shore-zone sites will be chosen from the 12 general areas (as described below). Each of the main shore-zone sites chosen as a transect will be considered to represent selenium exposure at a defined portion of the shoreline and for the immediately adjacent area associated with a transect running perpendicular into the lake from the shoreline. Sampling at the shore-zone sites will include collections from the shore edge to approximately 10 meters of water depth, recognizing that this may include locations from the shore up to several hundred meters into the lake.

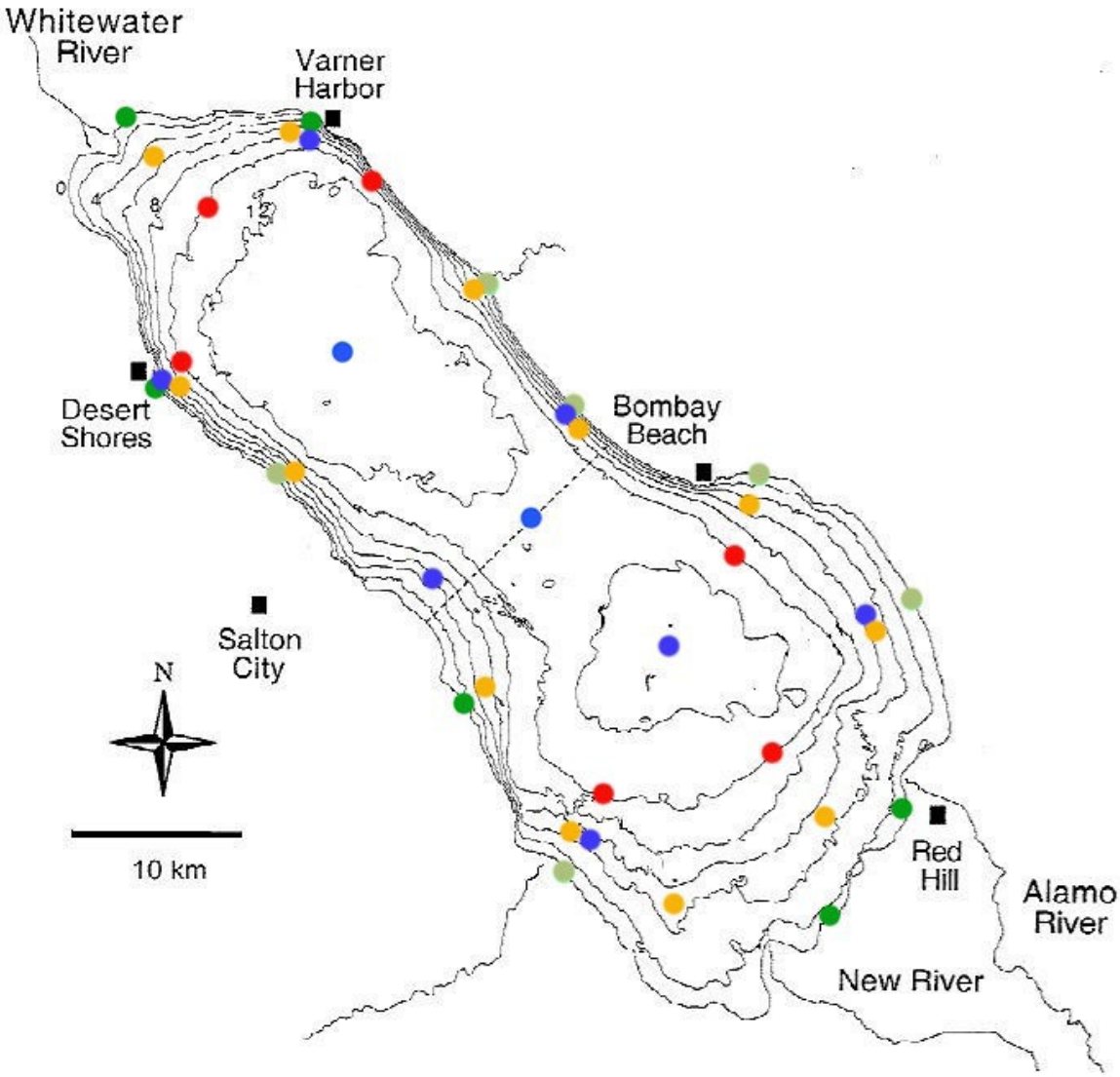

Figure A-1
Potential Sampling Locations

Green = Shoreline macroalgae, invertebrate, sediment/water sites, Blue = Zooplankton and water stations, Red = deeper (10 m) pileworm and sediment/water sites, Orange = shallower (5 m) pileworm and sediment/water sites. Six fish sites (< 2 m deep) will be chosen to match successful invertebrate collection sites.

As summarized in Table A-1, the water, sediment, and biota sampling sites are grouped as:

- 3 Deep-water plankton and water sites (12 - 14 m deep)
- Shore-zone areas (transects), including:
  - 6 biota and sediment collection sites (10 m deep)
  - 18 biota and sediment, plus 6 water collection sites (5 m deep)
  - 6 fish collection sites (< 2 m deep)
  - 12 biota and sediment sites (< 1 m deep)

Table A-1
Summary of Anticipated Samples to Support Ecological and Human Health Risk Assessments

Media	Quantitya	Analysis/Method
Salton Sea Sampling of Water, Sediment, Food-Chain Biota, and Fish (March and April 2005)		
Water	≤ 21	Total and dissolved selenium/EPA method 1638 mod w/DRC Selenite/ Laboratory SOP (BR-0023) Selenium(inorganic)/ Laboratory SOP (BR-0023) Selenate/ by difference as Se(inorganic) - selenite Se(organic)/ by difference as Se(total) - Se(inorganic)
Sediment	≤ 30	Total selenium/Hydride generation autoanalyzer (HGAA)
Food chain biota	< 180	Total selenium/ HGAA
Small (< 8 inch) fish	≤ 36	Total selenium/ HGAA
Large (> 8 inch) fish[b] Individual fillet (skin off)	≤ 50	Total selenium, cadmium, arsenic/Graphite furnace autoanalyzer (GFAA) by EPA method SW7000 Organic arsenic Mercury
Large (> 8 inch) fish[b] Composite fillets (skin off)	≤ 10	Organochlorine pesticides/EPA method 8081 PCBs w/congeners/EPA method 8082
Large (> 8 inch) fish[b] Remainder after filleting	≤ 50	Total selenium/GFAA
Lower Colorado River Sampling of Fish (April 2005)		
Large (> 8 inch) fish Individual fillet (skin off)	≤ 50	Total selenium and arsenic/GFAA
Salton Sea Sampling of Near-Shore Sediments and Surface Soils (April 2005)		
Archived sediments	40	Medium- and low-level metals/EPA method SW6010B and SW6020
New sediments[c]	40	Medium- and low-level metals/EPA method SW6010B and SW6020 Total mercury/EPA method SW7471A Total organic carbon (TOC)/Walkley-Black Particle size analysis/ASTM D422-63 Semivolatile organic compounds (SVOCs)/EPA method 8270B Organochlorine pesticides/EPA method 8081 PCBs w/congeners/EPA method 8082
Surface soils[c]	40	Medium- and low-level metals/EPA method SW6010B and SW6020 Total mercury/EPA method SW7471A Total organic carbon (TOC)/Walkley-Black Particle size analysis/ASTM D422-63 SVOCs/EPA method 8270B

Table A-1
Summary of Anticipated Samples to Support Ecological and Human Health Risk Assessments

Media	Quantitya	Analysis/Method
		Organochlorine pesticides/EPA method 8081 PCBs w/congeners/EPA method 8082
Bench-Scale Tests (Intact Cores and Bioassays) Using Salton Sea Sediments and Water (May-June 2005)		
Water	36	Total selenium/EPA method 1638 mod w/DRC
Water	24	Dissolved selenium/EPA method 1638 mod w/DRC Selenite/ Laboratory SOP (BR-0023) Selenium(inorganic)/ Laboratory SOP (BR-0023) Selenate/ by difference as Se(inorganic) - selenite Se(organic)/ by difference as Se(total) - Se(inorganic)
Sediment	44	Total selenium/ HGAA or GFAA
Benthic invertebrates	25	Total selenium/ HGAA or GFAA

Notes:

[a] Field QA/QC samples (field duplicates and MS/MSDs) will be added to this number as needed.

[b] If inadequate number of "catchable-size" fish are caught during Spring 2005 to support the OEHHA re-examination of the fish advisory, a separate sampling event in Summer 2005 may be planned with DFG staff.

[c] Analyses for organic parameters (SVOCs, pesticides, and PCBs) will be done only on half of the sediment and soil samples.

Fish will also be sampled at three locations on the Lower Colorado River (LCR) in order to provide a relevant comparison of selenium and arsenic concentrations for fish collected in the Salton Sea, These additional locations would represent fish tissue conditions before the Colorado River water passes through agricultural areas in the Imperial and Coachella Valleys before entering the Salton Sea. The three LCR locations also correspond to prior sampling locations under the National Contaminant Biomonitoring Program (Lake Havasu, Lake Mead, and Imperial Reservoir, and/or the Colorado River at Yuma, AZ) so that potential qualitative information on contaminant trends might be developed. The fish species to be sampled on the LCR will be focused on previously sampled species such as carp, bass, and or catfish, depending on availability.

There is relatively little information on the constituent concentrations in near-shore sediments and surface soils that can be used to assess the potential for adverse human health impacts should these area become exposed under various restoration alternatives being considered for the Salton Sea. In order to develop a better spatial characterization of sediments around the Salton Sea, especially in shallow, near-shore areas, up to 100 additional sediment samples and up to 50 near-shore surface soil samples will be analyzed, as summarized in Table A-1. Some of these sediment samples will be taken from archived sediments and some will be collected from new sample locations around the Salton Sea. New soil samples will be collected from areas that had recently been flooded but are now exposed. The choice of sample locations will be done so that sediment and soils are collected at intervals from around the entire perimeter of the Salton Sea.

The protocol for bench-scale tests using Salton Sea sediments (composites and intact cores) and water is being developed separately. The objective of those bench-scale tests will be to determine the selenium release characteristics under different water quality conditions that are expected to occur and to estimate selenium bioaccumulation by aquatic invertebrates. The required chemical analyses for the bench-scale tests are summarized in Table A-1.

A2.0 FIELD INVESTIGATION METHODS

This section describes the methods for collection of water, sediment, fish, and dietary items in the Salton Sea and for collection of near-shore surface soils around its perimeter. The same fish sampling methods used in the Salton Sea will be used to collect fish samples in the LCR. The following sections provide guidelines for sampling, field measurements, field QA/QC, and record keeping. All field activities performed under the scope of this project will conform to state and other applicable regulatory agency requirements.

A2.1 Sample Collection and Equipment

All sample collection will be conducted using clean techniques. Sediment samples will be collected using stainless steel shovels or trowels, disposable polyethylene trowels, or other standard sediment sampling devices (e.g. ponar dredges). Stainless steel shovels, trowels, or other re-used equipment will be decontaminated prior to use at and between drains (as described below in Section A3.0). Nets used for biota sampling will be washed with a dilute solution of Alconox or similar detergent before use at each site. All samples will be handled with polyethylene-gloved hands. Sterile whirl-pak or ziplock baggies will be used to store biota samples.

U.S. Environmental Protection Agency (USEPA)-recommended containers will be used for field sampling, and sampling procedures will adhere to USEPA-recommended preservation requirements for each parameter of interest (USEPA, 1996, 2001). Use of proper containers and preservation methods will retain sample integrity. Containers and preservatives will be provided by laboratory personnel.

Holding-time compliance and proper sample preservation begin during field sampling. Temperature control and pH adjustments are the most common preservation techniques. CH2M HILL will be responsible for using only fully trained field personnel who are familiar with the proper use of sample collection gear and acceptable sampling procedures. Table A-2 presents containers, preservatives, and holding times for each medium being collected.

All samples collected as part of this program will be handled under full “Chain of Custody” (COC) control. Samples will be marked with self-adhering labels containing unique IDs to facilitate sample tracking. These labels will include initials of samplers and date and time of sampling, and will be placed on each sample container and covered with clear tape to prevent peeling or damage to the label. Duplicate information will be placed on all COC forms. This information includes matrix, type of analysis to be performed, date and time of collection, station ID, and collector’s initials.

A2.2 Surface Water and Sediment Collection Procedures

A2.2.1 Surface Water

Prior to water collection, field parameters including dissolved oxygen (DO), pH, temperature, specific conductivity, and water depth will be measured. One surface water sample will then be collected using grabs from the top 3 meters of the water column using an integrated tube sampler. The water samples will be collected with appropriate care not to disturb sediments and transferred into the appropriate preserved sample containers. Water samples will be collected unfiltered (raw) water samples and analyzed for total recoverable selenium and speciated selenium. Additional raw water samples will also be filtered in the laboratory and analyzed for dissolved selenium. Collected water samples will be stored on ice immediately after collection and packed in coolers for shipment to the laboratory.

Composite water samples will be collected from the Salton Sea for use in bench-scale tests. The protocol for these tests is being developed separately but the anticipated chemical analyses are summarized in Table A-1.

Table A-2
Sample Container, Preservatives, and Analytical Holding Time Requirements

Medium	Analysis	Sample Container	Preservatives	Analytical Holding Times	Comments
Sediment	Total Selenium	4 oz glass jar	Chill to 4 deg C	180 days	Fill completely
	TOC	8 oz glass jar	Chill to 4 deg C	28 days	Fill completely
	Particle size	8 oz. glass jar (shared w/TOC)	None required	Indefinite	Fill completely
	Metals	8 oz. glass jar (shared w/TOC)	Chill to 4 deg C	180 days (Mercury = 28 days)	Fill completely
	Semi-volatile Organics	4 oz glass jar	Chill to 4 deg C	14 days to sample extraction, 40 days after extraction for sample analysis	Fill completely
	Organochlorine Pesticides	8 oz glass jar	Chill to 4 deg C	14 days to sample extraction, 40 days after extraction for sample analysis	Fill completely
	Aroclors	8 oz. glass jar (shared w/OC Pesticides)	Chill to 4 deg C	14 days to sample extraction, 40 days after extraction for sample analysis	Fill completely
Surface Water	Total Selenium	HCL cleaned 250-mL HDPE	1% HNO_3 in lab to pH < 2; chill to 4 deg C	180 days	Fill to bottle neck
	Dissolved Selenium	HCL cleaned 250-mL HDPE	Filter, HNO_3 in lab to pH < 2; chill to 4 deg C	180 days	Fill to bottle neck
	Selenate	125-mL glass with Teflon-lined lid	HCL to pH < 2; chill to 4 deg C	28 days	Fill to bottle neck
	Selenite	125-mL glass with Teflon-lined lid	HCL to pH < 2; chill to 4 deg C	28 days	Fill to bottle neck
	Organic Selenium	125-mL glass with Teflon-lined lid	HCL to pH < 2; chill to 4 deg C	Calculation	Fill to bottle neck
	Total Recoverable Selenium	HCL cleaned 250-mL HDPE	Filter, HNO_3 in lab to pH < 2; chill to 4 deg C	180 days	Fill to bottle neck

Table A-2
Sample Container, Preservatives, and Analytical Holding Time Requirements

Medium	Analysis	Sample Container	Preservatives	Analytical Holding Times	Comments
Fish	Total Arsenic, Selenium, and/or Cadmium	whirl-pak or ziplock baggies	Chill to 4 deg C – freeze ASAP	Indefinite (frozen)	Remove excess debris with deionized water rinse
	Organochlorine Pesticides	whirl-pak or ziplock baggies	Chill to 4 deg C – freeze ASAP	Indefinite (frozen)	Remove excess debris with deionized water rinse
	PCB Congeners	whirl-pak or ziplock baggies	Chill to 4 deg C – freeze ASAP	Indefinite (frozen)	Remove excess debris with deionized water rinse
Dietary Components	Total Arsenic and Selenium	whirl-pak or ziplock baggies	Chill to 4 deg C - freeze ASAP	Indefinite (frozen)	Remove excess debris with deionized water rinse

Notes
HDPE = high density polyethylene
HNO_3 = nitric acid
HCL = hydrochloric acid
oz = ounce
TOC = total organic carbon by Walkley-Black method

A2.2.2 Sediment

Sediment samples will be collected at various locations using clean stainless steel trowels, disposable polyethylene hand trowels, or other standard devices that can be decontaminated and used to sample to a maximum depth of 10 cm (4 inches). Samples will be packed into clean containers for shipment to the laboratory. Excess water will be decanted from the sample or sampling container prior to sealing or transfer; care will be taken to retain the fine sediment fraction during decanting. Debris, including rocks, plants, and other foreign materials will be excluded from the sample by either removing them by hand or screening the sample to remove those larger than about 3 mm (1/8 inch). Sediment samples will be placed in coolers and kept cold with bagged ice prior to shipment to the laboratory.

Composite and undisturbed sediment core samples will be collected from the Salton Sea for use in bench-scale tests. The protocol for these tests is being developed separately but the anticipated chemical analyses are summarized in Table A-1.

A2.3 Food-chain Component and Fish Collection Procedures

A2.3.1 Food-chain Components

Food-chain components to be collected include macroalgae, phytoplankton, zooplankton, and invertebrates (e.g. pileworms, waterboatmen, amphipods). Biological sampling usually requires an expanded areal coverage centered on the designated sampling station because of the dispersed nature of the biota and the need to composite an adequate weight of organism for analysis. All biological samples will be collected as close to the designated sampling location as possible. The location will be noted by the sampler. The proposed biota samples are summarized in Table A-1.

Collection methods will depend on water depth and substrate conditions but may include methods such as a sediment dredge sampler or seine and kicknets. Potential collection methods for each item are described below.

Phytoplankton. Phytoplankton will be collected using 20-µm nets and screening the sample through a 50-µm net.

Zooplankton. Zooplankton will be collected using 80-µm nets and screening the sample through a 300-µm net.

Benthic Invertebrates. Invertebrates will be collected using a variety of equipment including hand collection, a petite Ponar dredge, kick nets, or dip nets. Individuals will be sieved and washed for sediment with ambient water, placed in clean containers, and stored on wet ice until they can be frozen and shipped for whole-body analysis of selenium. Only those samples with sufficient weight for analyses will be saved for chemical analysis.

The most important benthic invertebrate to characterize in the Salton Sea is the pileworm (a nereid polychaete, *Neanthes succinea*). Composite samples will be collected at shallow-water locations (approximately 5 m depth) and deeper-water locations (approximately 10 m depth) around the Sea using a petite Ponar dredge. The sediment content of each grab will then be sieved through a 3-mm screen to retain only large pileworm individuals that will be placed in properly labeled bags. Up to three samples, each weighing 2 to 5 g, will be collected at each site, as available. It is recognized that field decisions will have to be made by the sampling team as to the potential of getting adequate sample size at any given site and/or the potential for getting replicate samples in a reasonable period of time.

If possible during the March 2005 sampling event, swimming heteronereid pileworms will be collected from accessible shoreline stations corresponding to the general shoreline transect locations (possibly 3 sites) using flashlights and dip nets. The peak pileworm swarming activity is shortly after dusk.

A2.3.2 Fish

Fish will be captured using seines and/or kick nets, using techniques that ensure minimal impact to pupfish. Fish collected will be sorted by species and placed in clean containers. Any pupfish that are inadvertently captured in the nets will be immediately released unharmed. Incidental catch of pupfish will be noted in the field notebook. Samples will be stored in clean whirl-pak or ziplock baggies placed on wet ice until they can be frozen and shipped for whole body analysis of selenium. Fish below 8-inches in length will be composited by sample location and kept for whole-body analyses for total selenium. The numbers of fish in each composite sample and the sample weight will be recorded.

Fish caught in the Salton Sea that are over 8-inches and can be used to make fillets will be individually wrapped and frozen for transport to the laboratory. Sample weight, fish length, species, and number of fish in the sample will be recorded in the field. Larger fish sent for analysis for fillets will be prepared for analysis in the laboratory.

A2.4 Surface Soil Collection Procedures

Surface soils will be collected from different locations around the perimeter of the Salton Sea. These surficial soil samples will be collected from areas that had been flooded recently, but are now exposed. The samples will be collected from 0 to 6 inches below the ground surface using disposable polyethylene hand trowels. The samples will be placed directly into sample containers provided by the analytical laboratory and placed immediately into a cooler chilled with bag ice. The samples will be kept chilled for transport to the analytical laboratory. Field descriptions of the sample location and soil (e.g., color, field texture, consistency) will be recorded and the sample location will be photographed. The position of sample location will be determined with a hand-held GPS device and recorded. The near-shore soil samples are summarized in Table A-1.

A composite sample from the different soil sample locations will be developed so it can be subjected to wind tunnel testing as part of a fine-fraction study. Two five-gallon buckets of dry soil are required for this testing. This composite will be sent to MRI in Kansas City, MO for independent testing in a high-volume cyclone/impactor system to determine the emission rate of $PM_{2.5}$ and PM_{10} particles. This independent test is not addressed in the QAPP included as Appendix B.

A3.0 DECONTAMINATION PROCEDURES

All abiotic and biotic media sampling equipment will be decontaminated prior to use at a sample location. Proper equipment decontamination is required to prevent the possibility of cross-contamination or obtaining false positive results (i.e., selenium contamination indicated when in fact it does not exist in the sample being analyzed). All sampling equipment will be decontaminated over a 5-gallon plastic bucket using the following procedure: 1) scrub equipment with a brush using a mixture of tap water and non-phosphate detergent such as Alconox, 2) rinse equipment with distilled water, and 3) double rinse with deionized (DI), organic-free water.

Equipment rinsate samples will be collected from each re-used sampling apparatus during each round of sampling to evaluate the decontamination procedures and the resulting cleanliness of the sampling equipment. The rinsate samples will be collected after a sample collection device was subjected to standard decontamination procedures. DI water will be poured over or through the sampling device and collected in the appropriate container for analysis.

A4.0 ANALYTICAL METHODS

The following sections describe in general the laboratory methods that will be used for analyzing the water, sediment, soil, and tissue samples. Additional QA/QC procedures are described in detail in the QAPP located in Appendix B.

A4.1 Chemical Analyses for Water, Sediment, Soil, and Tissue

Chemical analyses of water, sediment, soil, and tissue samples will be conducted using standard methods, designated by the USEPA when available. There is no USEPA method for speciation of selenium in water, so laboratory-specific methods may be used if they achieve the desired reporting limits. The constituents to be analyzed, methods to be used, and target reporting limits are summarized in Table A-2. The analytical methods to be used are briefly summarized below by medium.

A.4.1.1 Water

Total Recoverable Selenium. Samples will be prepared according to USEPA method 1640 and then analyzed using USEPA method 1638 modified w/DRC to determine total recoverable selenium. This method is capable of providing a reporting limit of 0.15 μg/L.

Dissolved Selenium. Samples will be filtered in the laboratory using a 0.45 micron filter. Filtered water samples will be prepared according to USEPA method 1640 and then analyzed using USEPA method 1638 modified w/DRC to determine dissolved selenium. This method is capable of providing a reporting limit of 0.15 μg/L

Selenate. Selenate will de determined by difference as inorganic selenium - selenite.

Selenite. Selenite will be determined by gaseous hydride generation with atomic absorption spectroscopy (HGAA) utilizing the laboratory's standard operating procedure. This method is capable of providing a reporting limit of 0.1 μg/L

Organic Selenium. By difference as total selenium – inorganic selenium.

Inorganic Selenium – Inorganic Selenium will be determined by HGAA utilizing the laboratory's standard operating procedure. This method is capable of providing a reporting limit of 0.1μg/L.

Conductivity, Temperature, Dissolved Oxygen, and pH. These parameters will be measured in the field using a field meter that will be calibrated at the beginning of each day using standard procedures. The calibration results will be recorded daily in a log book.

A4.1.2 Sediment and Surface Soil Samples

The following analyses will be completed for sediment samples that are collected to correlate with biota and water samples in the Salton Sea:

Total Selenium. Total selenium will be analyzed in sediments using HGAA. This method is capable of providing a reporting limit of 0.2 mg/kg. Sediment samples will be digested prior to analysis.

Moisture Content. Percent moisture will be determined by measuring sample weight before and after freeze drying the samples. The moisture content of the sample is then calculated from the weight difference and the final weight.

For near-shore sediment and surface soil samples around the Salton Sea that are being collected to develop information about potential human health impacts from fugitive dust and other exposure pathways, the following analyses will be completed:

Total medium-level metals. Total concentrations for medium-level metals in sediment and soil samples will be completed using EPA method SW6010B. The list of medium-level methods may include silver, barium, beryllium, cadmium, chromium, cobalt, copper, molybdenum, nickel, vanadium, and zinc. The reporting limits for this method range from 1 to 4 mg/kg.

Total low-level metals. Total concentrations for low-level metals will be completed in sediment and soil samples using EPA method SW6020. The list of low-level methods may include arsenic, antimony, lead, selenium, and thallium. The reporting limits for this method range from 0.3 to 0.5 mg/kg.

Total Mercury. Total mercury concentration in sediment and soil samples will be determined using EPA method 7471A. The reporting limit for this method is 0.1 mg/kg.

Semi-volatile Organic Compounds. Various semi-volatile organic compounds (SVOCs) in sediment and soil samples will be prepared using SW3550B and will be analyzed using EPA method SW8270C. The reporting limits for this method range from 330 μg/kg to 1660 μg/kg.

Organochlorine Pesticides. Various chlorinated pesticides in sediment and soil samples will be prepared using EPA method SW3550B and analyzed using EPA method SW8081A. The reporting limits for this method range from 1.7 μg/kg to 170 μg/kg.

Aroclors. Aroclors in sediment and soil samples will be prepared using SW3550B and analyzed using EPA method SW8082. The reporting limits for this method range from 33 μg/kg to 67 μg/kg.

Sediment Particle Size. Sediment grain size will be determined using the methods described in ASTM D422-63 to include size separation by screening plus settling tests for finer fractions.

Moisture Content. Percent moisture will be determined by measuring sample weight before and after drying to a constant temperature at 105 degrees celsius. The moisture contents is then calculated from the weight difference and the final weight.

Total Organic Carbon (TOC). Analysis for total organic carbon will follow the method of Walkley-Black (OSU 1989) or a similar method. Up to 10 grams of fine sediment will be placed in a 500 milliliter (ml) flask to which 10 ml of potassium dichromate has been added. Twenty ml of concentrated sulfuric acid will then be added while the flask is swirled. After 30 minutes, the sample will be diluted to a volume of 200 ml with DI water and filter the suspension. Add 3 to 4 drops of *o*-phenanthroline indicator and titrate the solution with 0.5*N* $FeSO_4$. As the endpoint is approached, the solution takes on a greenish cast and then turns dark green. At this point add ferrous sulfate heptahydrate drop by drop until the color changes sharply from blue to red (maroon color reflected light against a white background). The method detection limit for this methods is 0.05 percent TOC.

A4.1.3 Fish and Food-chain Components

Total Selenium and Arsenic. Total selenium will be analyzed in fish and dietary biota tissue using HGAA. In larger fish, fillet samples will also be analyzed for total arsenic, selenium, and cadmium using this same method. The HGAA method is capable of providing a method detection limit of 0.2 mg/kg for each analyte. Tissue samples will be digested prior to analysis.

Moisture Content. Percent moisture will be determined by measuring sample weight before and after freeze-drying the samples. The moisture contents is then calculated from the weight difference and the final freeze-dried weight.

Fish fillet samples that will be used to support the OEHHA re-examination of the Salton Sea fish advisory will also analyzed for different inorganic and organic parameters. Individual fillets (skin off) will be analyzed for:

Total Selenium. Total selenium will be analyzed in fish fillet tissues using graphite furnace atomic absorption spectroscopy(GFAA) by EPA method SW7060A. This method requires digestion of the sample by EPA method 200.3. The reporting limit is 1.5 mg/kg.

Total Arsenic. Total arsenic will be analyzed in fish fillet tissues using a GFAA by EPA method SW7740. This method requires digestion of the sample by EPA method 200.3. The reporting limit is 1.0 mg/kg.

Total Cadmium. Total cadmium will be analyzed in fish fillet tissues using a GFAA by EPA method SW7131A. This method requires digestion of the sample by EPA method 200.3. The reporting limit is 1.0 mg/kg.

Mercury. Mercury will be analyzed according to EPA method 1631 modified in fish fillets. The sample will be prepared according to the method prior to analysis using Vapor Atomic Fluorescence Spectrometer (CVAFS) that should achieve a reporting limit of 0.0004 mg/kg.

Inorganic Arsenic. Inorganic arsenic will be prepared and analyzed according to EPA method 1631 modified in fish fillets. The method uses Hydride Generation Quartz Furnace Atomic Absorption Spectrometry for analysis and that should achieve a reporting limit of 0.02 mg/kg.

Composites of these fillet samples will also be analyzed for:

Organochlorine Pesticides. A variety of pesticides will be determined by EPA method 8081. The chlorinated pesticide compounds analyzed by the method include 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; aldrin; alpha-BHC; alpha-chlordane; beta-BHC; delta-BHC; dieldrin; endosulfan I; endosufan II; endosufan sulfate; endrin; endrin aldehyde; endrin ketone; gamma-BHC (lindane); gamma-chlordane; heptachlor; heptachlor epoxide; methoxychlor; technical chlordane; and toxaphene. The extraction method for this analyses is EPA SW3545. The reporting limits for these compounds is 1.0 μg/kg assuming that adequate sample (5 g) material is provided.

PCBs. PCBs will be analyzed by EPA method 8082 with information provided on congener concentrations. This method yields information on 28 different PCB congeners. The reporting limit for this method is 0.4 μg/kg assuming that adequate sample (5 g) material is provided.

A4.2 Quality Assurance Plan

Data generated from this field investigation must be of sufficient quantity and quality to be useful. The field procedures and QA/QC procedures required to produce data that satisfy the DQOs are discussed briefly in this section. Appendix B describes QA/QC procedures in detail.

A4.2.1 Sample Documentation and Custody

A sample is physical evidence collected from a medium of interest or the immediate environment. A sample numbering system is necessary to identify each collected sample and associated duplicates for analysis. This system will provide a tracking number to allow retrieval and cross-referencing of sample information and will provide anonymity for field QA samples at the laboratories. A list of sample ID numbers will be maintained in the field notebook. The sample numbering system for the proposed sampling, which identifies the sample location and other sample information is presented in Appendix B.

COC procedures are used to maintain and document sample possession and to track the locations of samples from collection to the laboratory. The principal documents used to identify samples and to document possession are the following:

- COC records
- Air bills or shipping records
- Field notebooks

- Global positioning system (GPS) coordinates
- Photographs of the investigation

The Field Team Leader (FTL) will maintain a supply of field documents including sample custody seals and COC records.

A4.2.1.1 Chain of Custody

The following field COC procedures will be followed to document sample custody:

- Custody will be documented through the use of COC records
- A minimum number of individuals will handle samples
- The field collector will be personally responsible for the care and custody of the samples collected until they are transferred or shipped properly

A COC record will accompany samples. When transferring sample custody, all individuals relinquishing and receiving them will sign, date, and note the time of the transmittal on the record form.

Procedures for "split" samples will be described in the "remarks" section of the COC record. The information includes with whom the split is being made, signature of both parties, and other details of delivery of the samples.

Samples will be packaged properly for shipment and dispatched to the laboratory for analysis with a separate COC for each shipping container. Containers will be sealed with custody seals. Method of shipment, courier name, and other information are included in the "remarks" section of the COC document. All bills of lading and other receipts will be retained for additional documentation. COC documents will be distributed as follows:

- COC original is shipped with the samples
- COC copy is returned to the project files
- COC copy is sent to the Data Validation Manager

At the laboratory, the designated sample custodian will accept receipt and custody of the samples and verify that the samples received match those on the COC records. The appropriate information as to shipment will be recorded in the "remarks" section of the COC record. The sample numbers are recorded in a laboratory logbook.

The laboratory sample custodian uses sample identification numbers or assigns laboratory numbers to each sample and ensures that samples are transferred to the proper analyst or stored in the appropriate secure area.

Laboratory personnel will be responsible for the care and custody of the samples in the laboratory. After analyses are completed, all identifying seals, labels, and COC records will be retained as part of the permanent documentation.

A4.2.1.2 Custody Seals and Labels

All samples shipped to the laboratory will be placed in appropriate shipping containers (coolers) and sealed with custody seals containing the signature of the individual who packed the samples and sealed the container.

Sample bottles/containers will have labels attached that contain sample ID numbers, date and time of sample collection, and the sample collector's initials.

A4.2.1.3 Field Notebook

A daily record of sampling events, observations including presence of pupfish, and other field measurement (pH, conductivity, temperature, water depth, GPS coordinates, etc.) and sampling activities will be recorded in a bound field notebook maintained by the FTL. Entries in this notebook will be signed and dated by the FTL or other members of the field investigation team and will be maintained as a permanent record of the project.

If errors are made on original documents (labels, seals, field notebooks, and COC records), corrections will be made by crossing a line through that error and entering the correct information. The corrections will then be initialed and dated by the individual who made the entry and correction.

A4.2.1.4 Photographs and GPS Coordinates

A digital photograph will be taken at each terrestrial sampling location and will be documented in the field notebook with the date and time of the photograph, name of site, and general orientation.

GPS coordinates of the sampling location will also be taken and recorded in the field notebook.

A4.2.2 Quality Control

Analytical chemistry procedures will be reviewed before any surface water, sediment, or biota samples are collected so that the appropriate types and volumes of samples are obtained, shipped, and stored to ensure adequate project quality control. The analyses to be conducted will require specific sample handling and preservation procedures and furthermore will require specific sample container types, sample volumes, and numbers.

Samples collected, handled, preserved, and processed incorrectly, or of insufficient volume or number, are of little or no value. Close coordination with the laboratory before sampling begins will minimize later analytical problems and maximize data validity.

The FTL will ensure that field personnel who conduct sampling procedures are adequately trained. Furthermore the FTL will periodically directly observe and closely supervise the collection of samples and other field activities to ensure that proper procedures are conducted to meet the project's objectives for quality control.

The quality control checks for sediment and water including equipment blanks, and field duplicates will be instituted and are discussed in detail in Appendix B. Quality assurance and quality control measures for biota are briefly discussed below.

A4.2.2.1 QA/QC for Tissue Samples

Samples for each food-chain item will be composited using at least the required sampling weight (2 to 5 g). Samples of all biota for selenium analysis will be stored in whirl-pak plastic bags. All samples will be immediately chilled in ice chests in the field and frozen at the end of each day for storage prior to laboratory analysis. Sample handling will be minimized as a means of preventing contamination and field gear will be pre-cleaned and rinsed thoroughly with site water prior to each sampling event.

Field duplicates for biota will be collected at a frequency of 5 percent of the total samples collected and extra samples for laboratory matrix spike samples will be collected at the same frequency from each matrix category. The organisms in replicate biota samples will be as close in size to each other as possible. For dietary component samples, the matrices for matrix spike collections will be determined as separate dietary items (i.e., zooplankton, invertebrates etc.).

A5.0 REFERENCES

American Society of Testing and Materials (ASTM). 1982. Standard Test Method for Particle-Size Analysis in Soils *in Soil and Rock; Dimension Stone: Geosynthetics*. ASTM Volume 04.08.

CH2M HILL. 2005. *Draft Selenium at the Salton Sea and Summary of Data Gaps*. February 18.

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ATTACHMENT A-1

Fish Sampling and Analysis Protocol

ATTACHMENT A-1:
FISH SAMPLING AND ANALYSIS PROTOCOL

Provided to CH2M HILL by Cal EPA OEHHA Staff on February 18, 2005

Fish Sampling for Human Health Assessment at the Salton Sea

Objective: To collect fish species currently harvestable for human consumption from the Salton Sea and to analyze the concentration of chemicals of concern in fish muscle tissue. Collection and analysis should be done following protocols recommended by the Office of Environmental Health Hazard Assessment (OEHHA) so that the data can be used to re-evaluate and update the existing fish consumption advisory using current data.

Approach: The following sampling design is proposed based upon USEPA guidance (USEPA, 2000) and OEHHA protocols.

The existing fish consumption advisory for the Salton Sea includes the following fish species: tilapia, orangemouth corvina, sargo, and croaker (*Bairdiella*). Current samples of the same species, and/or other species presently harvestable for human consumption, should be collected and analyzed from the Salton Sea in order to re-evaluate and update the advisory. The appropriate target species for current sampling and evaluation should be identified based on reliable creel surveys or fish population and abundance surveys that document fish species currently present and harvestable by anglers in the Salton Sea.

OEHHA recommends that sampling be coordinated with the California Department of Fish and Game (DFG) Water Pollution Control Lab (WPCL) in order to provide consistency with the TSM datasets previously collected for the Salton Sea. DFG WPCL sampling personnel are familiar with OEHHA's general sampling needs. If sampling is conducted by another agency, it is important that they adhere to guidelines for OEHHA's data needs, and consult with OEHHA prior to and during sampling.

Sampling areas: Target sampling areas would ideally include the Salton Sea and mouths of the major tributaries. Samples collected from four geographically dispersed areas in the Salton Sea (*e.g.*, north, near the mouth of Whitewater River; south, Obsidian Butte/Redhill Marina/Mullet Island; east, Salton Sea State Recreation Area; and west, Desert Shores/Salton City) would provide the most complete geographic coverage and also correspond to locations where public fishing pressure was high in the past or where bottom sediments previously sampled by Levine-Fricke Recon found elevated selenium concentrations. Samples from every area, however, are not essential for re-evaluating fish consumption advice. Apparently, fish are no longer as abundant in the Salton Sea, so the most important factor guiding choice of sample locations should be to select area where target fish species can be caught. Representation of more than one geographic area, and especially areas with the greatest fishing pressure would be desirable. A reasonable sampling plan should be developed on the basis of fish population censuses or creel surveys conducted prior to fish sampling.

Species collection: Fish may be collected using electroshocking, hook-and-line, traps, or nets. Target fish species should include all species that are currently harvestable and consumed by the general public. If any of the following species are present in sufficient numbers, they should be sampled: tilapia, orangemouth corvina, sargo, and croaker (*Bairdiella*). Each species sampled should include a minimum of nine fish from each area sampled, but preferably 12 or more. Because the Salton Sea is a large water body and a larger dataset is more representative of the fish populations, re-evaluation of chemical concentrations in fish from the Salton Sea by OEHHA would be best accomplished with an overall minimum of 24 fish of the predominant fish species from more than one location, *e.g.*, 12 fish from each

of two locations for that species. If other species are present, but less abundant, a minimum of nine fish from each of these species should also be collected for evaluation.

Sampling season: Presuming that spring is a peak fishing period, sampling could be conducted at that time. Historically, much of the fish sampling was conducted in the fall, and fall sampling would also be acceptable.

Other information: Data on public consumption *rates* of Salton Sea fish are not needed as input for human health assessment; however, information on which species are currently harvestable for consumption, as discussed above, is critical to selecting target fish for samples used to developing consumption advice.

Fish sizes: Fish collected for analysis should meet OEHHA's guidelines for minimum sizes for human health assessments. These minimum sizes are based on either DFG legal size limits, or sizes that are most likely to be consumed and which constitute mature fish. The minimum legal size for orangemouth corvina is 18 inches total length. If orangemouth corvina is collected all fish must be 18 (457 mm) inches or longer. OEHHA uses a minimum "edible size" of 200 mm total length for tilapia, sargo, and croaker (*Bairdiella*). All fish should be measured in total length.

Sample preparation in the field: Total maximum length (mm) and weight (g) data should be recorded for each fish collected in addition to the sample date, time, location, sampling gear used, field taxonomic identification, and collectors' names. After collection, each fish will be double wrapped individually in aluminum foil, labeled, and placed in a sealed plastic bag. Fish from each sampling area will be placed in a sealed plastic bag for that area and placed on dry ice for shipment to the laboratory. Sample collection, processing, preservation, and shipping will be conducted in such a way as to ensure sample integrity and chain-of-custody for the field samples and associated information.

Laboratory analysis and preparation: Samples for analysis will be shipped to the laboratory following chain-of-custody procedures. Good laboratory Quality Assurance (QA) is essential to produce good data for re-evaluation of the advisory. Whichever laboratory is used will need to adhere to specific data quality objectives to ensure the data are accurate, precise, and meet appropriate detection limits. Samples of the edible portion of fish, skin-off fillets, will be removed in the laboratory or other sample processing facility by trained personnel and not in the field. Preparation and analysis of individual fish muscle tissue is recommended for metals analysis. The preparation of composite samples is recommended for analysis of organic contaminants. Following the collection of tissue from individuals for metals analysis fish should be grouped according to length and composite samples should be made from individual fish of the same species such that the smallest fish in a composite is no less than 75 percent of the length of the largest fish in the composite. Composites should be made from three to five fish such that a minimum of three composites will be analyzed for organic chemical contaminants, *e.g.* for nine fish three composites of three fish each should be prepared. It must be possible to associate individual fish (including those in a composite) with the unique identifier assigned during chemical analysis. It is recommended that OEHHA be consulted prior to forming composites.

Chemicals of concern: Fillet samples (skin-off) from individual fish should be analyzed for metals: arsenic (total and inorganic), selenium; mercury, and cadmium. Individual fillets should then be composited for analysis of organic chemicals. The exact number of fish per composite will depend on the final catch, but generally three to five individuals are included in each composite, with the same number of fish per composite to the extent possible. The resulting composite samples will be analyzed for synthetic organic contaminants such as organochlorine pesticides (total chlordane, total DDT, dicofol, dieldrin, endosulfan I and II, endrin, heptachlor epoxide, hexachlorobenzene, lindane, and toxaphene) and total PCBs. A method that includes congener analysis should be used for PCBs.

Laboratory analyses must use standardized and quantitative analytical methods with limits of detection that allow accurate quantification of the target chemical at or below levels of concern. Data from the lab must pass QA review before they are final, and data that have not passed QA should not be publicly released. Preliminary data should first be released with a QA report to the funding agency and OEHHA. OEHHA will use finalized data that has passed QA to assess whether the fish consumption advisory for the Sea should be kept in place, modified, or withdrawn. This assessment will include preparation of a technical support document, which will go through public review before being finalized.

References

U.S. Environmental Protection Agency, 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories – Volume 1 – Fish Sampling and Analysis, 3rd Edition, EPA 823-B0-0007, U.S. Environmental Protection Agency.

APPENDIX B

Quality Assurance Project Plan

Table of Contents

Items **Page**

List of Tables

APPENDIX B:
QUALITY ASSURANCE PROJECT PLAN

This site-specific Quality Assurance Project Plan (QAPP) presents the policies, organization, functions, and specific quality assurance (QA) and quality control (QC) activities associated with analytical data generation and assessment for proposed abiotic and biotic sampling for the Salton Sea Ecosystem Restoration Plan. Analytical data generation and assessment are designed to achieve the data quality objectives (DQOs), as discussed in the Field Sampling Plan (FSP) for this project. This QAPP, in conjunction with the FSP, serve as the Sampling and Analysis Plan (SAP) for this project.

B1.0 LABORATORY SERVICES

LET Analytical, Inc. of Columbia, Missouri will analyze sediment and biota (dietary components and whole-body fish) samples for arsenic and selenium for this task. Brooks Rand, LLC, of Seattle, Washington will complete the selenium analyses (including speciation) for the water samples. Columbia Analytical Services, Inc. of Redding, California will complete low- and medium-level metals, mercury, semi-volatiles, organochlorine pesticides, PCBs, particle size, and total organic carbon analyses for some sediment samples. CH2M HILL's Advanced Sciences Laboratory of Corvallis (ASL), Oregon will perform total arsenic and selenium, PCB congener, and organochlorine pesticide analyses of fish fillet samples. Frontier Geosciences of Seattle, Washington will provide the inorganic arsenic and low-level mercury analysis for fish fillet samples.

B2.0 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

Data collection and analyses for this project task will be consistent with the DQOs (see FSP), which are designed to ensure consistency in data reporting and comparability among sampling site locations, so that spatial and temporal variability in selenium can be adequately monitored. Reporting limits (RLs) have been established that are low enough to evaluate effects for various environmental media as summarized in Table B-1.

Table B-1
Constituents of Concern, Analytical Methods, and Target Reporting Limits

Analyte	Method	Target Reporting Limits[a]			
		Sediment (µg/kg-Organics mg/kg-Metals)	Water (µg/L)	Fish Tissue (µg/kg-Organics mg/kg-Metals)	Dietary Components (mg/kg)
Total Recoverable Selenium	EPA 1638 Mod w/DRC[b]	—	0.15	—	—
Dissolved Selenium	EPA 1638 Mod w/DRC[b]	—	0.15	—	—
Inorganic Selenium	Hydride Generation AA(BR0023)	—	0.1	—	—
Organic Selenium	Calculation	—	—	—	—
Selenate	Calculation	—	—	—	—
Selenite	Hydride Generation AA (BR0023)	—	0.1	—	—
Total Selenium and Arsenic	Hydride Generation AA	0.2	—	0.2	0.2

Table B-1
Constituents of Concern, Analytical Methods, and Target Reporting Limits

Analyte	Method	Target Reporting Limits[a]			
		Sediment (µg/kg-Organics mg/kg-Metals)	Water (µg/L)	Fish Tissue (µg/kg-Organics mg/kg-Metals)	Dietary Components (mg/kg)
Inorganic Arsenic	EPA 1632 Mod			0.02	
Low Level Mercury	EPA 1631 Mod			0.0004	
Arsenic	SW 6020/SW 7000 Series	0.5		1	
Antimony	SW 6020	0.3			
Barium	SW 6010B/ SW 6020	1			
Beryllium	SW 6010B/ SW 6020	1			
Cadmium	SW 6010B/ SW 6020/SW 7000 Series	1		1	
Chromium	SW 6010B/ SW 6020	2			
Cobalt	SW 6010B/ SW 6020	3			
Copper	SW 6010B/ SW 6020	2			
Lead	SW 6020	0.3			
Molybdenum	SW 6010B/ SW 6020	3			
Nickel	SW 6010B/ SW 6020	4			
Selenium	SW 6020/ SW 7000 Series	0.3		1.5	
Silver	SW 6010B/ SW 6020	2			
Thallium	SW 6020	0.3			
Vanadium	SW 6010B/ SW 6020	2			
Zinc	SW 6010B/ SW 6020	4			
Mercury	SW 7471A	0.1			
Alpha-BHC	SW 8081A	1.7		4	
Beta-BHC	SW 8081A	1.7		4	
Gamma-BHC(Lindane)	SW 8081A	1.7		4	
Delta-BHC	SW 8081A	1.7		4	
Heptachlor	SW 8081A	1.7		4	
Aldrin	SW 8081A	1.7		4	
Heptachlor Epoxide	SW 8081A	1.7		4	
Gamma chlordane	SW 8081A	1.7		4	
Endosulfan I	SW 8081A	1.7		4	
Alpha-chlordane	SW 8081A	1.7		4	
4,4'-DDE	SW 8081A	3.3		4	
Dieldrin	SW 8081A	3.3		4	
Endrin	SW 8081A	3.3		4	
Endosulfan II	SW 8081A	3.3		45	
4,4'-DDD	SW 8081A	3.3		4	

Table B-1
Constituents of Concern, Analytical Methods, and Target Reporting Limits

Analyte	Method	Target Reporting Limits[a]			
		Sediment (µg/kg-Organics mg/kg-Metals)	Water (µg/L)	Fish Tissue (µg/kg-Organics mg/kg-Metals)	Dietary Components (mg/kg)
Endrin Aldehyde	SW 8081A	3.3		4	
Endosulfan sulfate	SW 8081A	3.3		4	
4,4'-DDT	SW 8081A	3.3		4	
Endrin Ketone	SW 8081A	3.3		4	
Methoxychlor	SW 8081A	17		4	
Toxaphene	SW 8081A	170		20	
Technical Chlordane	SW 8081A	1.7		20	
Aroclor 1016	SW 8082	33			
Aroclor 1221	SW 8082	67			
Aroclor 1232	SW 8082	33			
Aroclor 1242	SW 8082	33			
Aroclor 1248	SW 8082	33			
Aroclor 1254	SW 8082	33			
Aroclor 1260	SW 8082	33			
N-Nitrosodimethylamine	SW 8270C	330			
Phenol	SW 8270C	330			
Aniline	SW 8270C	330			
BIS(2-chloroethyl)ether	SW 8270C	330			
2-Chlorophenol	SW 8270C	330			
1,3-Dichlorobenzene	SW 8270C	330			
1,4-Dichlorobenzene	SW 8270C	330			
Benzyl Alcohol	SW 8270C	330			
1,2-Dichlorobenzene	SW 8270C	330			
2-Methylphenol	SW 8270C	330			
BIS(2-chloroisopropyl)ether	SW 8270C	330			
4-Methylphenol	SW 8270C	330			
N-Nitroso-di-n-propylamine	SW 8270C	330			
Hexachloroethane	SW 8270C	330			
Nitrobenzene	SW 8270C	330			
Isophorone	SW 8270C	330			
2-Nitrophenol	SW 8270C	330			
2,4-Dimethylphenol	SW 8270C	330			
BIS(2-Chloroethoxy)methane	SW 8270C	330			
Benzoic Acid	SW 8270C	1660			
2,4-Dichlorophenol	SW 8270C	330			
1,2,4-Trichlorobenzene	SW 8270C	330			

Table B-1
Constituents of Concern, Analytical Methods, and Target Reporting Limits

Analyte	Method	Target Reporting Limits[a]			
		Sediment (µg/kg-Organics mg/kg-Metals)	Water (µg/L)	Fish Tissue (µg/kg-Organics mg/kg-Metals)	Dietary Components (mg/kg)
Naphthalene	SW 8270C	330			
4-Chloroaniline*	SW 8270C	330			
Hexachlorobutadiene	SW 8270C	330			
4-chloro-3-methylphenol	SW 8270C	330			
2-Methylnaphthalene	SW 8270C	330			
Hexachlorocyclopentadiene	SW 8270C	330			
2,4,6-Trichlorophenol	SW 8270C	330			
2,4,5-Trichlorophenol	SW 8270C	1660			
2-Chloronaphthalene	SW 8270C	330			
2-Nitroaniline	SW 8270C	1660			
Dimethylphthalate	SW 8270C	330			
2,6-Dinitrotoluene	SW 8270C	330			
Acenaphthylene	SW 8270C	330			
3-Nitroaniline	SW 8270C	1660			
Acenaphthene	SW 8270C	330			
2,4-Dinitrophenol*	SW 8270C	1660			
4-Nitrophenol	SW 8270C	1660			
Dibenzofuran	SW 8270C	330			
2,4-Dinitrotoluene	SW 8270C	330			
Diethylphthalate	SW 8270C	330			
4-Chlorophenyl-Phenylether	SW 8270C	330			
Fluorene	SW 8270C	330			
4-Nitroaniline	SW 8270C	1660			
4,6-Dinitro-2-Methylphenol	SW 8270C	1660			
N-Nitrosodiphenylamine	SW 8270C	330			
1,2-Diphenylhydrazine	SW 8270C	330			
4-Bromophenyl-Phenylether	SW 8270C	330			
Hexachlorobenzene	SW 8270C	330			
Pentachlorophenol	SW 8270C	1660			
Phenanthrene	SW 8270C	330			
Anthracene	SW 8270C	330			
Di-n-Butylphthalate	SW 8270C	330			
Fluoranthene	SW 8270C	330			
Pyrene	SW 8270C	330			
Butylbenzylphthalate	SW 8270C	330			
Bis(2-ethylhexyl)Phthalate	SW 8270C	330			

Table B-1
Constituents of Concern, Analytical Methods, and Target Reporting Limits

Analyte	Method	Target Reporting Limits[a]			
		Sediment (µg/kg-Organics mg/kg-Metals)	Water (µg/L)	Fish Tissue (µg/kg-Organics mg/kg-Metals)	Dietary Components (mg/kg)
3,3'-Dichlorobenzidine	SW 8270C	330			
Benzo(a)anthracene	SW 8270C	330			
Chrysene	SW 8270C	330			
Di-n-octylphthalate	SW 8270C	330			
Benzo(b)fluoranthene	SW 8270C	330			
Benzo(k)fluoranthene	SW 8270C	330			
Benzo(a)pyrene	SW 8270C	330			
Indeno(1,2,3-c,d)pyrene	SW 8270C	330			
Dibenz(a,h)anthracene	SW 8270C	330			
Benzo(g,h,i)perylene	SW 8270C	330			
IUPAC #8	SW 8082A			0.4	
IUPAC #18	SW 8082A			0.4	
IUPAC #28	SW 8082A			0.4	
IUPAC #44	SW 8082A			0.4	
IUPAC #52	SW 8082A			0.4	
IUPAC #66	SW 8082A			0.4	
IUPAC #77	SW 8082A			0.4	
IUPAC #81	SW 8082A			0.4	
IUPAC #101	SW 8082A			0.4	
IUPAC #105	SW 8082A			0.4	
IUPAC #114	SW 8082A			0.4	
IUPAC #118	SW 8082A			0.4	
IUPAC #123	SW 8082A			0.4	
IUPAC #126	SW 8082A			0.4	
IUPAC #128	SW 8082A			0.4	
IUPAC #138	SW 8082A			0.4	
IUPAC #153	SW 8082A			0.4	
IUPAC #156	SW 8082A			0.4	
IUPAC #157	SW 8082A			0.4	
IUPAC #167	SW 8082A			0.4	
IUPAC #169	SW 8082A			0.4	
IUPAC #170	SW 8082A			0.4	
IUPAC #180	SW 8082A			0.4	
IUPAC #187	SW 8082A			0.4	
IUPAC #189	SW 8082A			0.4	
IUPAC #195	SW 8082A			0.4	

Table B-1
Constituents of Concern, Analytical Methods, and Target Reporting Limits

Analyte	Method	Target Reporting Limits[a]			
		Sediment (µg/kg-Organics mg/kg-Metals)	Water (µg/L)	Fish Tissue (µg/kg-Organics mg/kg-Metals)	Dietary Components (mg/kg)
IUPAC #206	SW 8082A			0.4	
IUPAC #209	SW 8082A			0.4	
Total Organic Carbon	Walkley-Black	0.05%	—	—	—

Notes

— = not applicable

Biota samples also will be analyzed for moisture content by weight difference before and after freeze-drying.

Arsenic, Selenium, and Cadmium analyses will be done on fish fillet samples should they be collected.

[a] Results and reporting limits will be reported on a dry weight basis except for the fish tissue data provided by ASL which represent whole body concentrations.

[b] The samples will be prepared using draft method EPA 1640 prior to analysis.

This QAPP has been designed to maximize the probability that environmental data collected during this program will meet or exceed the DQOs. It provides a systematic approach to data acquisition and management to accomplish the following purposes:

- Ensure that data collection and measurement procedures are standardized among all team participants
- Monitor the performance of the various measurement systems being used in the program to maintain statistical control and provide rapid feedback, so that corrective measures, if needed, can be taken before data quality is compromised.
- Periodically assess the performance of these measurement systems and their components
- Verify that reported data are sufficiently complete, comparable, representative, unbiased, and precise, so that they are suitable for the intended use

The data quality criteria for this project consist of qualitative and quantitative indicators, including precision, accuracy, representativeness, completeness, and comparability. Accuracy, precision, and completeness requirements for various indicators are shown in Table B-2.

B2.1 Precision

Precision is a measure of reproducibility of analyses under similar conditions. Precision can be defined as the degree of mutual agreement among individual measurements and represents an estimate of random error. Precision values will be calculated by comparing actual sample results with results of replicate analytes (field duplicate and matrix duplicate [MD] QC samples) and Matrix Spikes/Matrix Spike Duplicates (MS/MSDs). Precision values will be expressed in terms of relative percent difference (RPD) or percent recoveries. MS/MSDs will compromise 5 percent of the sampling effort.

B2.2 Accuracy

Accuracy is the degree of agreement between a measured value and the “true” or expected value. As such, it represents an estimate of total error from a single measurement, including both systematic error (“bias”) and random error that may reflect variability due to imprecision. Accuracy is expressed in terms of

percent recoveries determined from results of MS/MSDs, Laboratory Control Sample (LCS), and replicate samples.

B2.3 Representativeness

Representativeness is the degree to which sample data accurately express the characteristics of a population of samples, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that is achieved through proper sampling program design through use of appropriate sampling strategies and techniques. For example, holding time requirements for different types of samples affect the representativeness of conditions at the site at the time the samples were collected. The use of QC samples that are similar in composition to samples being measured provides a means of estimating precision and accuracy that are representative of sample measurements. Factors that affect representativeness include site homogeneity, sample homogeneity at a single point, and available information around which the sampling program was designed. The sampling program has been designed to maximize representativeness through the location selection process and inclusion of field duplicate samples at a frequency of 5 percent of samples.

B2.4 Completeness

Completeness can be defined both qualitatively and quantitatively. Qualitative completeness is determined as a function of all factors that contribute to sampling. Quantitative completeness is calculated as the percentage of measurements that are judged to be valid compared to the total number of measurements planned. Effectively, it measures the amount of data available for valid measurement compared to the amount that is lost or destroyed. For this investigation, a completeness factor of 90 percent for all matrices is established, and is strictly defined as the ratio of the number of usable data points (not flagged “R” indicating the result has been rejected) over the possible number of data points, by method/matrix.

B2.5 Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another. Confidence is achieved by maintaining standard techniques and procedures for collecting and analyzing representative samples and reporting the analytical results in standard units. Standard USEPA methods are used for the analytical chemistry throughout this program unless laboratory-specific methods can be shown to provide equivalent results.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check		Frequency	Criteria	Corrective Action
Hydride Generation AA (HGAA)				
Calibration	Minimum four points (instrument blank should be included)	Daily prior to analyses	r > 0.995	1) Evaluate system and take corrective action. 2) Recalibrate, if appropriate.
	Initial Calibration Verification (ICV)	After calibration	Response for any analyte within ± 20% of predicted response	1) Evaluate system and take corrective action. 2) Repeat calibration.
	Initial Calibration Blank (ICB)	Immediately after each initial calibration curve	< RL	1) Appropriate corrective actions taken including investigating source of contamination. 2) Repeat blank analysis and reanalyze all samples associated with this blank. 3) Indicate sample results associated with blank contamination in the case narrative.
	Continuing Calibration Verification (CCV)	Immediately following initial calibration curve, every 10 analyses, and at the end of the analytical sequence.	Response for any analyte within ± 10% of predicted response	1) Evaluate system and take corrective action. 2) Reanalyze CCV once. 3) If source problem cannot be determined, a new calibration curve must be generated and all samples reanalyzed back to the last successful CCV.
	Continuing Calibration Blank (CCB)	Every 10 analyses and at the end of the analytical run. (To be done immediately after each CCV).	< RL	1) Appropriate corrective action taken including investigating source of contamination. 2) Repeat blank analysis and reanalyze all samples back to the last passing CCB. 3) Indicate sample results associated with blank contamination.
Quality Control	Method Blank (MB)	One per sample batch	< RL for all target analytes	1) Appropriate corrective action taken including investigating source of contamination. 2) Reprepare and reanalyze MB. 3) If MB fails again, then reprepare and reanalyze samples associated with MB.
	Matrix Spike (MS) and Matrix Duplicate (MD	One of each per sample batch, or at least 10 percent of samples	%R in MS = 75-125; At >10x MDL, RPD for MD = ≤ 20% At <10x MDL, [MD result-sample result] = < 2x MDL	1) Check calculations. 2) Check LCS, if recoveries are within limits, flag all associated data as attributable to matrix effects.
	Laboratory Control Sample (LCS)	One per sample batch	%R = 75-125	1) Review recent LCS data for trend. 2) If trend is observed, locate and correct problem. 3) Reanalyze LCS. 4) If LCS fails again, redigest and reanalyze all samples within the batch.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check		Frequency	Criteria	Corrective Action
Trace Metals by ICP-MS w/DRC				
Calibration	Calibration Standards	Daily, prior to sample analysis	r ≥ 0.995; 1st standard ≤ PQL	1) Reanalyze suspect calibration standard. 2) If criteria are still not met, then re-prepare standards and recalibrate the instrument.
	Internal Standards (IS)	Each standard, blank, and sample is spiked with IS	%R = 50-150 compared to calibration blank	1) If the responses of the internal standards in the following CCB are within the limit, re-run the sample at an additional 2x dilution. 2) If not, then samples must be reanalyzed on a new calibration.
	Check Calibration Verification (CV)	At beginning and end and 1 per 10 sample preparations	%R = 80-120	1) Halt analysis, correct problem, recalibrate, and reanalyze affected samples.
	Independent Calibration Verification (ICV)	1 following instrument calibration	%R = 90-110	1) Correct problem prior to continuing analysis; recalibrate if necessary.
Quality Control	Method Blank (MB)	Minimum of 3 per batch	Mean ≤ PQL Standard Deviation ≤ MDL	1) All samples associated with contaminated method blanks must be reanalyzed.
	Matrix Duplicate (MD)	Minimum of 1 per 10 samples	RPD ≤ 25% or results within 2x PQL if < 5x PQL	1) If RPD criteria not met, then sample may be re-prepared and reanalyzed, but this is not required (sample matrix may be heterogeneous). 2) A post-digestion duplicate (PDD) can be analyzed to evaluate instrument precision.
	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Minimum of 1 per 10 samples	%R = 75-125 RPD ≤25%	1) If RPD ≤ 25%, results must be qualified. 2) If RPD criteria not met, then sample may be re-prepared and reanalyzed, but this is not required (sample matrix may be heterogeneous). 3) A post-digestion spike (PS) and post-digestion spike duplicate (PSD) can be analyzed to evaluate instrument accuracy and precision, and also to determine if matrix interference is occurring at the prep stage or at the analytical stage. 5) An MSA curve may be prepared and analyzed along with the samples to quantify and correct for interference.
	Laboratory Control Sample (or Laboratory Fortified Blank/ Blank Spike)	Minimum of 1 per batch	%R = 75-125	1) If LFB recovery is outside of the control limit, then batch must be re-prepared and reanalyzed.
	Certified Reference Material (CRM)	Must be matrix matched to samples; minimum of 1 per batch	%R = 70-130, unless limits set by CRM manufacturer are greater	1) If CRM true value is ≥5 x the PQL and if the recovery is outside of the control limit, then batch must be re-prepared and reanalyzed.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check		Frequency	Criteria	Corrective Action
Selenium Species by HGAA (BR-0023)				
Calibration	Calibration Blanks (CB)			
	Calibration Standards (CS)	Whenever > 24 hours since last batch analyzed using the calibration or CV/Independent Check fail	RSD of response factors ≤ 20%; Calibration Coefficient (r) >0.995	1) Reanalyze suspect calibration standard. 2) If criteria still not met, then remake standards and recalibrate the instrument.
	Check Calibration Verification (CV)	At beginning and end and 1 per 10 sample preparations	%R = 80-120	1) Halt analysis, correct problem, recalibrate, and reanalyze affected samples.
	Independent Calibration Verification (ICV)	1 per 10 sample preparations	%R = 80-120	1) Correct problem prior to continuing analysis, recalibrate if necessary.
Quality Control	Method Blank (equivalent to CB for Se (IV)	2 per batch	Average ≤ 2x MDL and Standard Deviation ≤ 2/3x MDL or Average < 1/10th of associated samples	1) Halt analysis, correct problem. 2) Reanalyze affected samples. 3) Qualify data as necessary.
	Method Duplicates	Analyzed in conjunction with MS/MSD pair	RPD ≤ 25% or ±PQL if sample < 5x PQL	1) Correct problem and reanalyze all associated samples. 2) If problem persists, then eliminate source of imprecision, re-prepare and reanalyze samples.
	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	1 pair per 10 client samples	%R = 65-135; RPD ≤25%	1) Attempt to correct matrix problem and reanalyze sample. 2) Qualify data as necessary.
Metals by SW6010B				
Initial calibration (a blank and at least one standard)		Before sample analysis, every 24 hours, whenever modifications are made to the system, or when continuing calibration verification fails	If more than one standard is used, correlation coefficient must be > 0.995	N/A
Second-source calibration verification		Immediately following each initial calibration	All analytes within ±10% of expected value	Correct problem and repeat initial calibration.
Calibration blank		After every Second-source or Continuing calibration verification analysis	No analytes detected at or above the reporting limit	Correct the problem, and then reanalyze previous 10 samples.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±10% of expected value for SW6010B	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and reanalyze all associated samples
Interference check standard	At the start and end of each analytical sequence or twice during an 8-hour period, whichever is more frequent	All analytes within ±20% of expected value	Correct the problem, recalibrate, reanalyze ICS and all affected samples.
MS/MSD	One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed	All analytes within laboratory QC limits	None
Laboratory sample duplicate	Once per analytical batch if MSD not performed	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD >20% One sample result < RL and a difference of ±2 times the reporting limit	None
LCS	At least one per analytical batch	All analytes within laboratory QC limits	Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch.
Dilution test	Each new sample matrix	Result from 1:5 dilution must be within ±10% of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit)	Perform post-digestion spike addition.
Linear Range Calibration check standard	Once per quarter	All analytes within ± 10% of expected value	Correct problem then reanalyze or re-set linear range
Post-digestion spike addition	When dilution test fails	Recovery within 75-125% of expected value	None

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
Metals by SW6020			
Initial calibration (a blank and at least one standard)	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails	N/A	N/A
Second-source calibration verification	Immediately following each initial calibration	All analytes within ±10% of expected value	Correct problem and repeat initial calibration.
Calibration blank	After every Second-source or Continuing calibration verification analysis	No analytes detected at or above the reporting limit	Correct the problem, and then reanalyze previous 10 samples.
Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±10% of expected value	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and reanalyze all associated samples
Interference check standard	At the start and end of each analytical sequence or twice during an 8-hour period, whichever is more frequent	All analytes within ±20% of expected value	Correct the problem, recalibrate, reanalyze ICS and all affected samples.
MS/MSD	One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed	All analytes within laboratory QC limits	None
Laboratory sample duplicate	Once per analytical batch if MSD not performed	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD >20%. One sample result < RL and a difference of ±2 times the reporting limit	None
LCS	At least one per analytical batch	All analytes within laboratory QC limits	Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
Dilution test	Each new sample matrix	Result from 1:5 dilution must be within ±10% of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit)	Perform post-digestion spike addition.
Post-digestion spike addition	When dilution test fails	Recovery within 75-125% of expected value	None
Metals by SW7000 Series			
Multi-point initial calibration (a blank and at least five standards)	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails	Correlation coefficient of linear regression is ≥ 0.995	Correct the problem and repeat the initial calibration.
Second-source calibration verification	Immediately following each initial calibration	All analytes within ±20% of expected value	Correct the problem and repeat initial calibration.
Calibration blank	After every Second-source or Continuing calibration verification analysis	No analytes detected at or above the reporting limit	Correct the problem, and then reanalyze previous 10 samples.
Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±20% of expected value	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and reanalyze all associated samples
MS/MSD	One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed	All analytes within laboratory QC limits	None

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
Laboratory sample duplicate	Once per analytical batch if MSD not performed	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD >20%. One sample result < RL and a difference of ±2 times the reporting limit	None
LCS	At least one per analytical batch	All analytes within laboratory QC limits	Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch
Dilution test	Each new sample matrix	Result from 1:5 dilution must be within ±10% of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit)	Perform recovery test
Recovery test	When dilution test fails	Recovery within 85-115% of expected value	Analyze all samples by MSA
Pesticides and PCBs by SW8081A and SW8082			
Multi-point initial calibration (minimum five points) for single-response pesticides/congeners; single-point calibration for Toxaphene and Chlordane; multi-point calibration for Aroclors 1016 and 1260 only, but include mid-point standard for all other Aroclors for pattern recognition; if a specific Aroclor is found in any sample, quantitation for that Aroclor must be done using 5-point calibration.	Prior to sample analysis, or when calibration verification fails	To use average RRF for quantitation of any analyte, % RSD must be ≤ 20%; otherwise use calibration curve with coefficient of correlation or determination ≥ 0.99.	Correct the problem and repeat the initial calibration.
Second-source calibration verification – pesticides/congeners and Aroclors 1016 and 1260 (or Aroclors identified in samples)	Once for each multi-point initial calibration	All analytes within ±15% of expected value	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.
Continuing calibration verification – pesticides/congeners and Aroclors 1016 and 1260 (or Aroclors identified in samples)	At the start of each analytical sequence, after every 12 hours or 10 samples, whichever is more frequent, and at the end of the sequence	All analytes within ±15% of expected value	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
Endrin/DDT breakdown check (Not applicable when analyzing for Aroclors/PCB congeners only)	At start of each 12 hour period	Breakdown of either Endrin or DDT ≤ 15%	Evaluate injector port and take corrective action; re-calibrate and reanalyze affected samples if necessary
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and reanalyze all associated samples
Surrogate spike	Every standard, sample, method blank, MS/MSD, and LCS	At least one of the surrogates in samples, method blank, MS/MSD, and LCS within laboratory QC limits.	Correct the problem and reanalyze (re-prep if necessary).
MS/MSD	One set per 20 project-specific samples	All analytes within laboratory QC limits	None
LCS	At least one per analytical batch	All analytes within laboratory QC limits	Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch.
Second column confirmation	All samples with results above the reporting limit objectives must be confirmed within the holding time.	Confirmation to be done using second column of dissimilar phase and retention characteristics (or gas chromatography/mass spectrometry if sample concentration is sufficiently high). All calibration and QC acceptance criteria specified for primary analysis must be met in the confirmation analysis.	Failure to perform confirmation will result in potential re-sampling and analysis at no cost to the project.
Calibration and QC Requirements for Semivolatile Organic Compounds by SW8270C			
DFTPP Tuning	Prior to initial calibration and calibration verification (every 12 hours)	Refer to criteria listed in the method	Retune instrument and verify
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	SPCCs average RF ≥ 0.050 and %RSD for RFs for CCCs ≤ 30% and one option below:	Correct the problem and repeat the initial calibration.
		Option 1: Mean %RSD for all analytes ≤ 15% with no individual analyte RSD > 30%, if using average RRFs	

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
		Option 2: Least squares regression r ≥ 0.990	
Second-source calibration verification	Once for each multi-point initial calibration	All analytes within ±25% of expected value	Correct the problem and repeat initial calibration.
Continuing calibration verification	At the start of each analytical sequence and every 12 hours thereafter	SPCCs average RF ≥ 0.050 and %D for RFs for CCCs ≤ 20% All other analytes within ± 20% of expected value.	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.
Retention time window calculated for each analyte	Each analyte	Relative retention time of each analyte within ± 0.06 relative retention time units of the continuing calibration verification	Not applicable (used for identification of analyte)
Internal Standards	Each sample and QC sample, method blank, MS/MSD and LCS	Retention time within ±30 seconds from retention time of the daily continuing calibration verification standard. EICP area within –50% to +100% of the daily continuing calibration verification standard	Inspect mass spectrometer and gas chromatography for malfunctions; reanalyze all affected samples
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem, then re-prep and reanalyze all associated samples
Surrogate spike	Every standard, sample, method blank, MS/MSD and LCS	At least two surrogates per fraction in samples, method blank and LCS within laboratory QC limits	Correct the problem and reanalyze (re-prep if necessary).
MS/MSD	One set per 20 project-specific samples	All analytes within laboratory QC limits	None
LCS	At least one per analytical batch	Within limits specified in Accuracy and Precision table	Correct the problem, then re-prep and reanalyze the LCS and all samples in the analytical batch.

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
Total Inorganic Arsenic and Total Mercury			
Initial calibration	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails	Correlation coefficient of linear regression is ≥ 0.995	Correct problem and repeat initial calibration.
Initial calibration verification (ICV); must be from second source	Immediately following each initial calibration	All analytes within ±20%	Correct problem and repeat initial calibration.
Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	Total Inorganic Arsenic within ±25% of expected value Total Mercury within ±20% of expected value	Recalibrate and reanalyze all samples since the last acceptable CCV
Method Blank	At least three per analytical batch	No analytes detected in the mean of the blank concentrations at or above the CRDL	Correct the problem and re-prep and reanalyze all associated samples
Laboratory Duplicates	One per 20 samples	Analytes within 25% difference	Investigate possible causes and analyze a third aliquot to determine impact to results. Qualify the data accordingly.
Laboratory Control Sample	One per batch	Recovery must be within 75% - 125%.	Correct the problem and re-prep and reanalyze all associated samples
MS/MSD (One MS and one set of laboratory duplicates may be substituted for MS/MSD)	One set per 20 project samples	Recovery must be within 75% - 125%.	Investigate possible causes. Apply a method of standard additions to identify interferences.
Method ASA #9 29-3.5.2 – Total Organic Carbon in Sediment/Soils			
Initial calibration verification	Initially, prior to any runs. Performed each day prior to analyzing samples.	Analyzed result within 80-120% of the true value concentration	Correct problem then repeat initial calibration.
Method blank	One per analytical batch	< RL	Correct the problem then reprep and analyze method blank and all samples processed with the contaminated blank
Laboratory control sample (LCS)	1 per analytical batch	80-120% recovery	Correct the problem and reanalyze the LCS
Duplicate (DUP)	One DUP per 20 samples	RPD < 30%	If the DUP is outside of precision tolerances and LCS results are acceptable, flag DUP results and write QCER
MDL Study	Once per year	Detection limits established shall be ≤ the RL	None

Table B-2
Calibration and Quality Control Protocols for Analytical Methods

QC Check	Frequency	Criteria	Corrective Action
IDC Study	Once per analyst	QC acceptance criteria table	Recalculate results; locate and fix problem with the system and then re-run demonstration
Results reported between MDL and RL	None	None	None

Notes
R = recovery
RL = reporting limit
RPD = relative percent difference
PQL = practical quantitation limit
BR = Brooks Rand Standard Operating Procedure
Calibration and Quality Control Criteria reported by LET Analytical, Inc. and from Brooks Rand LLC CompQAP, revision 018.
ICP MS = Inductively Coupled Plasma - Mass Spectrometry

Total Organic Carbon:
RL-Soil = 0.05% by wt**
Precision Soil (RPD) = $\pm$30
** Reporting limit translates to roughly 1000mg/kg, based on 1.00g sample aliquot

B3.0 METHOD DETECTION LIMITS, REPORTING LIMITS, AND INSTRUMENT CALIBRATION REQUIREMENTS

B3.1 Method Detection Limits

The Code of Federal Regulations (40 CFR 136) defines Method Detection Limit (MDL) as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

The appropriate analytical laboratory will calculate and report an MDL for each analyte of interest in each matrix (i.e., water, sediment, tissue) prior to analyzing field samples. The laboratory will calculate the MDLs statistically, based on instrument performance, at least once annually for each analytical method employed as required under 40 CFR 136. The RLs shall be no less than 5 times the calculated MDL to assure that the quantification of detected compounds is valid.

The laboratory selected to perform the selenite, selenate and the organic selenium analyses may establish sensitivity using a standard other than 40 CFR part 136. Exceptions to the MDL requirement will be evaluated by the project manager.

B3.2 Reporting Limits

Only those data that result in quantification within the demonstrated working calibration range may be reported by the laboratory. Quantification based on extrapolation is not acceptable to report. If samples are outside the calibration range, they must be diluted or concentrated, as necessary, and analyzed again. Reporting limits are driven by the data quality objectives as defined in the FSP and must be greater than 2-5 times the calculated MDL. The laboratory may report data between the MDL established in accordance with Section B3.1 and the reporting limits provided in Table B-2 at the CH2M HILL's PM direction.

B3.3 Instrument Calibration

Prior to analysis, the laboratory instruments will be appropriately calibrated by qualified personnel prior to the analysis of each sample batch. The frequency and quality criteria for calibration under USEPA guidance depend on the analytical methods being performed. All calibrations also must meet method time requirements. Requirements for initial and continuing instrument calibration are specified in Table B-2.

B4.0 ELEMENTS OF QUALITY CONTROL

Internal QC checks are used to determine if analysis is "in control" (batch QC), as well as the effect of the sample matrix, if any, on data generated (matrix QC). The QC parameters include method blanks (MBs), laboratory control samples (LCSs), and MS/MSDs. Table B-2 presents quality control limits for MBs, LCSs, MDs, and MS/MSDs.

B4.1 Method Blank

Laboratory pure water serves as a method blank (also called laboratory reagent blank) to monitor each analytical batch for interference and for contamination from glassware, reagents, and other potential contaminants generated within the laboratory. The method blank is processed through the entire analytical procedure along with each sample batch during the sample preparation period. One method blank per sample batch is analyzed, and if the concentration is greater than the RL or is equal to or greater than three times the MDL for one or more analytes, a corrective action is triggered to identify and eliminate contamination sources.

B4.2 Laboratory Control Sample

Internal control samples are used as a reference to assess accuracy of an analysis. The LCS for this project will consist of reagent water or cleaned sand spiked with a known amount of analyte that comes from a separate source than that used to establish calibration standards. If LCS results exceed the specified control limits, corrective procedures must be implemented.

B4.3 Matrix Spike/Matrix Spike Duplicate

A sample matrix fortified with known quantities of specific compounds is called a matrix spike (MS). It is subjected to the same analytical procedures as the samples of interest to evaluate the effect of the sample matrix on the recovery of the compound of interest. In other words, the MS is used to estimate the analytical precision of the method. A matrix spike duplicate (MSD) is a second laboratory fortified sample matrix that also is used to determine analytical precision.

Recovery data for these fortified compounds will be used to determine the existence of matrix effects samples analyzed during the project. Low recovery rates might result from matrix interferences or might relate to instrument response, which could be checked using a calibration standard. Spiked sample results that exceed the control limits will be subject to evaluation of both calculations and instruments, followed by corrective action.

B4.4 Matrix Duplicate

A matrix duplicate is a laboratory duplicate sample that is a separate aliquot of the original sample, which is taken through the same digestion and analysis procedures as the original sample. It is similar to a field duplicate except that the duplicate is not 'blind' to the laboratory. These samples can be used to determine analytical precision by determining the absolute difference between the matrix duplicate result and the sample result or the RPD..

B4.5 Equipment Blank

Equipment blanks are processed by rinsing decontaminated sampling equipment with ASTM Type II/deionized water. The rinse water is collected in sample bottles, preserved, and handled the same as the samples. Frequency of sample collection is once for each sampling apparatus during each event.

B4.6 Field Duplicates/Replicates

Field duplicates provide yet another means of maintaining quality control by measuring the precision of the sampling process. The laboratory will not be given the identity of the duplicates, but the QA reviewer will receive source information to aid in data review and validation. At a minimum, abiotic and biotic media samples will be collected at 5 percent frequency.

B5.0 QUALITY CONTROL PROCEDURES

B5.1 Sample Custody

Table 2 of the FSP provides recommended holding times and preservation conditions that will apply to this project. The laboratory will designate a sample custodian who will log in samples using a standardized Sample Receipt Form. The custody seal will be inspected to verify that it is intact, and the sample custodian will then check the condition of samples and verify custody records. If present within the container, ice will be noted, and temperature recorded. Any breakage, leakage, or other damage will be noted and recorded. The sample custodian will record all tracking information and pass it to the data librarian and the laboratory project manager. All of this information will appear on the Sample Receipt Form. If discrepancies are noted between the Chain-of-Custody (COC) report and the actual contents of the container, these will immediately be reported to the contractor, who will in turn report to the CH2M HILL project manager. Along with sample receipt documentation, the following information will be documented on the Sample Receipt Form by the sample custodian:

- Date Samples received
- Contractor sample ID Number
- Laboratory sample ID number
- Analytical tests requested for each sample batch
- Sample matrix
- Number of samples in the batch
- Container description and location in the laboratory

After being logged in, the samples will be refrigerated or frozen as appropriate. The laboratory must have formally documented procedures for sample holding and storage, and laboratory personnel will know the required sample holding times and preservation conditions. If samples are not extracted or analyzed within the required holding time for the appropriate method, the contractor project manager will be advised of the problem, and the contractor will notify immediately the CH2M HILL project manager for guidance on corrective action. All corrective actions must be fully documented. After confirmation by the CH2M HILL project manager, samples with expired holding times will be discarded.

B5.2 Deliverables

The laboratory that will perform analyses must have established procedures to conduct data reduction, review, and reporting. Laboratory-specific procedures are evaluated during technical systems audits to ensure that the process steps discussed in this section are properly performed.

The primary analyst(s) will be responsible for review of their work as their work is being performed and for applying the measurement qualifiers (i.e., laboratory qualifier flags) based on the DQOs. During this process, a case narrative or QC exception report will be generated documenting nonconformance issues and resolutions. A designated peer reviewer, a qualified staff member who is not the primary analyst, will perform an independent review to determine the project specifications have been met. The Laboratory Manager or designee will be responsible for final approval of the laboratory analytical report prior to sending the report to project staff. All raw data will be archived in confidential laboratory files.

Most laboratories use a Laboratory Information Management System (LIMS) to store, transfer, and report analytical data. The LIMS files must also undergo a QC check to verify that results are complete and correct. The laboratory is responsible for generating hard copies (i.e., final analytical report) and electronic files of the analytical results in standard formats needed by the project staff. The specific information and electronic file formats are established and tested prior to analysis of any samples to ensure that the formats will be compatible with the project database, and that all required information is reported.

The hard copy and electronic laboratory reports for all samples and analyses will contain the information necessary to perform data evaluation. The following information is typically included for each preparation batch (when applicable) and each analytical batch:

- Field ID number
- Date received
- Date prepared
- Date analyzed
- Method
- Results for each analyte
- Sample-specific reporting limit
- Units
- Laboratory qualifier flags, also called measurement qualifiers, for all data that do not meet project QC specifications
- Narrative
- Matrix spike and laboratory control spike concentrations
- Matrix spike and laboratory control spike results
- Matrix spike and laboratory control spike recoveries and relative percent differences (RPDs)
- Method blank results
- Initial and continuing calibration verification results (hard copy only)
- Initial and continuing calibration verification recoveries (hard copy only)
- Analytical batch number
- Preparation batch number
- Analytical sequence or laboratory run log that contains sufficient information to correlate samples reported in the summary results to the associated method QC information, such as initial and continuing calibration analyses.
- Confirmation results
- Calibration blank results for inorganic analyses (required in hardcopy format only)

- ICP interference check sample true and measured concentrations and percent recoveries (required in hardcopy format only)
- Method of standard addition results (if applicable; required in hardcopy format only)
- Post-digestion spike recoveries (if applicable; required in hardcopy format only)
- Internal standard recovery and retention time information, as applicable
- Instrument Tuning and mass calibration information for gas chromatography/mass spectrometry and ICP/ mass spectrometry analyses
- Any other method-specific QC sample results

Complete documentation of sample preparation and analysis and associated QC information will be maintained by the laboratory for all project samples in a manner that allows easy retrieval in the event that additional validation or more information is required.

Data flow from the laboratory and field to the project staff and data users follows established procedures to ensure that data are properly tracked, reviewed, and validated for use. The field data are generally entered into a computer master log and COC forms are generated for submittal to the laboratory with the samples. The field data are verified by the data management task leader after entry by comparison with field data sheets and notebooks. Field data are transferred to the project database by downloading the electronic master log files daily.

The electronic analytical data from the laboratory are submitted with hard-copy reports and uploaded to the project database by using a set of programs to read, check, and match the analytical results to the field data in the database. The electronic results are reviewed by project staff to ensure accurate reporting and adherence to project specifications. Tem percent of all electronic results will be reviewed for correct sample identification, dates, sample specific detection limits, flags, and agreement between the hard copy and electronic data. If systematic errors or frequent occurrence of random errors are observed, a successively higher percentage of reports will be reviewed. After the analytical reports are used to verify the electronic transfer process, they are permanently stored in project files.

B5.3 Sample Dilutions

Dilution of the samples results in elevated reporting limits and ultimately affects the usability of the data as it pertains to decision making processes related to potential actions at the sampling site. It is important to minimize dilutions and maintain the lowest possible reporting limits. When dilutions are necessary due to high concentrations of target analytes, lesser dilutions should also be reported to fully characterize the sample for each analyte. The level of the lesser dilution that provides the lowest possible reporting limits without having a lasting deleterious effect on the analytical instrument.

B6.0 SAMPLING PROCEDURES

B6.1 Field Sampling

Where appropriate, environmental samples will be collected directly into pre-cleaned containers provided by the laboratory. Sampling procedures will adhere to USEPA-recommended preservation requirements for each parameter of interest. Use of proper containers and preservation methods will retain sample integrity. Containers and preservatives will be provided by the laboratory that will be completing the analytical testing.

Holding time compliance and proper sampling preservation begin during field sampling. Temperature control and pH adjustment are the most common preservation techniques. Field personnel who will conduct sampling for this project will be thoroughly trained in proper use of sample collection gear and acceptable sampling procedures. Table 2 of the FSP presents sample containers, sample volumes, and preservation requirements for each analyte and sample type.

B6.2 Sample Handling and Custody

Field sampling personnel will maintain a daily, waterproof field notebook. The field notebook will contain the following information:

- Date and time sampling commenced
- Name of sampling personnel
- Location of sampling station (i.e. name/number and GPS coordinates)
- Station description
- Type of sampling and equipment used
- Field observations (e.g., weather, depth of water, condition of water, other relevant conditions)
- Number of grabs made and amount of sample taken
- Types of analyses to be performed
- Physical properties of water (conductivity, temperature, dissolved oxygen (DO), and pH)

As required by the project manager, additional information will be recorded in the field notebook.

Samples will be transported to the laboratory, as appropriate based on media, with proper COC records for each sample. For example, water samples will be shipped within 24 hours of collection while sediment and biota may be shipped after each sampling event provided the samples are properly preserved and stored. Each person who releases a set of samples will sign and date the COC form and require the receiver to sign and date the form. Each will keep a copy of the signed form. Each form will consist of a record of all samples taken from each station. Each form will include the sample identification (ID) number, drain name(s), and date collected.

Field sampling personnel will attach labels to the outside and/or inside of the sample containers. Labels will include the following information:

- Sample Identification (ID) number
- Collection station number/Station name
- Date samples collected (added in field)
- Matrix (coded as to sediment, water, or biota type)
- Time samples collected (added in field)
- Initials of sampling team (added in field)

The sample ID number will follow the format below:

Station Date Matrix Replicate

Where the first four characters indicate the location (i.e., Northern Shore 01), the next two letters indicate the matrix (i.e., SD-sediment), and the last two digits indicate the sample number (i.e., 01 through 03 [or 04 for a duplicate]). The staff from the SDSU Salton Sea Ecosystem Research Group may use a different sample naming convention that will be tracked separately from the samples we submit for this project.

Replicate quality control samples for water, sediment, and tissue chemistry will be taken at a rate of 1 per 20 field samples (i.e., 5 percent frequency) collected.

Sample coolers will be packed with sufficient ice to keep them cool for at least 48 hours. Each sample group will be double-bagged in pre-cleaned plastic bags closed with cable ties to keep all samples within the container isolated from each other. Ice chests must be driven or flown to the laboratory within 24 hours of collection, except for biota samples that are frozen.

B7.0 SCREENING ANALYTICAL METHODS

B7.1 Field Instrument Calibration Procedures

Several types of real-time instruments can be used to monitor and evaluate the physical/chemical parameters of water and sediment. The field instrument(s) to be used in this investigation should be able to measure temperature, pH, DO, and conductivity in water. To ensure the instrument is operating properly and is producing accurate and reliable data, routine calibration will be performed prior to and during use. This will include calibrating pH and conductivity with at least two standard calibration solutions that bracket the expected range of measurements. Factory calibrations will be performed at a frequency recommended by the manufacturer. Field calibrations will be performed at least once a day, prior to instrument use. If field calibration reveals the instrument is outside established accuracy limits, the instrument will be serviced in the field. If necessary, the instrument will be returned to the manufacturer for immediate repair and servicing. A backup instrument will be available for each of the critical real-time instruments used in the field.

B8.0 DATA VALIDATION

Measurement data should be consistently assessed and documented to determine whether program DQOs have been met, to assess data quality quantitatively, to identify potential limitations on data use, and to assess whether site-specific DQOs have been met. The data evaluation calculations and applications for chemical data used for the project are generally based on USEPA Guidelines.

B8.1 Chemical Data Evaluation

A batch QA review for all data will be performed by a third-party firm, EcoChem, Inc. of Seattle, Washington. A batch review is typically referred to as data evaluation.

The routine QC procedures conducted in the laboratory are established in the published methods, this QAPP, and the analytical SOPs prepared by the laboratory. The laboratory will be responsible for following the specific procedures as specified in this QAPP and the FSP and operating analytical systems within statistical control limits. These procedures include proper instrument maintenance, calibration and calibration checks, and laboratory QC sample analyses. Associated QC sample analytical results are reported with the sample results so the project staff can evaluate the analytical process performance.

All project data will be reviewed as part of data evaluation and a QA/QC report prepared regarding the findings of the data evaluation process. The review will be conducted on an analytical or preparation batch basis or by evaluating QC samples and all associated field sample results. Project data evaluations procedures established for the project generally include:

- Review of initial and continuing calibration verification;
- Initial review of analytical and field data for complete and accurate documentation, COC records, analytical holing time compliance, and required frequency of field and laboratory QC samples;
- Evaluation of method and field blank results to identify systematic contamination;

- Comparison of all types of spike and duplicate results with project objectives for precision and accuracy;
- Statistical calculations for overall method accuracy and precision using the appropriate QC sample results;
- Assigning data qualifier flags to the data necessary to reflect limitations identified by the process; and;
- Calculating completeness by method and matrix or by analyte, if designated.

Project staff will review laboratory reports to verify adherence to QAPP specifications and the FSP. A checklist will be completed for each work order.

Qualifier flags will be applied to sample results that fail to meet the DQOs Tables A-3 and A-4 presents the flagging conventions. This table should be used as minimum data evaluation criteria. The qualifier codes or flags will be stored in the database with the data. If variation from the outlined flagging guidelines is necessary, the reasoning for this variation will be documented. Reanalysis or resampling may be recommended as a corrective action if data are determined to be unacceptable for the intended use. Definitions of the qualifier flags are presented in Table B-5.

A distinction must be made between quality control and data review conducted as part of laboratory operations and the project-related data evaluation conducted after data have been reported. Planning, use of standard field, analytical, and QC procedures, and auditing performed during field and laboratory activities are designated to control the sampling and analytical processes to produce data of sufficient quality for project needs. If a problem occurs in spite of these controls, the data evaluation must identify the problem, determine which data are affected, state how use may be limited, and make recommendations for corrective actions as necessary.

The QA/QC staff conducting data evaluation is responsible for ensuring data qualifier flags are assigned as needed based on the established QC criteria, and any limitations are communicated to the data users. These data qualifier flags are not related to any flags that may be assigned by the laboratory. Data qualifier flags explain the type and extent of limitation placed on a result, while laboratory flags identify QC results that are outside laboratory tolerances and may or may not lead to subsequent data qualifiers assigned during data evaluation. The QA/QC staff is also responsible for initiating corrective actions for analytical or other problems identified during the data evaluation process. Corrective actions range from verifying that the method was in statistical control during the analytical runs, to reanalysis of the sample or resampling or reissuing the laboratory report for clerical errors.

B8.2 Chemical Blank Data Evaluation

Blank results indicate whether any reported analytes may be attributed to laboratory sources (instrument, reagents, glassware etc.) or field sources or conditions (equipment, shipping etc.) rather than the sampled media. Laboratory blanks include method and/or system blanks in each analytical batch. Equipment blanks are field blanks that are collected at specified frequencies or under selected conditions to monitor contamination from non-laboratory sources.

Equipment or field blank results are evaluated individually, related to the field samples. The probable contamination source is identified and associated sample results are qualified as necessary based on the relative concentrations between the blank and sample. For example, if equipment blank results show contamination and the sample collected from the sampling equipment rinseate shows the same analyte at concentrations attributable to blank concentrations, the sample results are “U” flagged to indicate they should be considered nondetect. Samples collected before and after the blank are also evaluated to determine the potential sources and impacts of carryover.

Table B-3
Flagging Conventions - Minimum Data Evaluation Criteria for Inorganic Metals Methods

Quality Control Check	Evaluation	Flag	Flag Definition	Samples Affected
Holding Time	Holding time exceeded for analysis	J	positive results	Sample only
		UJ	non detects for all other methods	
	Holding time exceeded by a factor of two	R	non detect results	
Sample Preservation	Sample preservation requirements not met (sample preservation may be adjusted at the laboratory with no flagging required)	J	positive results	Sample
		UJ	non detects	
Temperature Blank	> 6 degrees C	J	positive result	Samples in same cooler
		UJ	non detects	
Calibration Verification: ICV, CCV	%R > UT	J	positive results	All associated samples in analysis batch
	%R < LT	J	positive results	
		UJ	non detects	
Interference Check Sample	%R > UT	J	positive results	All associated samples in analytical batch
	%R < LT	J	positive results	
		UJ	non detects	
Laboratory Control Sample	%R > UT	J	positive results	All samples in digestion batch
	%R < LT	J	positive results	
		UJ	non detects	
Blanks: MB, ICB, CCB	Multiply highest blank concentration by 5	U	flag reported results < calculated values	All samples in digestion batch (MB); all samples in analysis batch (ICB, CCB)
Equipment Blank	Multiply highest blank concentration by 5	U	flag reported results < calculated values	All samples, same field team, matrix and date
Matrix Spikes	%R > UT	J	positive results	All samples from same site as parent sample
	%R < LT	J	positive results	
		UJ	non detects	
	RPD > UT	J	positive results	

Table B-3
Flagging Conventions - Minimum Data Evaluation Criteria for Inorganic Metals Methods

Quality Control Check	Evaluation	Flag	Flag Definition	Samples Affected
Laboratory Duplicates (including MDs)	One or both sample results < 5 times the RDL and a difference of ± RDL for water not met.	J	positive result	All samples in digestion batch
	Concentration of reported analyte > 10 times MDL in either sample and RPD > UT;	J	positive result	
	Concentration of reported analyte < 10 times MDL in either sample and absolute difference > 2 x RL	J	positive result	
Serial Dilution	If concentration is > 25 time MDL and % difference > UT	J UJ	positive result non detects	All samples from same site as parent sample if analytical spike not performed
Field Duplicates	Concentration of reported analytes are > 5 times RDL in either sample and RPD > UT (35% for sediment).	J	positive results	Field duplicate pair
	One or both sample results < 5 times the RDL and a difference of a ± 2 times RDL for water (± 4 times for soil).	J UJ	positive results non detects	

Notes

Spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.

CCB: continuing calibration blank
CCV: continuing calibration verification
ICB: initial calibration blank
ICV: initial calibration verification
LT: lower tolerance
MSA: method of standard addition
MB: method blank
RPD: relative percent difference
MD: matrix duplicate
%R: percent recovery
UT: upper tolerance
MDL: method detection limit
PQL: practical quantitation limit

Table B-4
Flagging Conventions - Minimum Data Evaluation Criteria for Organic Methods

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time	Holding time exceeded for extraction or analysis	J positive results; UJ non-detects	Sample
	Holding time exceeded by a factor of two	J positive results; R non-detects	
Temperature	> 6°C	J positive results; UJ non-detects	All samples in same cooler
Initial Calibration	RRF <0.050 (SW8270C)	J positive results, R non-detects	All associated samples in analysis batch
	%RSD >30.0% (SW8270C), or > 20% (SW8081A, and SW8082), AND calibration curve not used; OR calibration curve used, but with coefficient of correlation or determination < 0.99	J positive results, UJ non-detects	
Calibration Verification (Second-source and continuing calibration verification)	RRF < 0.050 (SW8270C)	J positive results, R non-detects	All associated samples in analysis batch
	%Drift > 25.0% (SW8270C) or > 15% (SW8081A and SW8082)	J positive results, UJ non-detects	
Laboratory Control Sample	%R > UT	J positive results	All samples in preparation batch
	%R < LT	J positive results, UJ non-detects	
Method Blank	Convert blank concentration to soil units, if applicable; multiply the highest blank concentration by 5	U positive sample results < 5x highest blank concentration	All samples in preparation batch or analytical batch, whichever one applies, associated with method blank or calibration blank
Equipment Blank			All samples, same site, matrix and date (water) or all samples, same site, matrix (soil) associated with equipment blank
MSs			
% Recoveries	%R > UT	J positive results	MS analytes in parent sample and field duplicate, if any.
	%R < LT	J positive results, UJ non-detects	
RPDs	RPD > UT	J positive results	MS analytes in parent sample and field duplicate, if any.
Surrogates			
SW8082	%R > UT	J positive results	All analytes in sample
	%R < LT and none < 10%	J positive results; UJ non-detects	
	%R < 10%	J positive results; R non-detects	

Table B-4
Flagging Conventions - Minimum Data Evaluation Criteria for Organic Methods

Quality Control Check	Evaluation	Flag	Samples Affected
SW8270C	2 or more surrogates in same fraction with %R > UT	J positive results	All analytes in same fraction in sample
	2 or more surrogates in same fraction with %R < LT but not <10%	J positive results; UJ non-detects	
	2 or more surrogates in same fraction with %R < LT and <10%	J positive results; R non-detects	
SW8081A	More than 1 surrogate with %R > UT	J positive results	All analytes in sample
	More than 1 surrogate with %R < LT but not <10%	J positive results; UJ non-detects	
	More than 1 surrogate with %R < LT and <10%	J positive results; R non-detects	
Internal Standards (SW8270C)	Area >UT	J positive results	Associated analytes in sample
	Area <LT but not <10%	J positive results; UJ non-detects	
	Area <10%	J positive results; R non-detects	
Field duplicates	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD > UT (30% for water samples; 50% for soil samples)	J positive results	Field duplicate pair
	One or both sample results < 5 times the reporting limit and a difference of ±2 times the reporting limit for water (±4 times for soil).	J positive; UJ non-detect	
Confirmation (SW8081A and SW8082)	RPD between primary and confirmation results > 25%	J positive results	Sample

Notes:

All QA/QC criteria will be used for validation criteria.

Organic Methods include: SW8081A, SW8082, and SW8270C

Spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.

For methods requiring confirmation, the qualification s applies to primary analysis results (either of the two columns/detectors may be designated as the primary column/detector).

Where one MS recovery meets acceptance criteria and the other MS of the pair does not, professional judgment may be used to determine if the parent sample should be qualified for matrix effects by comparing the MS recoveries to other QC results within the batch or sample site.

Qualifier may not apply in cases where a surrogate coelutes with a non-target analyte.

It is assumed that two surrogates are used for SW8081A analyses. If only one is used, that surrogate must pass the acceptance criteria, otherwise flags will be applied.

Qualifier may not apply in cases where low surrogate recoveries are due to sample dilution.

LT = Lower tolerance.

MB = Method blank.RPD = Relative percent difference.

UT = Upper tolerance. %R = Percent recovery.

Table B-5
Qualifier Flag Definitions

Flag	Definition
J	Analyte was present but reported value may not be accurate or precise, value is estimated
R	This result has been rejected
U	This analyte was analyzed for but not detected at the specified DL
UJ	This analyte was not detected above the reported PQL but the reported PQL is approximate and may or may not represent actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Notes
DL - detection limit
PQL - practical quantitation limit

B8.3 Chemical Accuracy

Accuracy is associated with correctness and is a comparison between a measured value and a known or expected value. Accuracy is assessed by comparing LCS, MS, and performance evaluation (PE) sample recoveries with the project objectives as well as manufacturer's tolerances on commercially purchased PE samples.

B8.4 Laboratory Control Samples

Laboratory control samples are spikes of method analytes in reagent-grade water (or may be commercially purchased solid LCSs). The LCSs are taken through sample preparation and analysis to assess statistical control of method. If recovery is outside the established tolerances, samples from the same preparation and/or analytical batch may exhibit similar analyte recoveries and should be qualified. Any non detected sample results associated with low LCS recoveries (after the duplicate has been analyzed with the same result) indicate a potential false negative and may be flagged as estimated. The system must be assessed to determine the reason for out-of-tolerance occurrence, and corrective action may be indicated, up to and including re-extraction and reanalysis (if still within holding time) or resampling of affected samples.

B8.5 Matrix Spikes

Matrix spike results are assessed by comparison with the recovery ranges presented in this QAPP. If MS recoveries are outside this range, two conditions must be evaluated:

- The spike concentration relative to the parent sample concentration; and
- The associated LCS recovery.

If the parent sample concentration is greater than four times the spike concentration, the spike concentration is considered insignificant, relative to sample dilution and /or analytical variability. Since the recovery does not represent the ability to recover the analyte from the matrix, it is generally not calculated, or at least should not be used to qualify data.

If MS and/or MSD recovery is outside the range cited and the associated LCS is within specification, matrix interference is demonstrated and sample results are qualified as estimates or rejected if recoveries are extremely high or low. If systematic matrix interference is exhibited, similar sample results such as those from the same site or lithology must be evaluated. The reviewer's judgment is used to determine if the results should be qualified.

The qualified data are discussed in the sampling task QC report, and specific limitations such as poor or enhanced recovery for specific analytes is discussed. Further investigation or corrective action may be taken to find methods to reduce interferences.

B8.6 Precision

Precision is a measure of variability between duplicate analyses and is calculated for field and laboratory duplicates. Precision is evaluated by comparing the RPD of MS/MSDs, matrix duplicates, and field duplicate samples with RPD objectives stated in Section B4.0.

If field duplicate RPDs exceed the objective, the analytical results for the samples collected by the sampling team, from the same equipment, from the same site, from similar matrices, or on the same day may be affected. Close evaluation of the results should indicate the most likely source variability, and the corresponding samples are qualified as warranted.

If all analytical specification are satisfied and sampling error is not suspected, the field duplicate results indicate the variability of the matrix. The field duplicate objectives should be used to initiate further evaluation but are not expected to control the analysis or field conditions. Estimated qualifier flags (FD) may be assigned for samples or matrices with high field duplicate RPDs to indicate sample heterogeneity or high matrix variability rather than a data quality problem.

An average RPD may be calculated and reported as a measure of overall analytical precision or matrix variability for methods and analytes with many duplicate samples or analyses.

B8.7 Completeness

Completeness is calculated for each method and matrix after the QC data have been evaluated and data qualifiers assigned. The calculation for completeness can be found in Section B2.4.

B9.0 DATA MANAGEMENT

This section describes the processes used to collect, validate, disseminate, and archive new analytical data as they are generated during the field investigation. To facilitate information utilization and decision making, CH2M HILL has developed an internal set of guidelines for delivering data management services on site characterization and remediation projects which will be followed on this project task.

B10.0 CORRECTIVE ACTION

Corrective action may be required as a result of deviations from field or analytical procedures. Deficiencies identified in audits and data quality evaluations may also call for corrective action. All project personnel have the responsibility, as part of the normal work duties, to identify, report, and solicit approval of corrective actions for conditions adverse to data quality.

The QAPP has specified the corrective action to be taken when deviations from calibration and QC acceptance criteria occur. Field and laboratory staff may encounter conditions that require immediate corrective action that are not addressed in the FSP or QAPP. These personnel will document conditions and the results of corrective actions in a field logbook or laboratory non conformance report and communicate their actions as soon as feasible to the field team leader, laboratory supervisor, and if necessary, the project chemist for immediate input. A mechanism must be in place to allow for supervisory review and/or client input for all deviations or deficiencies. A corrective action reporting system that requires immediate documentation of deviations or deficiencies and for supervisory review of the actions taken to correct them will be established. At a minimum, the corrective action report should include:

- The type of deviation or deficiency
- The date of occurrence
- The impact of the deviation or deficiency, such as samples affected
- The corrective action taken
- Documentation that the process has been returned to control

The only time that a corrective action report may be waived is when a deviation or deficiency is immediately corrected and its impact is precluded. An example would be an unacceptable initial calibration that is repeated before samples are analyzed.

Each corrective action report must be reviewed and approved by a person of authority, such as the field team leader or laboratory supervisor. The ultimate responsibility for the laboratory corrective action process is the QC Manager, who must ensure that proper documentation, approval and close out of all out-of-control or non-conformance events is performed. A non-conformance report will summarize each non-conformance condition Corrective action reports that could potentially affect data quality must be brought to the attention of the Project Manager. Report disposition will be the responsibility of the Project Manager. Copies of corrective action reports must be maintained in the laboratory or field project files.

B11.0 PREVENTIVE MAINTENANCE

The primary objective of an instrument/equipment maintenance program is to promote the timely and effective completion of a measurement effort. The maintenance program is designed to minimize the downtime of crucial sampling and/or analytical equipment due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- Establishment of maintenance responsibilities;
- Establishment of maintenance schedules for major and/or critical instrumentation and apparatus; and
- Establishment of an adequate inventory of critical spare parts and equipment.

These are discussed in the following subsections.

B11.1 Maintenance Responsibilities

Equipment and instruments used in this project fall into two general categories:

- Laboratory instruments (e.g., Inductively Coupled Plasma (ICP), Atomic Absorption (AA) Spectrophotometers, etc.); and

- Field sampling equipment (e.g., field meters, etc.).

Maintenance of laboratory instruments is the responsibility of the laboratory contracted to perform the analytical portion of this program. Generally, the laboratory manager or supervisor of a laboratory is responsible for the instruments and equipment in his or her work area. The laboratory manager will establish maintenance procedures and schedules for each major equipment item. Although this responsibility may be delegated to laboratory personnel, the manager retains responsibility for ensuring adherence to prescribed protocol. All laboratories are bound by analytical contractual agreements to maintain the ability to produce data that meet the project objectives and to follow method specifications. This ensures that adequate spare parts, maintenance schedules, and emergency repair services are available.

Maintenance responsibilities for field equipment are assigned to the field manager and task leaders for specific sampling tasks. However, the field team using the equipment is responsible for checking the status of the equipment prior to use and reporting any problems encountered. The field team is also

responsible for ensuring that critical spare parts are included as part of the field equipment checklist. Non-operational field equipment is removed from service and a replacement obtained.

All field instruments will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed to maintain its operating integrity during variable temperature ranges that are representative of ranges that will be encountered during hot or cold weather working conditions. It is recommended, but not required, that at the end of each working day, all field equipment be taken out of the field and placed in a cool, dry room for overnight storage.

B11.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each piece of equipment. Other maintenance activities are conducted on an as-needed basis. Manufacturers' recommendations provide the primary basis for established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., LC instruments, atomic absorption spectrometers, analytical balances, etc.).

Each analytical instrument is assigned an instrument logbook. All maintenance activities are recorded in the instrument log. The information to be entered includes:

- Date of service;
- Person performing service;
- Type of service performed and reason for service;
- Replacement parts installed (if appropriate);
- Date of next scheduled service
- Equipment calibration records; and
- Miscellaneous information.

B11.3 Spare Parts

In addition to a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. The inventory includes those parts and supplies that:

- Are subject to frequent failure;
- Have limited useful lifetimes; or
- Cannot be obtained in a timely manner should failure occur.

Field managers and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, an in-house source of backup equipment and instrumentation should be available.

B12.0 AUDITS

B12.1 External Audits

Announced and unannounced audits of the field operations and of the laboratories may be conducted during any stage of the project.

B12.2 Internal Audits

Annual audits of the laboratory shall be conducted by the laboratory's Quality Assurance Officer (QAO). The audits shall verify, at a minimum, that written standard operating procedures are being followed;

standards are traceable to certified sources; documentation is complete; data review is being done effectively and is properly documented; and data reporting, including electronic and manual data transfer, is accurate and complete. All audit findings shall be documented in QA reports to management. Necessary corrective actions shall be taken within a reasonable time frame. The QAO shall verify that such actions are effective and complete and shall document their implementation in an audit closeout report to management.

To assess sample and data collection procedures, performance evaluations will be conducted and will consist of technical systems audits and performance audits.

B13.0 REFERENCES

USEPA. 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823-B-01-002. Office of Water. October.

APPENDIX C:

Site-Specific Health and Safety Plan and Illness/Injury Prevention Plan

Table of Contents

Attachments

Figure

APPENDIX C:
CH2M HILL HEALTH AND SAFETY PLAN
SALTON SEA ECOSYSTEM RESTORATION PLAN

This HSE plan applies to:

- All CH2M HILL staff, subcontractors, and tiered subcontractors of CH2M HILL working on the project.
- All CH2M HILL visitors (including visitors from the Client, the Government, the public, and other staff of any CH2M HILL company)

This HSE plan does not apply to the third party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M HILL.

This HSE plan defines the procedures and requirements for the health and safety of CH2M HILL staff and visitors when they are physically on the project site. The project site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This HSE plan will be kept onsite during field activities and will be reviewed as necessary. The HSE plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The HSE plan adopts, by reference and as appropriate, the Standards of Practice (SOPs) in the CH2M HILL Corporate Health and Safety Program. In addition, this HSE plan may adopt procedures from the project Work Plan, OSHA, or any other governing regulations. If there is a contradiction between this HSE plan and any governing regulation, the more stringent and protective requirement shall apply.

All CH2M HILL staff and subcontractor supervisors must sign the CH2M HILL HSE Plan Employee Sign-Off Form located in Attachment 1. Copies of this form will be maintained onsite by the Safety Coordinator(SC) and a copy will be sent to the Regional HS&E Office for filing.

1.0 PROJECT INFORMATION AND DESCRIPTION

PROJECT NO: 320019

CLIENT: California Department of Water Resources

PROJECT/SITE NAME: Salton Sea Ecosystem Restoration

SITE ADDRESS: Salton Sea, Imperial County, California

CH2M HILL PROJECT MANAGER: Gwen Buchholz

CH2M HILL OFFICE: SFO

SITE ACCESS: Not restricted

DATE(S) OF SITE WORK: April 1, 2005 through December 31, 2005

SITE DESCRIPTION AND HISTORY:

The Salton Sea was formed between 1905 and 1907 when the Colorado River burst through poorly built irrigation controls south of Yuma, Arizona. Almost the entire flow of the river filled the Salton Basin for more than a year, inundating communities, farms and the main line of the Southern Pacific Railroad.

Continued filling of the Salton Sink was finally stopped in 1907, when a line of protective levees was built by boxcars dumping boulders into the breach from Southern Pacific tracks. By then, this inland lake was about 40 miles long and 13 miles wide, covering an area of about 400 square miles.

The Salton Sea is currently 35 miles by 15 miles and can be as long as 40 miles by almost 20 miles in particularly wet years. It has an average depth of 29.9 feet and, at its deepest, is 51 feet. It contains 7.3 million acre feet of water and evaporates 1.3 million acre feet each year. There is a five-mile-long trench on the south end of the Sea that is 51 feet deep. The Sea is currently 228 feet below sea level. Interestingly, the bed of the Salton Sea is only five feet higher than the lowest spot in Death Valley.

The Salton Sea is beset by several serious problems. Because the Sea has no outlet, water is lost only through evaporation, leaving dissolved salts behind and gradually raising salinity. The Sea's salinity has now reached 44 parts per thousand (ppt), about 25 percent higher than ocean water. CH2M HILL is working with the Department of Water Resources to help solve the salinity problem and protect the wildlife in this area.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED BY CH2M HILL AND SUBCONTRACTORS:

The following scope of work will be conducted as part of the Salton Sea project:

- Site visits for observations and sampling. Areas to be visited will include quarries, wetlands, agricultural drains, rivers, shoreline, and the open sea.
- Construction of meteorological towers and stations
- Collecting data from new and existing meteorological stations
- Sampling of sediments and soils at the shoreline, in shallow areas and on beaches and terraces nearby the shoreline.
- Fish sampling will be conducted at the Salton Sea and at three stations within the Lower Colorado River. Sampling activities will be conducted by CH2M HILL and personnel from San Diego State University and the California Dept. of Fish and Game. Fish sampling will involve working from boats or near shore using gill or seine nets to collect fish samples from 6 stations around the Sea in shallow, medium, and deep sampling locations.
- On Sea sampling efforts will also include sampling of sediment (ponar dredge sampler); surface water, and other kinds of biota (invertebrates, attached algae, pileworms). The invertebrates and pileworms will likely be seived from the sediment dredges.
- Up to 38 additional shallow sediment sampling locations will also be sampled around the Sea. Soil sampling will be done at 40 different near-shore locations. All the samples collected will be shipped to analytical laboratories for analysis under chain of custody methods.

Figure 1
Site Map

2.0 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED

2.1 Project Organization

Project Manager:	Gwen Buchholz/SFO
Project Management Team	John Dickey/SAC Dave Christophel/SAC Daryl Hayes/SAC
Task Managers:	Steve Long/SAC Harry Ohlendorf/SAC Pamela Vanderbilt/SAC Randy Bushey/WPB
Safety Coordinators:	At least one safety coordinator will be present onsite during field work that involves working on water, or during construction of met station footings and towers.
Health and Safety Manager:	Trish Danby/SAC

2.2 Responsibilities

Project Manager

- Overall responsibility for executing the project.

Project Task Managers

- Manages project and is responsible for planning and supervision of project field work.

Safety Coordinators/Field Team Leaders (CH2M HILL employee based on training and experience)

- Enforces all guidelines of the Health and Safety Plan.
- Plans and supervises technical and administrative aspects of fieldwork.
- Authorizes field team members to initiate fieldwork in accordance with the work plan and this HSP.
- Completes and submits all required recordkeeping.
- Administers this HSP during operations included in the scope of this project.
- Verifies current certifications of individuals medical, training, and respirator, and respirator fit prior to authorizing access to areas where site control is established.
- Verifies that onsite and offsite emergency communication systems are operational.
- Conducts pre-emergency planning.
- Conducts employee health and safety communications.

Health and Safety Manager

- Directs the development, implementation, and operation of this HSP. Provides review and approval of subsequent HSP amendments.
- Oversees compliance with this HSP. Conducts field audits as necessary and in accordance with CH2M HILL policies and procedures.
- Provides project and field team personnel with technical guidance for conducting fieldwork in a safe and healthful manner.
- Conducts investigations of accidents to determine the cause and necessary corrective actions.

2.3 Description of Subcontractor Tasks

When specified in the project documents (e.g., contract), this plan may cover CH2M HILL subcontractors. However, this plan does not address hazards associated with tasks and equipment that the subcontractor has expertise in (e.g., operation of excavator). Specialty subcontractors are responsible for health and safety procedures and plans specific to their work. Specialty subcontractors may be required to submit plans and the Subcontractor Safety Questionnaire to CH2M HILL for review and approval before the start of fieldwork. Subcontractors must comply with the established health and safety plan(s). CH2M HILL must monitor and enforce compliance with the established plan(s).

General health and safety communication with subcontractors contracted with CH2M HILL and covered by this plan is to be conducted as follows:

- Request that the subcontractor, if a specialty subcontractor, submit a safety or health plan applicable to their expertise (e.g., drill-rig safety plan or nuclear density gauge [NDG] health plan); attach the reviewed plan.
- Supply subcontractors with a copy of this plan, and brief them on its provisions.
- CH2M HILL's SC will direct health and safety communication to the subcontractor's competent person or safety representative.
- Notify the subcontractor-designated representative if a violation of the plan(s) is observed. Specialty subcontractors are responsible for mitigating hazards in which they have expertise.
- If a hazard condition persists, inform the subcontractor. If the hazard is not mitigated, stop affected work as a last resort and notify the project manager.
- When an apparent imminent danger exists, promptly remove all affected personnel. Notify the project manager.
- Make clear that consistent violations of the health and safety plan by a subcontractor may result in termination of the subcontract.

Subcontractors under this scope of work are as follows:

- San Diego State University

2.4 Employees Responsibilities (Refer to Section 3.0 for further guidance)

- **All employees working onsite will comply with the guidelines specified in this Health and Safety Plan. The SC or Field Team Leader has total enforcement authority and will remove any employee from this project if the safety guidelines are not followed, and it is warranted.**
- All work on and around the lake requires a minimum of two persons (buddy system);
- Prior to working on the lake in a boat, weather forecast information will be obtained and evaluated for safe working conditions.
- All field teams must have a minimum of the following safety equipment in their vehicle- fire extinguisher, cellular phone (with car-cigarette lighter charger) or other communication devices, first aid kit, sunscreen, enough clothing to cover all exposed skin, and water.
- Prior to performing field work, each team is to hold a short tail-gate safety meeting in which hazards and precautions to be taken will be discussed, and each employee is to sign a form to prove attendance (Site Safety Briefing Form is located in Attachment 4).

Additionally, there may be unique hazards associated with this project (i.e. geothermal areas, dust during high wind conditions, extreme heat, solar radiation, remote conditions, etc.). Each employee is responsible for reading and understanding the specific hazard information in Section 3.0.

3.0 HAZARD EVALUATION AND CONTROL

3.1 Physical (Safety) Hazard Analysis and Control

3.1.1 General Safety Hazards

Hazard	Control Measure
Geothermal features	Geothermal features consisting of the following may be present at the site. Know the location of these areas and communicate locations and hazards with other CH2M HILL and subcontractor staff. The best way to protect yourself against geothermal hazards is to remain aware of your surroundings. **Mud Pots** Where hot water is limited and hydrogen sulfide gas is present (emitting the "rotten egg" smell common to thermal areas), and sulfuric acid is generated. The acid dissolves the surrounding rock into fine particles of silica and clay that mix with what little water there is to form seething and bubbling mud pots. Mud pots may be present in the Salton Sea area. Remain aware of your surroundings and footing to remain outside of geothermal areas. See section 3.4 for more information on hydrogen sulfide. **Hot Springs** Hot springs are a natural spring that puts out water warmer than body temperature and therefore feels hot; may collect in pools or flow into streams and lakes. Stay out of hot springs. The water in some hot springs can be extremely hot and cause scalding and even death. **Fumarole** Fumaroles are a small hole or vent in the Earth's surface, found near volcanic areas, from which steam or gases shoot out. If fumaroles are seen near the project site, stay away from them to prevent exposure to sulfur dioxide, hydrogen sulfide, and hot steam/gas.
Working Above or Near Water	• Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PDFs), or life jacket, shall be worn. • Inspect PFDs prior to use. Do not use defective PFDs. • Check the weather forecast and do not go out on the Sea if high winds, lightening or other severe weather is likely. • Implement safe boating procedures (See Attachment 6 for Coast Guard Requirements)
Steep Slopes and Uneven Terrain	The following safety precautions should be implemented when working on or near steep slopes: • Always avoid these areas whenever possible. “Climbing” in these areas should be minimized and limited to that which does not require the using climbing equipment. • Exercise caution when relying on rocks and trees/tree stumps to support yourself – many times they are loose. • Whenever possible, switchback your way up/down steep areas, • Maintain a slow pace with firm footing.
Manual Lifting	• Proper lifting techniques must be used when lifting any object. – Plan storage and staging to minimize lifting or carrying distances. – Split heavy loads into smaller loads. – Use mechanical lifting aids whenever possible. – Have someone assist with the lift — especially for heavy or awkward loads. – Make sure the path of travel is clear prior to the lift.
Inadequate Illumination	Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."

Electrical Safety	• All temporary wiring, including extension cords, shall have ground fault circuit interrupters (GFCIs) installed. • Extension cords must also be equipped with third-wire grounding. Cords passing through work areas must be covered, elevated or protected from damage. Cords should not be routed through doorways unless protected from pinching. • Electrical power tools and equipment must be effectively grounded or double-insulated UL approved. • Electrical power tools, equipment and cords are to be inspected for damage before use. If damaged, they must be tagged and removed from service. • Only qualified personnel are to work on energized electrical circuits and equipment. Only authorized personnel are permitted to enter high-voltage areas.
Dealing with the Public	• Although most transients are harmless and will not bother you, unstable or dangerous transients are occasionally encountered • Avoid anyone that appears to be living in the field. • Avoid cars parked suspiciously. • Should you feel threatened, leave the are immediately (you can always return with someone else at another time). • Do not threaten or provoke people you encounter in the field. • Should you encounter people with guns and you feel threatened, leave and finish the site another day. • When parking the field vehicle in undeveloped areas, try to park so that the vehicle is not easily visible to passing traffic. This will reduce the risk of vandalism.
Blisters	• Blisters most commonly occur on the feet, especially if someone uses inappropriate socks, wet socks or boots, or boots that do not fit or are not broken in. • Preventing blisters is the most important first aid: if someone feels a "hot spot" starting (from friction between the skin and the boot) stop immediately and do something about it. Place a thin layer of moleskin or (believe it or not) duct tape on the affected area. If you don't take care of the hot spot, it will become a blister: in this case, use the moleskin, but with a hole in it, so that you don't place adhesive directly over the blister. You want to minimize pressure on the blister by building up protective padding around it, but not too much or you'll cause more problems. Generally you should not pop blisters, both because they can become infected, and because they may become more painful as you continue to walk
Sunburn	• Sunburn can increase risk of cancer. Also, by the time we feel sunburnt, it's too late. This is especially true in winter, when we don't feel hot even though the sun beats down on us and reflects off the snow into our faces. • We can best prevent sunburn by covering up and by frequently applying copious amounts of sunblock with a high SPF rating (16 or higher). • First aid is the same as for any burn: if the skin is blistered, cover it with a loose sterile gauze dressing
Headaches	• Headaches result from many different things: dehydration, sunlight, tension, etc. • You can best treat the headache by treating the cause, if you know it. • Suggest that the person affected take aspirin, acetaminophen (e.g., Tylenol), or ibuprofen (e.g., Advil), drink water, eat a little, and, if possible, take a rest break. • Wearing sunglasses may prevent headaches from too much sunlight.

Nosebleeds	• Nosebleeds more commonly occur in cold than in hot weather because of the very dry air. • If someone gets a nosebleed, try to stop the bleeding by pinching the nostrils with your fingers. • Be patient, because nosebleeds often take a while to stop. • If pinching the nostrils doesn't work, you may insert a small, clean pad of gauze into the affected nostril, and pinch it again. • If someone is prone to nosebleeds, especially in cold weather, it may help to wear a bandanna over the nose and mouth. • As he or she breathes out, the bandanna traps some warmer, moist air, which may be enough to prevent a nosebleed.
Fainting	• Fainting results from loss of blood from the brain and is best treated by lowering the head in relation to the heart. • If someone feels faint, have him or her sit down, or lie down (on a sleeping pad or some other insulation, if possible) until feeling better. • Only allow him or her to stand up slowly when he or she feels able
Cuts and Scrapes	• Take the time to wash the cut with soap and water, or an antiseptic towelette. • Cleaning the wound immediately will help prevent infection later
Cramps	• If someone experiences muscle cramps, have him or her sit or lie down and relax. • Massage and stretch the sore muscle slowly, gently, and carefully. • Have him or her drink water, eat a little, and start again slowly. • Drinking a sports drink like Gatorade will help replace salts that are lost because of sweating. • Replacing these salts may help reduce the muscle cramps and prevent them from recurring.
Sprains	• If the sprain is minor, the victim may be able to walk with little or no assistance. • To reduce the swelling of a minor sprain, you must put ice on the injury (of course, be careful of frostbite and hypothermia in cold weather). • You will also need to tape the injured joint using sports tape or an ace bandage and allow the injured person to take ibuprofen (only if they are not allergic to aspirin), if they intend to walk out. • On the other hand, major sprains may appear to be fractures and should be treated as such. • Splint the injury and plan the best way to get the victim to medical care.
Drinking Water	• Never drink untreated water from streams or lakes. • Many areas are prone to natural contamination (e.g., giardia). • All drinking water must be packed in, or properly treated.

3.2 Environmental Hazards

3.2.1 Inclement Weather

Nationally, the months of June through September have the highest incidence of deaths by lighting. Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop or stand under a lone tree; seek low areas); staying away from open water, metal equipment, wire fences, and metal pipes; and spreading people out several yards apart.

Remember that lightning may strike several miles from the parent cloud, so work should be stopped/restarted accordingly. If you feel your hair stand on end or smell ozone, lightning may be about to strike you. Immediately drop to your knees and bend forward - do *not* lie flat on the ground.

Flash floods are also a concern with the high mountains surrounding the lake. Pay close attention to thunder storms in the mountains and be aware of flash flood potentials. Look for signs of previous flood plains.

High winds can cause a sand blasting effect if dry sand is present along the shore. If winds increase and dust is generated, seek shelter or evacuate the area.

High winds are also a factor in boating safety.

3.2.2 Temperature Extremes

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SC/SC to avoid progression of heat-related illness.

Guidelines For Working In Temperature Extremes While Wearing Personal Protective Equipment (PPE)

Temperature	Work Cycle	Rest Cycle	Control Measures
72° to 77° F	2 hrs	5 min	Review heat stress in safety meeting. Take resting pulse rate before beginning work. Drink 8 ounces of cool water before beginning work, and 4 ounces at rest break. Have ice available.
77° to 82° F	2 hrs	5 min	As above, but seated rest break. Monitor pulse rate. (See below.)
82° to 87° F	60 min	15 min	As above, but rest area to be shaded.
87° to 90° F	30 min	15 min	As above. Try to provide a shaded work area.
>90° F	15 min	15 min	As above. Provide a shaded area with seats in the work area for team members to use as needed. Try to reschedule work to avoid mid-day heat.

PULSE CRITERIA. Take resting radial (wrist) pulse at start of work day; record it. Measure radial pulse for 30 seconds as rest period begins. Pulse not to exceed 110 beats per minute (bpm), or 20 bpm above resting pulse. If pulse exceeds this criteria, reduce work load and/or shorten the work cycle by one third, and observe for signs of heat stress. No team member is to return to work until his/her pulse has returned to <110 bpm, or resting pulse +20 bpm.

Symptoms and Treatment of Heat and Cold Stress

Heat Stroke	Heat Exhaustion	Hypothermia
Symptoms: Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high body temperature.	Symptoms: Pale, clammy, moist skin; profuse sweating; weakness; normal temperature; headache; dizzy; vomiting.	Symptoms: Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment: Cool victim rapidly by soaking in cool (not cold) water. Get medical attention immediately!!	Treatment: Remove victim to a cool, air conditioned place. Loosen clothing, place in head low position. Have victim drink cool (not cold) water.	Treatment: Remove victim to a warm place. Have victim drink warm fluids—not coffee or alcohol. Get medical attention.
Controls: Carry plenty of potable water and have some sort of shade set-up (tents have worked before on the lake)	Controls: Carry plenty of potable water and have some sort of shade set-up (tents have worked before on the lake)	Controls: Ensure personnel dress in layers. Then, depending body temperature fluctuations, layers can be added or removed to avoid hypothermia.

3.3 Biological Hazards and Controls

Hazard and Location	Control Measures
Snakes typically are found in underbrush, around rocks, and tall grassy areas.	If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Carry the victim or have him/her walk slowly if the victim must be moved. Try to identify the type of snake: note color, size, patterns, and markings.
Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with medical or other potentially infectious material, or when coming into contact with landfill waste or waste streams containing such infectious material.	Training is required before a task involving potential exposure is performed. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.
Mosquitoes	West Nile Virus is transmitted from several species of mosquitoes infected with the virus. During blood feeding the mosquito injects the virus, contained in its saliva, into the person. Human illness from West Nile virus is rare, even in areas where the virus has been reported. The chance that any one person is going to become ill from a mosquito bite is low. On rare occasions, West Nile virus infection can result in a severe and sometimes fatal illness known as West Nile encephalitis (an inflammation of the brain). The risk of severe disease is higher for persons 50 years of age and older. There is no evidence to suggest that West Nile virus can be spread from person to person or from animal to person. Most infections of West Nile are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. The incubation period in humans (i.e., time from infection to onset of disease symptoms) for West Nile encephalitis is usually 3 to 15 days. If symptoms occur, see your doctor immediately.

	You can reduce your chances of becoming ill by protecting yourself from mosquito bites. • Apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) to exposed skin when outdoors. Read and follow the manufacture's direction for use, as printed on the product. • Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing. • Wear long-sleeved clothes and long pants treated with repellent and stay indoors during peak mosquito feeding hours (dusk until dawn) to further reduce your risk. • Avoid activities in areas where mosquitoes are plentiful. • Limit the number of places available for mosquitoes to lay their eggs by eliminating standing water sources. A West Nile Virus Fact Sheet has been developed that provides more detailed information.
Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.	Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or the buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

Information concerning other biological hazards is included in Attachment 3. Please review these attachments for information on the following hazards:

- Valley Fever
- Hanta Virus
- Poison Oak
- Snakes
- Stinging Insects

3.4 Health Hazards

The following health hazards may exist on this project. Personnel who experience symptoms of contaminant exposure must terminate their activity and contact the SC.

Silica is a naturally occurring mineral that is present in sand and other types of soil. Silica can be inhaled into the lungs when silica and dust are suspended in the air (i.e., dust cloud, heavy wind, excavation, etc.). Employees will minimize exposure to silica by leaving the area if high winds are causing visible dust, and minimizing the amount of soil disturbed during met station installation by implementing dust control if necessary. The following information outlines the health hazards associated with silica.

Crystalline Silica (Christobalite, Quartz, Tridymite, Tripoli)
Cal/OSHA PEL = 0.05 mg/m^3 (christobalite, tridymite)
Cal/OSHA PEL for Quartz Dust = 0.3 mg/m^3

Crystalline silica compounds are colorless and tasteless, and are stable at high temperatures. Christobolite and tyidymite have been given a lower PEL/TLV value because they demonstrate a more fibrous configuration which enables them to penetrate the lungs easier than quartz and tripoli. The main route of exposure is inhalation. In the lung, scar tissue nodules are formed around the silica

crystal which make that portion of the lung inoperable: this effect is called silicosis and usually evolves from years of exposure. Severe silicosis can cause death.

Selenium is also known to be present in the soil and water at the site, but selenium does not pose a health effect to site employees.

The site also contains hydrogen sulfide due to the geothermal activity in the area. Hydrogen sulfide smells like rotten eggs and has a very low odor threshold. The following information presents the health effects associated with hydrogen sulfide. If any employee experiences symptoms of possible exposure, contact Trish Danby/SAC immediately.

Hydrogen Sulfide (H_2S)
Cal/OSHA PEL = 10 ppm PEL/STEL = 15 ppm Ceiling = 50 ppm
Fed/OSHA PEL = 20 ppm (ceiling)
TLV= 10 ppm REL = 10 ppm (ceiling)

In higher concentrations hydrogen sulfide gas is a rapidly acting systemic poison which causes respiratory paralysis, leading to unconsciousness and death from asphyxiation. Inhalation of lower concentrations may cause headache, dizziness, and upset stomach. Hydrogen sulfide can also irritate the eyes, nose and throat. Eye effects may occur at concentrations beginning slightly above the PEL. Hydrogen sulfide has a strong rotten egg odor. Although the mean air-odor threshold is 0.008 ppm, the nose may lose its ability to detect elevated levels above the PEL, notably in the range where acute systemic toxic effects occur. Because of this inadequate warning property, air monitoring is required to prevent exposure to elevated levels of H_2S. H_2S can also pose a significant fire/ explosion hazard in concentrations well above the PEL. Its LEL is 4.3 percent and UEL is 46 percent. H_2S has a very high vapor pressure (20 atmospheres) and an ionization potential of 10.46 eV.

3.5 Hazard Communication

CH2M HILL will not be using any hazardous chemicals as part of this project.

4.0 PERSONNEL

4.1 CH2M HILL Employees

CH2M HILL employees working on this project will receive training on project hazards by the Safety Coordinator during the weekly tailgate safety meetings. Safety Coordinators must have received a minimum level of training (either 40-hour Hazardous Waste Operations or 10-hour Construction) and have received CH2M HILL's Safety Coordinator training course, along with FA/CPR, Fire extinguisher operation, Dangerous Goods Shipping, Bloodborne Pathogens, Hazard Communication, and other pertinent courses as required. All employees performing field work on this project will be trained on the safe work practices to be implemented during this projects, and the requirements outlined in this safety plan.

5.0 EMERGENCY RESPONSE

5.1 Emergency Response Coordinator

The SC will act as the "Emergency Response Coordinator" and has the following responsibilities:

- Verify that the Emergency Information Form located in Attachment 2 is available in every field vehicle.
- Coordinate emergency response with local emergency response providers as appropriate.
- Communicate emergency procedures with all CH2M HILL site employees and subcontractors.

5.2 Emergency Procedures

Site emergency alarms/signals:

To be determined by the SC based on position of field team.

Site evacuation routes:

To be determined by the SC based on position of field team.

Site evacuation assembly areas:

To be determined by the SC based on position of field team.

Site evacuation procedure:

- Personnel will leave the work area, via the excavation routes, and gather at the assembly areas upon hearing the emergency signal for evacuation.
- The SC will account for all personnel at the assembly area.
- The SC will communicate and coordinate emergency actions with the local emergency providers and the client.
- The SC will write up the incident as soon as possible after it occurs and will submit a report to the corporate director of health and safety.

5.3 Emergency Equipment and Supplies

The SC should verify that these supplies are available and in proper working order.

Emergency Equipment and Supplies	Location
10 lb fire extinguisher (A, B, and C classes)	Field Vehicle
First aid kit	Field Vehicle
Eye Wash	Field Vehicle
Potable Water	Field Vehicle
Bloodborne-pathogen kit	Field Vehicle
Cellular Telephone	Field Vehicle

5.4 Emergency Medical Treatment

The following emergency medical treatment procedures should be implemented in response to serious injuries/illnesses:

- Notify appropriate emergency responders that are listed in Attachment 2 “Emergency Information Form” (e.g., 911).
- The SC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury and initiate first aid and CPR where feasible.
- Make certain that the injured person is accompanied to the emergency room.
- Notify the field team leader, project manager, HSM and corporate director of health and safety of the injury.
- Complete CH2M HILL’s “Accident Reporting Form” and submit the form to the corporate director of health and safety and the corporate human resources department (COR) within 24 hours. Refer to SOP HS-14 *Injury and Illness Reporting* for more detailed information.

5.4.1 Suspected Chemical Overexposure Incidents

During a time of no emergency, contact CH2M HILL's Medical Consultant for advice and guidance. Refer to Attachment 2 “Emergency Information Form” for the phone number.

State that you are calling about a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

6.0 APPROVAL

This Health and Safety Plan has been written for use by CH2M HILL and their subcontractors only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. This HSP is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

Written by: **Trish Danby/SAC** **Date:** **March 15, 2005**

Approved by: **Trish Danby/SAC** **Date:** **March 15, 2005**

ATTACHMENT 1

Employee Sign-off Sheet – Field Safety Instructions

CH2MHILL

EMPLOYEE SIGNOFF SHEET - FIELD SAFETY INSTRUCTIONS

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this Health and Safety Plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

ATTACHMENT 2

Emergency Information Form

CH2MHILL

EMERGENCY INFORMATION FORM

Emergency Contacts – Attachment 2

24-hour CH2M HILL Emergency Beeper – 888/444-1226

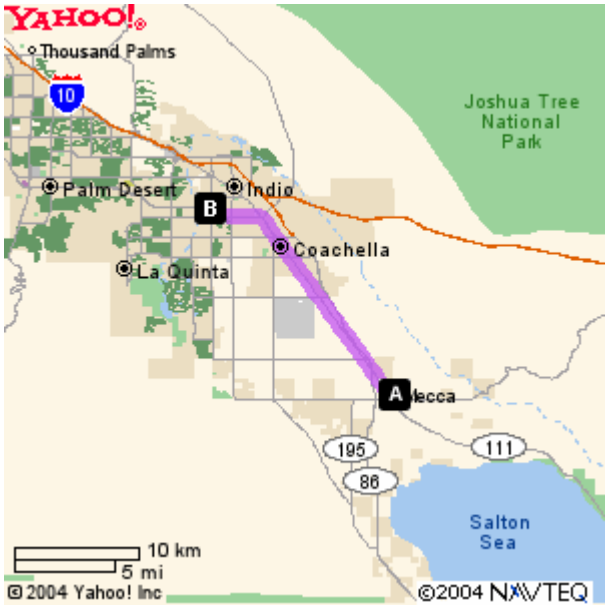
Medical Emergency – 911	CH2M HILL Medical Consultant Health Resources Dr. Jerry H. Berke, M.D., M.P.H. 600 West Cummings Park, Suite 3400 Woburn, MA 01801-6350 1-781-938-4653 1-800-350-4511 (After hours calls will be returned within 20 minutes)
Fire/Spill Emergency — 911	**Corporate Director Health, Safety & Environment** Name: Dave Waite/SEA Phone: 425/453-5000 24-hour emergency beeper: 888-444-1226
Security & Police – 911	**Regional Health & Safety Program Manager (RHSPM)** Name: Trish Danby/SAC Phone: 916/920-0212 ext. 287
Regional Human Resources Department Name: Lisa Covey/SAC Phone: 916/920-0212 ext. 254	**Corporate Human Resources Department** Name: Pete Hannan/COR Phone: 303/771-0900
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**Worker's Compensation:** Contact Regional HR dept. to have form completed or contact Julie Zimmerman after hours: 303/664-3304
CH2M HILL Emergency Number for Shipping Dangerous Goods Phone: 800/255-3924	**AUTOMOBILE ACCIDENTS:** Rental: Carol Dietz/COR 303/713-2757 CH2M HILL owned vehicle: Zurich Insurance Co. 800/987-3373

Contact the PM. Generally, the PM will contact relevant government agencies.

Hospital Information:

Hospital Information - From Mecca, CA (North end of Salton Sea) - 15 miles

John F Kennedy Memorial Hospital
47111 Monroe St., Indio, CA 92201
(760) 347-6191

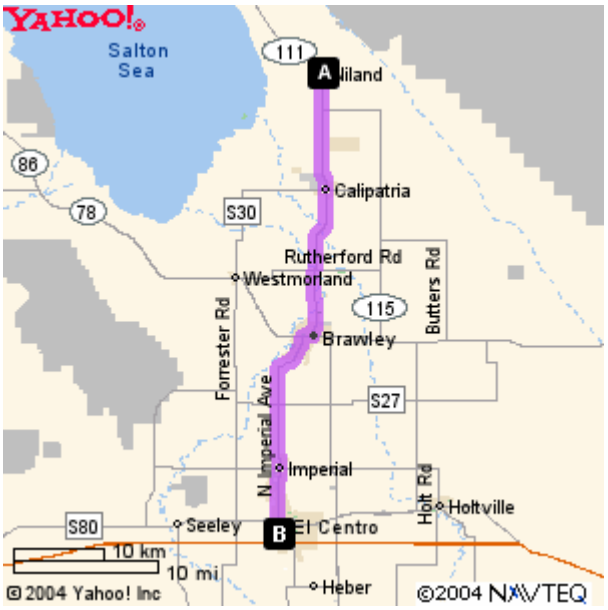


Directions

1. Starting in **MECCA, CA** on **4TH ST** - go **0.1** mi
2. Turn left (L) on **HAMMOND RD** - go **< 0.1** mi
3. Turn right (R) on **4TH ST** - go **0.1** mi
4. Turn right (R) on **CA-111** - go **11.0** mi
5. Turn left (L) on **AVENUE 48** - go **2.5** mi
6. Turn right (R) on **MONROE ST** - go **0.4** mi
7. Arrive at **47111 MONROE ST, INDIO,** on the left (L)

Hospital Information - From Niland, CA - South end of Salton Sea - 34 miles

El Centro Regional Medical Center
1415 Ross Avenue
El Centro, CA 92243
(760) 339-7100



Directions

1. Starting in **NILAND, CA** on **1ST ST** - go **0.1** mi
2. Turn left (L) on **CA-111** - go **18.5** mi
3. Turn right (R) on **CA-78** - go **0.6** mi
4. Turn left (L) on **CA-86 SOUTH** - go **13.3** mi
5. Continue on **IMPERIAL AVE** - go **1.0** mi
6. Turn left (L) on **W ROSS AVE** - go **0.1** mi
7. Arrive at **1415 ROSS AVE, EL CENTRO,** on the right (R)

ATTACHMENT 3
Fact Sheets

BEE AND OTHER STINGING INSECTS FACT SHEET

Bees and other stinging or biting insects (centipedes, chiggers, and ants) may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Use these suggestions to decrease your risk of harm from these insects:

- Watch for and avoid nests.
- Keep exposed skin to a minimum and use insect repellants and netting as necessary.
- Routinely perform body checks to locate any attached insects (pay close attention to the waist, ankles, and scalp areas). Remove insects carefully so that the mouth parts come out intact and that the bug is not squashed.
- Carry a kit (anti-venom treatment prescribed by you physician) if you have had allergic reactions in the past, and inform your Safety Coordinator.
- If you are traveling to a location that has a high occurrence or is endemic for vectorborne disease (i.e., malaria and yellow fever), notify the Health and Safety Department for risk evaluation and so they may refer you to a physician for prophylactic treatment.

If you are stung or bitten:

- If a stinger is present, remove it carefully by gently scraping it out with a blunt-edged object, such as a credit card or dull knife, avoid pinching or squeezing because this may force more toxins into the wound.
- Wash and disinfect the wound with soap and water, cover it, and apply ice.
- A baking soda and water paste, or meat tenderizer and water paste, followed by a cool compress has been reported to minimize the local reaction.
- Taking antihistamines may relieve mild local symptoms.
- Watch for allergic reaction; seek medical attention if a reaction develops.
- Seek immediate medical attention if you are stung in the mouth or nose as swelling may block airways.

Killer Bees

Africanized honeybees have acquired the name "killer bees" because they will viciously attack people and animals who unwittingly stray into their territory, often resulting in serious injury or death. Though their venom is no more potent than native honeybees, killer bees attack in far greater numbers and pursue perceived enemies for greater distances. When disturbed, colonies may remain agitated for 24 hours, attacking people and animals within a range of a quarter mile from the hive. Killer bees are common to the southwest and use a variety of natural and man-made objects for their nests, including hollow trees, walls, porches, sheds, attics, utility boxes, garbage containers, and abandoned vehicles.

Precautions to avoid being stung:

- Wear light-colored clothing. Bees tend to attack dark things. Dark clothing, dark hair, anything dark in color could draw the attention of killer bees.

- Bees are sensitive to odors, both pleasant and unpleasant. The smell of newly cut grass has been shown to disturb honeybees. Avoid wearing floral or citrus aftershaves or perfume.
- Be alert for bees that are acting strangely. Quite often bees will display some preliminary defensive behavior before going into a full-fledged attack. Killer bees usually have a small number of sentry bees patrolling the perimeter of the hive's territory. In most cases, these sentry bees will initially head-butt (not sting) any animal that enters the hive's territory. If the animal continues closer to the hive, stinging will ensue. If bees start head-butting you, use this behavior as a warning to retrace your steps and walk away from the hive.
- If you do find a swarm or colony, leave it alone and keep people and pets away. Call a pest control company or a local beekeeper to solve the problem.

What to do if attacked:

- Cover your head and face and seek shelter. Bees target the head, and nearly all those who suffer serious stinging incidents with killer bees are overcome by stings to the head and face. Use a blanket, coat, towel, or anything that will give you momentary relief while you look for an avenue of escape. If you have nothing else, pull your shirt up over your face. The stings you may get on your chest and abdomen are far less serious than those to the facial area.
- Find shelter as soon as possible. Take refuge in a house, tent, or a car with the windows and doors closed.
- Do not jump into water, bees will wait for you to come up for air.
- If you have been stung more than 15 times, or if you are having any symptoms other than local pain and swelling, seek medical attention immediately.

Fire Ants

Fire ants are small reddish-brown ants that are common in the southern United States, but colonies have been found as far north as New Jersey. Their nests can appear as dome-shaped mounds up to 18 inches high and over 2 feet wide. Fire ants inflict a fiery sting that causes a small blister to form at the site of each sting after several hours. The blisters become itchy while healing and are prone to infection if broken. Fire ants have killed deer, cows, and even humans. When one fire ant bites, it releases pheromones that prompt other ants to swarm and bite. Survey your work area for fire ant mounds and be careful where you step. Wear rubber boots and gloves powdered with talc when required to work close to fire ant mounds.

If you are stung by a fire ant:

- Apply a cold compress to relieve the swelling and pain.
- Gently wash the affected area with soap and water and leave the blister intact.
- People who are allergic to insect stings should seek medical attention if a reaction develops.

HANTAVIRUS FACT SHEET

What Is Hantavirus?

Hantavirus is a family of viruses known to cause either Hantavirus Pulmonary Syndrome (HPS) or hemorrhagic fever with renal syndrome. HPS is the most common of the Hantaviruses found in the United States.

What Are the Symptoms of HPS?

Early universal symptoms include fatigue, fever, and muscle aches, especially the large muscle groups—thighs, hips, back, and sometimes shoulders. About half of all HPS patients will experience headaches, dizziness, chills, and abdominal problems, such as nausea, vomiting, diarrhea, and abdominal pain. Late (4 to 10 days) symptoms include coughing and shortness of breath.

How Is HPS Transmitted and Contracted?

HPS is transmitted by infected rodents through urine, droppings, or saliva. Humans can contract the HPS when they breathe in aerosolized virus. Disturbing (sweeping, vacuuming, walking on, etc.) areas laden with droppings will cause the virus to become airborne, whereupon it can be inhaled by humans. Other routes of infection include being bitten by infected rodents, contamination of open wounds, contamination of foodstuffs, and through the eyes. Human-to-human transmission of the virus or the disease itself has not been documented.

Can HPS Be Detected and Treated?

At its onset, HPS exhibits flu-like symptoms, hence early diagnosis is difficult. Accurate diagnosis relies on sophisticated laboratory testing. There is no specific treatment, cure, or vaccine for hantavirus infection. Instead, treatment is usually supportive in nature, with patients typically being given broad-spectrum antibiotics, mechanical ventilation, and maintenance of fluid and electrolyte balances. Therefore, if you have been around rodents and have symptoms of fever, deep muscle aches, and severe shortness of breath, see your doctor immediately. Be sure to tell your doctor that you have been around rodents. This will alert your physician to look closely for any rodent-carried disease, such as HPS.

How Can HPS Be Prevented?

Avoidance is the best prevention. If rodents, their habitats, or droppings can not be avoided, the following practices will reduce the potential for contracting the disease.

- Treat all rodents, their droppings, and their nesting materials as though they are infectious. Never directly contact rodents (either dead or alive), their droppings, or their nesting materials. Use gloves at a minimum. Coveralls and a high-efficiency particulate (HEPA) filter-equipped respirator should be used if substantial quantities are involved.
- Never vacuum or sweep rodent droppings or nesting materials. These actions will most certainly cause the virus (if it is present) to become airborne. Thoroughly wet carcasses, droppings, and nesting materials prior to handling. Use a household disinfectant, such as ammonia, bleach, or brand name products such as Lysol® (read the label first to ensure that the product is in fact a disinfectant).
- Double bag collected waste materials and dispose of properly.
- Thoroughly wash gloves in disinfectant prior to removal. Then after removing the gloves, wash your hands thoroughly.

- Wash and sanitize any protective clothing and equipment immediately after use and sanitize the decontaminated area with a household disinfectant.
- Never use poison to rid an area of rodents. This will allow poisoned rodents to retreat to inaccessible areas, wherein they will remain and die. Continuous trapping is preferred.

Deer Mouse

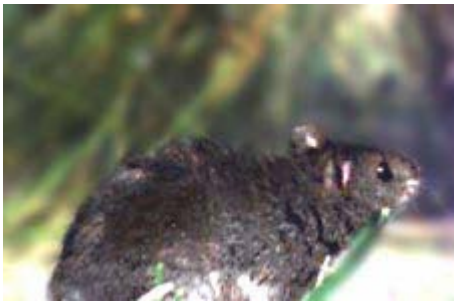
White-footed Mouse

The following rodents found in the United States are known to be Hantavirus carriers:

The deer mouse is a deceptively cute animal, with big eyes and big ears. Its head and body are normally about 2 to 3 inches long, and the tail adds another 2 to 3 inches in length. You may see it in a variety of colors, from gray to reddish brown, depending on its age. The underbelly is always white and the tail has sharply defined white sides. The deer mouse is found almost everywhere in North America. Usually, the deer mouse likes woodlands, but also turns up in desert areas.

The white-footed mouse is hard to distinguish from the deer mouse. The head and body together are about 4 inches long. The tail is normally shorter than its body (about 2 to 4 inches long). Topside, its fur ranges from pale brown to reddish brown, while its underside and feet are white. The white-footed mouse is found through southern New England, the Mid-Atlantic and southern states, the midwest, and into the western states. It prefers wooded and brushy areas, although sometimes it will live in more open ground.

Cotton Rat



Rice Rat

The cotton rat found in the southeastern United States has a bigger body than the deer mouse—head and body about 5 to 7 inches, and another 3 to 4 inches for the tail. The hair is longer and coarser, of a grayish brown color, even grayish black. The cotton rat prefers overgrown areas with shrubs and tall grasses.

The rice rat is slightly smaller than the cotton rat, having a head and body 5 to 6 inches long, plus a very long, 4- to 7-inch tail. Rice rats have short, soft, grayish brown fur on top, and gray or tawny underbellies. Their feet are whitish. This rat likes marshy areas and is semi-aquatic. It is typically found in the southeastern United States.

MEMORANDUM CH2MHILL

ASSESSING THE POTENTIAL FOR VALLEY FEVER IN THE CONTEXT OF THE SALTON SEA ECOSYSTEM RESTORATION PLAN

TO: Gwen Buchholz; John Dickey; and Pamela Vanderbilt

COPIES: Salton Sea project file

FROM: Steve Long

DATE: March 7, 2005

The issue of Valley Fever was raised in early discussions about air quality assessment by Catherine McDavid/SAIC. This prompted a limited investigation into how the potential for any increase in Valley Fever (VF) health risks under different restoration alternatives being considered for the Salton Sea could be assessed. This memorandum is being written to document the result of that investigation and the reason why an assessment for VF is not being undertaken as part of the initial data collection phase of the air quality investigations, and how it will be addressed in the Restoration Plan.

What Is Valley Fever and Why Is It Important?

The medical term for VF is coccidioidomycosis - often called 'cocci' for short. VF is an infection (usually of the lungs) by a particular fungus, *Coccidioides immitis*, found in alkaline soils in arid, southwestern US. The VF fungus is spread through inhalation of airborne dust containing VF spores. When weather and moisture conditions are favorable, the fungus 'blooms' and forms many tiny spores (arthrospores) which lie dormant until they are stirred up by the wind, vehicles, excavation, etc. and become airborne. These very light, microscopically small (2 to 4 micron) arthrospores can float invisibly in the air for a long time and travel many miles. VF can NOT be spread from person to person.

The area in California where VF occurs most frequently is Kern County located at the southern end of the San Joaquin valley. While Kern County is considered as a highly endemic area for VF, the areas in California to the south and east (including the area around the Salton Sea) are considered as endemic. During the early 1990's, the incidence of VF in California increased dramatically.

While most VF infections are subclinical or self-limited, the outbreak is estimated to have cost more that $66 million in direct medical expenses and time lost from work in Kern County alone. Besides this financial loss, this pathogen causes serious and life-threatening disseminated infections, especially among the immuno-suppressed, including AIDS or cancer patients. Others at risk include elderly persons, African-Americans, persons of Asian descent, and women in the third trimester of pregnancy. While most cases of VF require no treatment, in more susceptible populations VF can be treated with fungus-killing medicines. There is currently a program to develop a VF vaccine, but right now, VF can only be diagnosed with a blood test or culture. VF can also affect animals, especially dogs, horses, cattle, and llamas.

How Can the Potential for an Increased Incidence of VF Be Assessed?

During the discussions of potential air quality impacts that could be caused by a shrinking Sea (and corresponding expanded playa areas), a decision was taken to gather some near-shore soil and sediment samples. These samples would be subjected to a suite of laboratory analyses that would provide data that could then be used to assess the potential for a increase in human health impacts. Among the parameters considered for the air quality assessments was VF. The question was raised to find out if it were possible

to collect soil or sediment samples and subject these samples to some laboratory test or protocol to determine if VF spores were present.

The search to answer this question began with a search of web-based information. This initial search led to a site for the Valley Fever Center of Excellence (VFCOE). The following questions were posed via email: Is there a way to look for VF spores in soil? Are there any standard protocols for determining the presence of VF spores? (And if so) Are there any laboratories that are qualified to do VF testing?

On March 2, 2005, I got a call back from Dr. John Galgiani, a professor of medicine at the University of Arizona and the Director of the VFCOE. His answer was that there were no simple answers to the questions posed. He said that there was one study in a medical journal where researchers (Deb Green and John Taylor) had grown 4 or 5 isolates of the VF organisms from soil, however, the protocol to do so remains experimental. The Cocci can also be grown *in vivo* in mice.

Dr. Galgiani's said that it is extremely difficult to find in soils because of the wide range of other organisms, it was like looking for the 'proverbial needle in the haystack'. He also thought that because the VF organisms occur in very sparse distribution in arid soils, the notion of sampling error was very great. Basically, one could look at a large number of samples and even if the VF organism was not found, its presence could not be ruled out.

Dr. Galgiani said that one laboratory in Phoenix had isolated some cocci cultures but they had been destroyed before he could get down to verify it. Because VF cultures are regulated as a 'select agent' according to the Centers for Disease Control (like smallpox and Ebola virus), it is a felony under the Patriot Act to keep these cultures. Also, the growth of these cultures to confirm the presence of the organism, were it useful and practical, could be extremely hazardous under all but the most controlled circumstances.

Valley Fever is a reportable disease nationwide. However, Dr. Galgiani indicated that reported data are 'soft' data because they are linked to the location of the reporting doctor's office and may not be linked to the location where the infection tool place. It may be possible to use an epidemiological approach to assess the impact of Salton Sea restoration alternatives on VF incidence (i.e. by comparing VF cases in Riverside and Imperial Counties over time and against Kern County infection rates). The CA Department of Public Health (DPH office in Berkeley) would have those statistics. Dr. Galgiani referred me to Dr. John Werner (510-540-2566) in the DPH and I left a message for him, but apparently he is on vacation until his imminent retirement. His call was returned by Dr. John Rosenberg, who suggested that Dr. Demosthenes Pappagianis at UC Davis might be able to provide more information on laboratory testing for VF.

Significance of This Information for the Salton Sea Project

A straightforward option for laboratory VF testing of soils or sediments around the Salton Sea does not exist. An epidemiological approach could used, however it may not be very sensitive (even if veterinary records were also factored in). It may be best to combine that analysis with a qualitative assessments based on changes in the areal extent and location of playas to assess the potential for VF impacts.

POISONOUS PLANTS FACT SHEET

Poison ivy, poison oak, and poison sumac are the most common poisonous plants encountered in North America. These plants are considered "poisonous" because they contain a colorless and sticky oil called urushiol in their roots, stems, leaves, and fruit that causes allergic reactions. Allergic response to urushiol ranges from no reaction to a severe skin rash or dermatitis. Research has found that 85 percent of the population will develop a skin rash if exposed to urushiol. About 10 percent of the population will have severe reactions, and an equal number of people will not be sensitive at all.

When urushiol touches the skin, it begins to penetrate in a matter of minutes. The rash appears as a line within 12 to 48 hours after exposure. Redness and swelling are followed by blisters and severe itching, and within a few days, the blisters become crusted and scaly. The rash will heal in about 10 days. Exposure to these plants may result in an Occupational Safety and Health Act (OSHA) recordable illness because as the rash becomes severe many people seek medical care and get prescription cortisone creams to reduce the suffering caused by the itch.

Urushiol is released when the plant is bruised, making it easier to contract dermatitis in the spring and early summer when leaves are tender. Urushiol may be deposited on the skin by direct contact with the plant or by contact with contaminated objects, such as shoes, clothing, tools, and animals. Severe cases have occurred from urushiol-coated soot in the smoke of burning plants. Because urushiol is inside the plant, brushing against an intact plant will not cause a reaction. But undamaged plants are rare because these are all very fragile plants. Stems or leaves broken by the wind or animals and even the tiny holes made by chewing insects can release urushiol.

These plants typically are found in brush or wooded areas and are more commonly found in moist areas or along the edges of wooded areas. Plants are red and dark green in spring and summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in fall, but the plant loses its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. Urushiol oil stays active on any surface, including dead plants, for up to 5 years.

- Poison ivy is a climbing vine with three serrated-edges and pointed leaves. It grows in the eastern, midwestern, and southern United States. In the northern and western states, poison ivy grows as a non-climbing shrub.
- Poison oak also has three leaves and grows in the sandy soil of the southeastern United States as a small shrub. In the western states, poison oak is a very large plant, which grows as a standing shrub or climbing vine.
- Poison sumac is a shrub or bush with two rows of 7 to 13 leaflets and is most commonly found in the peat bogs of the northern states and in swampy southern regions of the United States.

Poison Ivy

Poison Sumac

Poison Oak

Prevention

Exposure to poisonous plants is not an unavoidable part of working outdoors!

- Learn to recognize and avoid these plants.
- Wear protective clothing that covers skin and clothes.
- Avoid contact with clothing and equipment that may have contacted these plants.
- If you must remove plants, use gloves to pull it up by the roots, and discard the plant carefully, then discard or wash the gloves.
- If poisonous plants are prevalent where you will be working, barrier creams are a good precaution. Barrier creams may keep the urushiol from bonding to the skin and lessen the allergic reaction.
- Dispose of all personal protective equipment immediately after use or wash thoroughly.
- If skin contacts a plant, clothing, or equipment contaminated with urushiol, wash the area with soap and water immediately.
- Wash all clothing and equipment that may have contacted these plants before re-use.
- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with Tecnu® or other product designed for removing urushiol. If you do not have Tecnu®, wash with cold water. Do not take a bath, as the urushiol can form and invisible film on top of the water and contaminate your entire body upon exiting the bath. Tecnu® may also be used to decontaminate equipment.
- A new product on the market called Zanfel works by removing the oil from the skin, even after a rash has occurred. It can be purchased at most drug stores, but can be on the expensive side - 1 oz. for $40. Contact your HSM for additional information or access to Zanfel if you have a poison oak exposure.

SNAKE FACT SHEET

Of the many different snake species in the United States, only four are poisonous: rattlesnake, copperhead, water moccasin, and coral snake. The first three are known as pit vipers and have three common characteristics:

- Triangular, flat head wider than its neck
- Elliptical pupils (e.g., cat's eye)
- Heat-sensitive "pit" located between each eye and nostril

Pit vipers have a variety of colors and patterns throughout their life cycles. Therefore, they can readily be confused with non-venomous snakes.

Coral snakes have a characteristic pattern of black, yellow, and red rings that encircle its body. The red and yellow bands are adjacent to each other on a coral snake. This pattern distinguishes it from many look-alike non-venomous snakes. To help you remember this distinguishing characteristic, there is an old rhyme, "Red next to yellow is a deadly fellow, red next to black is a happy Jack."

Prevention

- Wear high-top leather boots and heavy pants (e.g., jeans), because more than half of all bites are on the lower parts of the legs.
- If working in a remote location, have a working cellular telephone.
- Avoid walking at night or in grass and underbrush.
- Walk heavily because snakes sense ground vibrations better than sound and this might frighten snakes, causing them to leave.
- Do not climb rocky ledges without visual inspection.
- Be very aware of where you are stepping. During the day when it is hot, rattlesnakes will be in shaded areas (e.g., behind rocks, under overhangs, in burrows of other animals). In the morning, they will be in sunny areas like on top of rocks.
- Take care when turning over pieces of wood or rocks, especially in areas that are known to have snakes.
- Try to keep hands and feet out of crevices in rocks, wood piles, and deep grass.
- If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area.
- Give the snake a chance to get away from you. Snakes will avoid you if given the opportunity.
- Do not engage the snake (i.e., do not poke or throw rocks at it).
- Do not attempt to kill snakes unnecessarily; many people are bitten in such an attempt. Many snakes are threatened and endangered species and are protected by federal and state laws.

What to Do if Bitten by a Snake

The degree of toxicity resulting from a snake bite depends on the potency of the venom, the amount of venom injected, and the general health, size, and age of the person bitten. Poisoning may also occur from absorption of venom through cuts or scratches.

- Remain calm and try to remember what the snake looked like (to help in proper treatment at the hospital or clinic). A snake may bite a person and not inject venom.
- Call 911 or the appropriate emergency number for the area you are working
- Immobilize the person and the bitten part in a horizontal position, with the bitten part lower than the heart if possible.
- Wash the bitten area with water but avoid manipulation of the bitten area.
- Treat for shock and transport to the nearest medical facility.
- Carry the victim or have them walk slowly if the victim must be moved.
- Do not apply ice, cut the wound, or apply a tourniquet.
- Do not allow the person to walk, run, or drink alcoholic beverages or stimulants such as sodas, coffee, or tea.

Symptoms and signs of envenomation include the following:

- The presence of fang marks (two small puncture wounds about ½ inch apart)
- Severe burning pain at the bite site
- Rapid and progressive swelling around the bitten area within 5 to 10 minutes
- Faintness, weakness, or sweating
- Nausea and vomiting
- Alterations in body temperature, pulse, and blood pressure

Western Diamondback Rattlesnake

Copperhead Snake

Partly because of its wide distribution, rattlesnakes account for more serious and fatal snake bites than any other in North America. Rattlesnakes have a wide range of color variations with emphasis on gray, tan, and black with sometimes a strong yellowish, reddish, or greenish tone.

Sizes range from about 10 inches (newborn) to around 60 inches (adult) long. The loud buzzing rattler sound coupled with a high rising and very threatening coil is usually ample identification. They are largely defensive and tend to stand their ground if provoked.

The copperhead is characterized by the rich copper colors with wide alternating bands that extend completely around the underside. They are extremely well camouflaged in nature, so they are usually quite close at hand when finally spotted. Most adults range in size from 18 to 26 inches in length.

Cottonmouth Water Moccasin

Coral Snake

The cottonmouth water moccasin is semi-aquatic snake that averages around 30 inches in length. It is characterized by a brown, olive, or blackish dark body with lighter belly and body crossbands that have a distinct border extending all the way around and across the yellowish stomach. Regional variations do occur, so never handle a water snake of any kind. They may be found lying dormant on logs, rocks, or limbs at water's edge awaiting approaching prey in a sprawled coil, head flung back, with the mouth resting in an open position exposing the white inner surface of the mouth almost straight up.

The coral snake is seldom seen, tends to be very nocturnal, and spends much of its life underground in cracks and crevices. When disturbed, the coral snake often lays its head out of sight, rattles its flattened elevated tail, and emits a popping sound with its vent lining.

TICK-BORNE PATHOGENS FACT SHEET

There are six notable tick-borne pathogens that present a significant field hazard, and in some areas account for more than half of our serious field incidents. These procedures should be applied during any field activity – even those field efforts that are located predominantly in paved areas but with bordering vegetation.

Hazard Control

The methods for controlling exposure to ticks include the following, in order of most to least preferred:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or the application of a pesticide
- Personal protection through the use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

In most circumstances, treating persons who only have a tick bite (i.e., no signs of illness) is not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. Stay within established paths or clearings and avoid traversing through brushy areas. In areas with significant tick infestation, consider stopping work and withdrawing until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants – tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by (1) disrupting tick habitats and/or (2) direct population reduction through the use of non-restricted tick-toxic pesticides (e.g., Damminix, Sevin). This approach is more commonly practical in smaller, localized areas or perimeter areas that might require frequent access.

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced between 72 percent and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing and tree trimming or removal; and direct population reduction can be achieved with non-restricted pesticide application (e.g., Damminix, Sevin). Consumer (non-restricted) pesticides can be used when use is consistent with product label requirements, application will not occur in environmentally sensitive areas, and property owner concurrence is obtained. When pesticides are used at an industrial facility, provide written notification so that the facility can consider including such use in their Community Right-to-Know reports.

Habitat controls must be implemented with appropriate health and safety controls, in compliance with environmental requirements, and may be best left to the property owner, tenant, or licensed pesticide applicator. Contact your regional Environmental Compliance Coordinator (ECC) to determine whether the desired area of application includes environmentally sensitive areas. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected.

Personal Protection

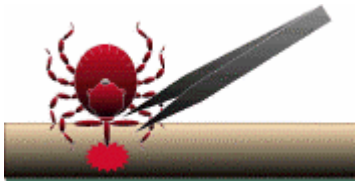
After other prevention and controls are implemented, personal protection is still necessary in controlling exposure to ticks. Personal protection must include all of the following steps:

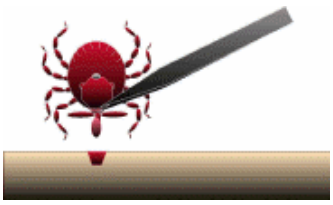
- So that ticks may be seen on your clothing, wear light-colored clothing. Full-body New Tyvek® (paper-like disposable coveralls) may also be used, worn entirely or up to one's waist.
- To prevent ticks from getting underneath clothing, tuck pant legs into socks or tape to boots.

- Consider using hip waders (even treated with Fluon) in heavily infested areas.
- Wear lightweight long-sleeved shirts, a hat, and high boots. Tie back long hair.
- A 0.5 percent formulation of permethrin (applied to clothes) *is the most effective product available in controlling ticks* (this is the same product used in strengths of 1 percent to 5 percent to control head lice). Apply permethrin repellent/insecticide to the outside of boots and clothing before wearing, per product label. Consider applying to work-only cotton coveralls or disposal coveralls (e.g., New or QC Tyvek®).
- Apply DEET repellent to exposed skin or clothing per product label.
- Frequently check for ticks and remove from clothing. Roller-type, double-tape lint remover can be used to effectively remove ticks from clothing.
- At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower.
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves when ticks are handled.
- Pregnant women and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid hand-to-face contact, eating, drinking, and smoking when applying or using repellents. Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.
- In most circumstances, treating persons who only have a tick bite (i.e., no signs of illness) is not recommended. Even if signs and symptoms of illness are not experienced, report all work-related tick bites to your supervisor, Health & Safety (H&S), and Human Resources (HR).

Tick Removal

1. Use fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.
2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.)





3. Do not squeeze, crush, or puncture the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.
4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.
5. After removing the tick, thoroughly disinfect the bite area and wash your hands with soap and water.

6. You may wish to save the tick for identification in case you become ill. Your doctor can use the information to assist in making an accurate diagnosis. Place the tick in a plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.

Note: Folk remedies, such as petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick-removal devices have been marketed, but none are better than a plain set of fine-tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first aid. Clean and wash hands and disinfect the bite area after removing the embedded tick. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses develop. Even if signs and symptoms of illness are not experienced, report all work-related tick bites to your supervisor, H&S, and HR.

Medical treatments for tick-borne infections include antibiotics and other medical interventions. Diagnosis of specific illness includes both clinical and laboratory confirmations. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

Previously infected individuals are not conferred immunity – reinfection from future tick bites can occur even after a person has contracted a tick-borne disease.

Hazard Recognition

An important step in controlling tick-related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

Tick Identification

There are four varieties of hard-bodied ticks that have been associated with transmitting one or more tick-borne pathogens. These tick varieties include the following:

- Deer (Black Legged) Tick (eastern and pacific)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In the eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north central states, tick habitats are generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture. On the Pacific coast, the tick habitats are more diverse. Here, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses – Signs and Symptoms

There are six notable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite – normally many hours after initial attachment. The illnesses, presented in approximate order of most to least common, include the following:

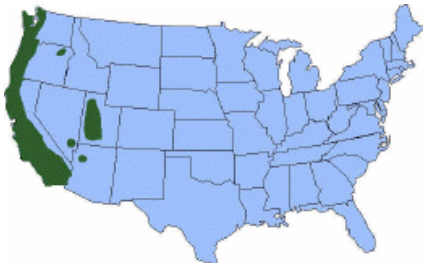
- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs and symptoms: fever; headache; muscle aches; stiff neck; joint aches; nausea; vomiting; abdominal pain; diarrhea; malaise; weakness; and small, solid, ring-like, or spotted rashes. The bite area may be red, swollen, or develop ulceration or lesions. A variety of long-term symptoms may result when untreated, including debilitating effects and death.

Deer Tick

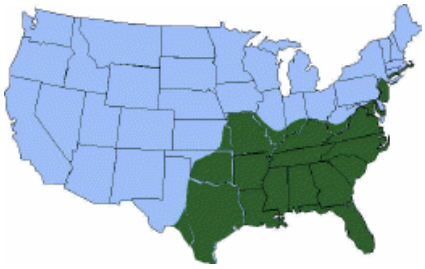
Distribution of Deer Tick (Green)

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)



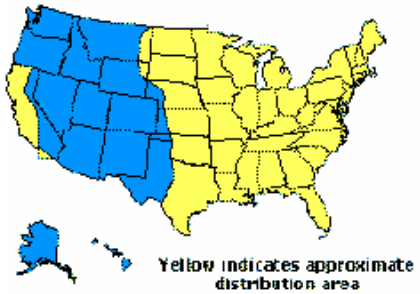
Distribution of Pacific Deer Tick (Green)

Lone Star Tick



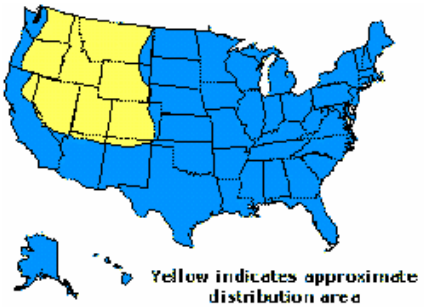
Distribution of Lone Star Tick (Green)

Dog Tick



Distribution of Dog Tick (Yellow)

Rocky Mountain Wood Tick



Distribution of Rocky Mountain Wood Tick (Yellow)

ATTACHMENT 4
Site Safety Briefing Form

CH2M HILL Daily Tailgate Safety Briefing Form		
Project Name:	Project Number:	
Date:	Start Time:	Completed Time:
Site Location:		
Type of Work (general):		

Safety Issues
Tasks (this shift):
PPE Requirements:
Physical Hazards:
Control Measures:
Special Topics (i.e., incidents, near misses, etc.)

Daily Checklist		
HSP up to date and present onsite?	Yes	No
Personnel training current?	Yes	No
Hospital Route Map and Emergency Phone Numbers posted onsite?	Yes	No
PPE present and worn by personnel?	Yes	No
Comments:		

Attendees	
Print Name	**Sign Name**
Meeting conducted by:	

ATTACHMENT 5

Incident Report Form

CH2M HILL

Incident Report Form (Hardcopy)

Fax completed form to:
916-920-8463
CH2M HILL Sacramento Office
Attention: Human Resources (Lisa Narlesky) and HS&E (Trish Danby)

Type of Incident (Select at least one)

- ☐ Injury/Illness
- ☐ Property Damage
- ☐ Spill/Release
- ☐ Environmental/Permit Issue
- ☐ Near-Miss
- ☐ Other

General Information (Complete for all incident types)

Preparer's Name: _____ Preparer's Employee Number: _____
Date of Report: _____ Date of Incident: _____ Time of Incident: _____ am/pm

Type of Activity (Provide activity being performed that resulted in the incident)

- ☐ Asbestos Work
- ☐ Confined Space Entry
- ☐ Construction Mgmt- Haz Waste
- ☐ Construction Mgmt - Non-Haz Waste
- ☐ Demolition
- ☐ Drilling-Haz Waste
- ☐ Drilling-Non Haz Waste
- ☐ Drum Handling
- ☐ Electrical Work
- ☐ Excavation Trench-Haz Waste
- ☐ Excavation Trench-Non Haz
- ☐ Facility Walk Through
- ☐ General Office Work
- ☐ Keyboard Work
- ☐ Laboratory
- ☐ Lead Abatement
- ☐ Motor Vehicle Operation
- ☐ Moving Heavy Object
- ☐ Other (Specify) _____
- ☐ Process Safety Management
- ☐ Tunneling
- ☐ Welding
- ☐ Wetlands Survey
- ☐ Working from Heights
- ☐ Working in Roadways
- ☐ WWTP Operation

Location of Incident (Select one)

- ☐ Company Premises (CH2M HILL Office: _____)
- ☐ Field (Project #: _____ Project/Site Name: _____ Client: _____)
- ☐ In Transit (Traveling from: _____ Traveling to: _____)
- ☐ At Home

Geographic Location of Incident (Select region where the incident occurred)

- ☐ Northeast
- ☐ Southeast
- ☐ Northwest
- ☐ Southwest
- ☐ Corporate
- ☐ Canadian
- ☐ Asia Pacific
- ☐ Europe Middle East
- ☐ Latin America

If a CH2M HILL subcontractor was involved in the incident, provide their company name and phone number: _____

Describe the Incident (Provide a brief description of the incident): _____

Injured Employee Data (Complete for Injury/Illness incidents only)

If CH2M HILL employee injured
Employee Name: _____ Employee Number: _____

If CH2M HILL Subcontractor employee injured
Employee Name: _____ Company: _____

Injury Type

- ☐ Allergic Reaction
- ☐ Amputation
- ☐ Asphyxia
- ☐ Bruise/Contusion/Abrasion
- ☐ Burn (Chemical)
- ☐ Burn/Scald (Heat)
- ☐ Cancer
- ☐ Carpal Tunnel
- ☐ Concussion
- ☐ Cut/Laceration
- ☐ Dermatitis
- ☐ Dislocation
- ☐ Electric Shock
- ☐ Foreign Body in eye
- ☐ Fracture
- ☐ Freezing/Frost Bite
- ☐ Headache
- ☐ Hearing Loss
- ☐ Heat Exhaustion
- ☐ Hernia
- ☐ Infection
- ☐ Irritation to eye
- ☐ Ligament Damage
- ☐ Multiple (Specify)

_____

- ☐ Muscle Spasms
- ☐ Other (Specify)

_____

- ☐ Poisoning (Systemic)
- ☐ Puncture
- ☐ Radiation Effects
- ☐ Strain/Sprain
- ☐ Tendonitits
- ☐ Wrist Pain

Part of Body Injured

- ☐ Abdomen
- ☐ Ankle(s)
- ☐ Arms (Multiple)
- ☐ Back
- ☐ Blood
- ☐ Body System
- ☐ Buttocks
- ☐ Chest/Ribs
- ☐ Ear(s)
- ☐ Elbow(s)
- ☐ Eye(s)
- ☐ Face
- ☐ Finger(s)
- ☐ Foot/Feet
- ☐ Hand(s)
- ☐ Head
- ☐ Hip(s)
- ☐ Kidney
- ☐ Knee(s)
- ☐ Leg(s)
- ☐ Liver
- ☐ Lower (arms)
- ☐ Lower (legs)
- ☐ Lung
- ☐ Mind
- ☐ Multiple (Specify)

_____

- ☐ Neck
- ☐ Nervous System
- ☐ Nose
- ☐ Other (Specify)

_____

- ☐ Reproductive System
- ☐ Shoulder(s)
- ☐ Throat
- ☐ Toe(s)
- ☐ Upper Arm(s)
- ☐ Upper Leg(s)
- ☐ Wrist(s)

Nature of Injury

- ☐ Absorption
- ☐ Bite/Sting/Scratch
- ☐ Cardio-Vascular/Respiratory System Failure
- ☐ Caught In or Between
- ☐ Fall (From Elevation)
- ☐ Fall (Same Level)
- ☐ Ingestion
- ☐ Inhalation
- ☐ Lifting
- ☐ Mental Stress
- ☐ Motor Vehicle Accident
- ☐ Multiple (Specify)

_____

- ☐ Other (Specify)

_____

- ☐ Overexertion
- ☐ Repeated Motion/Pressure
- ☐ Rubbed/Abraded
- ☐ Shock
- ☐ Struck Against
- ☐ Struck By
- ☐ Work Place Violence

Initial Diagnosis/Treatment Date: _____

Type of Treatment

- ☐ Admission to hospital/medical facility
- ☐ Application of bandages
- ☐ Cold/Heat Compression/Multiple Treatment
- ☐ Cold/Heat Compression/One Treatment
- ☐ First Degree Burn Treatment
- ☐ Heat Therapy/Multiple treatment
- ☐ Multiple (Specify)

_____

- ☐ Heat Therapy/One Treatment
- ☐ Non-Prescriptive medicine
- ☐ None
- ☐ Observation
- ☐ Other (Specify)

_____

- ☐ Prescription- Multiple dose
- ☐ Prescription- Single dose
- ☐ Removal of foreign bodies
- ☐ Skin Removal
- ☐ Soaking therapy- Multiple Treatment
- ☐ Soaking Therapy- One Treatment
- ☐ Stitches/Sutures
- ☐ Tetanus
- ☐ Treatment for infection
- ☐ Treatment of 2nd/3rd degree burns
- ☐ Use of Antiseptics – multiple treatment
- ☐ Use of Antiseptics – single treatment
- ☐ Whirlpool bath therapy/multiple treatment
- ☐ Whirlpool therapy/single treatment
- ☐ X-rays negative
- ☐ X-rays positive/treatment of fracture

Number of days doctor required employee to be off work: _____
Number of days doctor restricted employee's work activity: _____
Equipment Malfunction : Yes ☐ No ☐ Activity was a Routine Task: Yes ☐ No ☐
Describe how you may have prevented this injury: _____
_____

Physician Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Hospital Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Property Damage (Complete for Property Damage incidents only)

Property Damaged: _____ Property Owner: _____
Damage Description: _____
Estimated Amount: $ _____

Spill or Release (Complete for Spill/Release incidents only)

Substance (attach MSDS): _____ Estimated Quantity: _____
Facility Name, Address, Phone No.: _____
Did the spill/release move off the property where work was performed?: _____
Spill/Release From: _____ Spill/Release To: _____

Environmental/Permit Issue (Complete for Environmental/Permit Issue incidents only)

Describe Environmental or Permit Issue: _____
Permit Type: _____
Permitted Level or Criteria (e.g., discharge limit): _____
Permit Name and Number (e.g., NPDES No. ST1234): _____
Substance and Estimated Quantity: _____
Duration of Permit Exceedance: _____

Verbal Notification (Complete for all incident types)(Provide names, dates and times)

CH2M HILL Personnel Notified: _____
Client Notified: _____

Witnesses (Complete for all incident types)

Witness Information (First Witness)
Name: _____
Employee Number (CH2M HILL):_____
Address: _____
City: _____
Zip Code:_____
Phone: _____

Witness Information (Second Witness)
Name: _____
Employee Number (CH2M HILL: _____
Address: _____
City: _____
Zip Code:_____
Phone :_____

Additional Comments: _____
_____

ATTACHMENT 6

U.S. Coast Guard Safe Boating Requirements