U.S. Department of Energy

Oakland Operations Office, Oakland, California

DRAFT
RISK ASSESSMENT PROTOCOL

for the

Department of Energy Areas at the Laboratory for Energy-Related Health Research (LEHR) University of California at Davis, California

Submitted to:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 95612

Prepared by:

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March 15, 1997
Rev. B

DOE Oakland Operations Office, Contract DE-AC03-96SF20686

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Approvals Page

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1. INTRODUCTION AND OBJECTIVES

1.1 Introduction

This protocol has been prepared on behalf of the U.S. Department of Energy (DOE), for the Laboratory for Energy-Related Health Research (LEHR Site), by Weiss Associates (WA), Emeryville, California. The purpose of this document is to describe the technical approach for the human health and ecological risk evaluations to be conducted as part of the ongoing CERCLA action at the site. The risk evaluation to be conducted for the site will cover only those areas for which DOE is the responsible party, based on the draft Memorandum of Agreement (MOA) (most current draft No. 4, 27 Jan 1997) between the DOE and the University of California, Davis (UCD). The areas for which DOE is responsible are summarized in Table 1-1.

Table 1-1. Summary of DOE Areas at the LEHR site.

Operable Unit	Investigative Area	Description
OU-1	Southwest Trenches	Disposal trenches and chemical dispensing area in the southwest corner of the LEHR site.
OU-1	DOE Disposal box	Subsurface disposal area bounded by metal matting located between the two sets of dog pens.
OU-2	Radium Treatment System	Radium-226 treatment tank and associated leach field and dry wells.
OU-2	Strontium Treatment System	Strontium-90 treatment tank and associated leach field and dry wells.
OU-3	Dog Pen Areas	Western and eastern set of dog pens, including the southern portion of the area currently occupied by the Cellular Biology Lab. The North Chemical Dispensing Area is also included.
OU-4	Domestic Septic Systems	Seven domestic septic tanks at the site

Environmental restoration of ground water and surface water at the site, (Operable Unit 6) is the responsibility of UCD. However, because these areas encompass media that could result in potentially complete exposure pathways with respect to the DOE areas, they will be included in the assessment of human and environmental risk to the extent necessary to do a complete evaluation.

Figure 1-1 shows the general site configuration and identified the OUs. Locations for each of the exposure scenarios to be evaluated are also shown on this figure, and are discussed in the next section. Figure 1-2 shows the ground water monitoring well locations and the surface water monitoring locations for reference.

The DOE risk assessment scope has been discussed in the following meetings:

- Remedial Project Managers (RMP) meeting of Jan 30, 1997 at LEHR site in Davis, California.
- RESRAD workshop of February 26, 1997 at DOE Oakland, California.

1.2 Objectives

The overall objective of this risk evaluation is to provide a basis for establishing preliminary remediation goals, or action levels, for contaminated soil in the DOE OUs, for both chemical constituents of concern (COCs) and radionuclide COCs. Action levels for carcinogenic compounds will be calculated for the risk range of 10^{-4} to 10^{-6} established in the National Contingency Plan. Action levels for non-carcinogens will be based on a hazard index of 1.0.

For the human health risk evaluation, the objectives are to establish:

- Contaminants of potential concern within each OU;
- The methodology for determining background levels for constituents in soil;
- The exposure scenarios to be evaluated;
- Complete exposure pathways to be evaluated in each scenario;
- Appropriate scenario and pathway-specific exposure parameter values;
- The basis for toxicological data to be used;
- The methodology for fate and transport analysis to be conducted to relate concentrations in surface soil, air, and ground water at offsite locations to those onsite;
- The general approach to determine single-constituent action levels for site soil.

During the February 26, 1997 workshop, the EPA and CAL-EPA DTSC agreed that the RESRAD model could be used to calculate action levels for radionuclides if, for equivalent input parameters, the results can be shown to be consistent with those produced using the EPA Region IX program RISKCALC (the implementation *of Risk Assessment Guidance for Superfund (RAGs) Part B* chapter 4). Therefore, the last objective of this protocol with respect to the human health risk evaluation is to:

- Demonstrate that RESRAD can produce consistent with results to RISKCALC (action levels in soil at an example dose level equivalent to 10^{-}

^{6} risk) for Cs-137 and Sr-90 for commercial and residential soil, when considering the ingestion, inhalation, and external radiation pathways as included in RISKCALC.

This demonstration is included as Attachment A.

For the ecological evaluation, the objectives of this protocol are to establish the technical approach to complete a Scoping Assessment following the *Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities* (CAL-EPA DTSC July, 1996). Specifically the protocol attempts to establish:

- Methodology for site characterization with respect to ecological contaminants of potential concern;
- Methodology for identification and evaluation of plant communities and habitats (biological characterization);
- Methodology for identification and evaluation of invertebrate and vertebrate animal populations and communities (biological characterization);
- Methodology for characterization of spatial and temporal distribution of ecological components (i.e. habitat distribution, home range areas, seasonal migration habits etc.) (pathway assessment); and
- Methodology for assessment of ecosystem attributes influencing distribution and nature of contamination (pathway assessment);
- Decision criteria for the need for Phase I predictive assessment.

1.3 General Approach

The general approach for establishing preliminary remediation goals, or action levels, for site soil is outlined in Figure 1-3. It involves the parallel use of RESRAD for radionuclides and a *Risk Assessment Guidance for Superfund (RAGS)*-based approach for chemical constituents.

The general approach for the ecological scoping assessment is shown in Figure 1-4, and the general approach for conducting the Phase I predictive assessment, if necessary, is shown in Figure 1-5.

The purpose of this document is to gain consensus from the involved regulatory agencies and their technical staff regarding the technical approach for the risk evaluation. Therefore, immediately following agency review of this document, DOE and WA will schedule a technical working session to discuss agency comments on the technical approach, if necessary.

2. HUMAN HEALTH RISK ASSESSMENT PROTOCOL

2.1 DATA EVALUATION

2.1.1 Selection of Chemical Data Set to be Used

The data set to be used in this risk evaluation consists of all data that were collected and analyzed by appropriate procedures and methodologies and validated by established EPA data validation procedures and recorded in the site database with no substantial errors or omissions of information. Appropriate data collection procedures are outlined in the RI/FS Workplan for LEHR Environmental Restoration (Dames and Moore 1994). Sample analysis methodologies are certified procedures as established by the USEPA Contract Laboratory Program. Data validation procedures are from the USEPA Contract Laboratory Program national functional guidelines for data review as outlined in the RI/FS Workplan. Data containing substantial untraceable omissions or errors will be corrected or removed from the database before proceeding to determine the concentration terms.

The following specific data comprises the data sets that will be used for this risk evaluation:

- OU-1 shallow soil: 8 samples collected during the Limited Field Investigation (LFI), between 7/23/96 and 8/2/96.
- OU-1 subsurface soil: 57 samples collected during the LFI, between 7/23/96 and 8/27/96.
- OU-2 shallow soil: 4 samples collected during the LFI, on 8/27/96.
- OU-2 subsurface soil : 58 samples collected during the LFI, between 8/6/96 and 8/21/96.
- OU-3 shallow soil: 17 soil boring samples collected during the December 1994 soil investigation, inclusive dates 12/7/94 to 12/14/94. In addition, 15 soil samples collected during the LFI on 7/31/96.
- OU-3 subsurface soil: 27 soil boring samples collected during the December 1994 soil investigation, inclusive dates 12/7/94 to 12/14/94.

- OU-4 shallow soil: No relevant shallow soil data are available in the existing data set. Note: OU4 sources are all subsurface so this does not represent a data gap with respect to the risk evaluation.

- OU-4 subsurface soil: 7 samples collected during LFI, between 8/16/96 and 8/19/96.

- Surface water: Putah Creek stations PCU, STPO, PCD: 18 quarterly monitoring samples collected from each station (19 from STPO) between 11/9/90 and 2/21/95.

- Storm water runoff stations: 4 samples collected between 11/15/94 and 3/20/95.

- Ground water data: quarterly monitoring between 10/29/90 and 2/23/95.

2.1.2 Selection of Potential COCs by Operable Unit

The flowchart for determining potential COCs in site soils is presented as Figure 2-1. The assembled database consists of samples from all data collection efforts conforming to the criteria discussed in section 2.1.1 and from all OU locations for which the DOE is responsible. The data will be sorted by OU, medium and chemical. All chemical results with few or no detections in a medium will be evaluated through historical records and data from other media to determine whether the compound is likely to be present. If only a few samples contain detectable concentrations and the contaminant is likely to be present, the maximum detected concentration is selected as the concentration term. A background comparison will be conducted to eliminate concentration terms that are not significantly above the concentrations determined from the background database. The remaining concentration terms for each medium and each operable unit will be carried forward into the risk assessment as the potential COCs.

The concentration of some compounds are below laboratory detection limits for all samples collected from the LEHR site operable units. In some cases the compound is not suspected exist in one or all environmental media in an operable unit. The concentration may be zero for compounds that do not occur naturally and were not used in previous site activities. Compounds that are not detected in any environmental media and are not suspected to exist at the LEHR site from historical review of previous site activities will be eliminated from the risk assessment data set and will not be considered potential COCs.

Figures 2-2 and 2-3 similarly outline the selection of potential COCs for surface water and ground water pathways. For surface water, it is important for this analysis to eliminate chemicals for which DOE OUs are not the source. The only significant transport mechanism from DOE source areas (site soils) to Putah Creek is through surface erosion during a rainfall event followed by runoff to the creek. Therefore, the flow chart in Figure 2-2 first eliminates, as potential COCs, those chemicals detected at higher levels at the upstream Putah Creek sampling

locaton. Secondly, contaminants not detected in DOE OU storm water runoff will be eliminated as contaminants of potential concern with respect to DOE sources.

Tables 1 through 12 at the end of the text include the preliminary results of the identification of potential non-radionuclide COCs in surface an dsubsurface soils by OU. The reduction of radionuclide data is not yet complete.

2.1.2.1 Use of Qualified Data

The use of qualified data will follow the procedures outlined in RAGS Part A (EPA 1989). Most qualified data will be used to determine the concentration term. Data with R (rejected) or Uz (laboratory contamination) qualifiers will not be used to determine the concentration term if the data were rejected due to substantial analytical failures, grossly exceeded holding times or contained concentrations less than five times the level of contamination in the associated blank (10 x for common laboratory contaminants). Significant outlier data will be removed if they have been flagged with a J qualifier indicating problems with quantitative accuracy.

2.1.2.2 Evaluation of Tentatively Identified Compounds

The use of tentatively identified compounds (TICs) data will follow the procedures outlined in RAGS Part A (EPA 1989). Most of the tentatively identified compounds found in the analysis of soil and water samples at the LEHR site were unidentified hydrocarbons with mass spectra typical of saturated hydrocarbon chains. The dominant ions present indicate the presence of straight chain hydrocarbon structures typical of common fats and oils. No convincingly positive identifications of compounds or classes of compounds of toxicological significance were made. The response of most TICs was near or below the quantitation limit of compounds in the target compound list. The response of a mass spectral detector to saturated hydrocarbon compounds should not be significantly different than the response to the internal standards used in the USEPA CLP methods. The only other TIC consistently found in LEHR samples was an aldol condensation product which is due to laboratory sample preparation chemicals.

2.1.2.3 Elimination of background chemicals

Chemicals that were detected in site soil, ground water and surface water will be evaluated against background data where background data are sufficient. Chemicals that have been positively detected in site soils but for which no background data have been collected will be carried forward to the risk evaluation. Chemicals whose RME concentration is not greater than background will not be carried forward through the risk assessment.

2.1.2.4 Elimination of contaminants with < 2% occurrence

Some contaminants may be detected with a frequency of occurrence that is less than 2% of the collected data for a media within an OU (e.g., 1 detect from 51 data points). Some of these chemicals may have historical reason for existing at the LEHR site due to the research activities that were conducted or because they were detected in other site media. Some chemicals may have detectable results due to errors such as sample container contamination, laboratory

contamination, false identification or transcription errors. An arbitrary cut off frequency of 2% was selected to remove chemical data that may have been reported with a detected concentration due to human error, or which are isolated detection and not representative of a OU-wide COCs. Chemicals with a frequency of occurrence that is less than 2% and that are not otherwise suspected to exist at the LEHR site will not be carried through the risk assessment.

2.1.3 Establishing RME Concentrations in Each Medium for Each OU

2.1.3.1 Definition of Surface vs. Subsurface Soil.

Surface and subsurface soil data will be divided at a depth of three feet below ground surface (bgs). The three foot depth was selected due to the historical rodent control activities at the LEHR site. Rodents are controlled at the LEHR site by tilling the surface soil to destroy habitat. It is unlikely that soil from a three foot depth or below will be mechanically lifted to the ground surface because the tilling operations are not expected to penetrate beyond a three foot depth. For this reason, soil from shallower depths than three feet bgs will be classified as surface soil and soil from depths of three feet and below will be classified as subsurface soil.

2.1.3.2 Determination of Data Distributions.

As a first conservative estimate, all data will be assumed normally distributed for OU soils. Due to the relatively large number of compounds present in DOE OU site soil, and in some cases the limited number of samples available, it is not feasible to statistically test each individual distribution. If necessary or appropriate, histograms of the data will be plotted to visually determine whether the data are normally or lognormally distributed. If the distribution type is not obvious from inspection of the histogram, the data will be tested to determine the goodness-of-fit of the lognormal or normal distribution. When tested, data distributions with greater than 10 and less than 50 data points will be tested by the Shapiro-Wilk Test (*Gilbert*, 1987). Data distributions with more than 50 data points will be evaluated using D' Agostino's Test (*Gilbert*, 1987) to test the null hypothesis of normality or lognormality. Lognormal or normal distributions for which the null hypothesis is not rejected will be selected for calculation of the 95% upper confidence limit on the mean (95% UCL).

2.1.3.3 Selection of Maximum vs. 95% UCL as RME Concentration.

The maximum detected concentration will be selected as the reasonable maximum exposure (RME) concentration term for data sets with less than 50% detected data points. The 95% UCL on the mean will be calculated to determine the RME concentration term for data sets with more than 10 detected data points. The 95% UCL on the mean is a conservative estimator of the true mean concentration of a contaminant in an environmental media. An estimator of the mean concentration is used for the concentration term because the exposed individual is expected to move throughout the entire exposure area with time. The 95% UCL on the mean will be calculated as presented in the Supplemental Guidance to RAGS: Calculating the Concentration Term (USEPA 1992) (Supplemental Guidance). The 95% UCL on the mean will

be calculated using the equations presented in Highlight 5 and Highlight 6 of the Supplemental Guidance for lognormally and normally distributed data, respectively.

2.1.3.4 Handling Data Below the Detection Limit in Statistical Calculations.

For those chemicals or radionuclides that are identified as of potential concern, the concentration term for non-detect results that are part of a larger data set will be set to one half of the detection limit when such an assumption is necessary for statistical calculations (USEPA 1992).

2.1.4 Determination of Background Concentrations

2.1.4.1 Background Data Sets.

Soil.

During the Phase II Site Characterization, Dames & Moore collected 12 soil samples from off-site monitoring wells UCD-17 and UCD-18 at depths of 5, 10, 20, 30, and 40 ft. The Phase II Site Characterization Report (Dames & Moore, 1993) notes that the quantity and locations of samples taken might not be sufficient for a definitive assessment of background values for the LEHR facility. Quality assurance performed during the collection and analysis of these samples is not documented.

In 1995, Dames & Moore conducted a more extensive background investigation involving the collection of twenty-four background samples at depths of 0, 4, 19, and 39 ft bgs at 6 locations outside, but within one-half mile, of the LEHR site. The samples were analyzed for radionuclides, metals, and inorganic compounds (e.g., salts), and were validated. Table 13 presents the background range of values for metals obtained from 1995 investigations near the LEHR site, as well as regional background range of values (Shacklette and Boerngen, 1994). It should be noted that the regional background ranges apply to surficial soil (up to about 8 in bgs) only, whereas soil samples collected and analyzed in the 1995 study are from both the surface and discrete depths below the surface.

For purposes of this risk evaluation, the sample set consisting of 26 discrete samples from the 1995 investigation has been used to calculate background concentrations for inorganic constituents.

Ground and Surface Water

Wells UCD1-18 and UCD2-17 are located upgradient (west) of the LEHR site and are the background wells for the two impacted hydrostratographic units (HSU-1 and HSU-2) at the site. Water quality in these wells has been used to help determine the impact of DOE and UCD activities on ground water at the LEHR site. Wells UCD1-34 and UCD2-35, installed south of the LEHR site in October 1995, also provide information about background water quality.

The surface water monitoring program at the LEHR site began in November 1990 and is conducted at three locations along the South Fork of Putah Creek. Station PCU is located upstream of the LEHR site and is therefore the background surface water sampling point (Figure 1-2).

Air

Air monitoring began at the LEHR site in August 1995 and was conducted at three locations along the perimeter of the site and at one off-site (background) ambient air monitoring station. The background air monitoring station is located approximately 10 kilometers west of the LEHR site.

2.1.4.2 Calculation Methods

Soils

The 95th quantile of the data has been selected to represent background. The complete calculation methodology, data set, and histogram backups are included in Attachment B. Statistical calculations have not yet been completed for radionuclides, but will use the same approach.

Ground Water

The ground water background levels will be calculated similarly to the soil levels. Those calculations have not yet been completed.

Surface Water

Because of the limited data set available for surface water, background will be established at the maximum concentration detected in any sampling event at the upstream sampling location PCU. Inadequate data are available for a statistical determination. Further, WA notes that the UCD treatment plant outfall (station STPO) is between the background, upstream sampling location PCU and the downstream sampling location PCD; sampling results from STPO, as well as PCU, demonstrate that contamination found in PCD is not completely attributable to the DOE areas of the LEHR site. DOE recognizes, however, that some historical data from the summer rounds of the water monitoring programs wre collected during dry years when there was effectively no flow in Putah Creek. These samples will likely not be used in establishing surface water background establishing surface water background. Further, the downstream sampling point PCD is also downstream of surface stormwater discharge from UCD OU5 (the landfill), and therefore does not represent solely contributions from DOE OUs.

2.2 Exposure Assessment

2.2.1 Physical Setting

The LEHR site is located in a rural area in the Sacramento Valley. The land within a one-mile radius of the site is owned both privately and by UC Davis, and is used for animal research, agriculture, and recreation. Immediately adjacent to the LEHR site to the east and west are UC Davis-owned research facilities. Privately-owned lands within one mile to the south and east of the site include permanent residences and support some crops. Approximately 75 percent of the surrounding land in the general vicinity of the LEHR site is used for agriculture. Major crops include fruits, nuts, and grains. Approximately 40 percent of the agricultural land in the LEHR vicinity is irrigated, and some of the nearby lands are used for cattle grazing (DOE, 1988).

Climate - The climate is temperate with mild winters and warm summers. The mean winter and summer temperatures are 46.9 degrees Fahrenheit (^{o}F) and 73.0 ^{o}F respectively. The average daily minimum in winter is 37.6 ^{o}F and the average daily maximum in summer is 92.3 ^{o}F (NOAA, 1985; DOE, 1988). The mean annual precipitation at the Davis 2 WSW station was 17.0 inches from data collected between 1908 and 1990 (National Climactic Data Center).

Meteorology - The dominant wind direction is from the south with most winds along a south - north axis. Winds from the north are almost as common as winds from the south, however, with the 180-degree change being seasonal in nature. Northeast and southeast wind directions also occur. Most wind speeds are in the 1 to 3 mile per hour (mph) and 4 to 7 mph ranges (PNNL 1996).

Geologic Setting - Sediments below the LEHR site and vicinity consist primarily of silt and clay with localized interfingered coarse grained sediments to a depth of approximately 180 feet below ground surface (bgs) (Weiss Associates 1996). The depths and major types of sedimentary units encountered below the site are:

- 0 to 80 feet bgs: interbedded silt, clay and sand with some sand and gravel channel deposits.
- 80 to 135 feet bgs: cobbles and gravels.
- 135 to 143 feet bgs: Clay with some silt.

Ground Water Hydrology - Ground water generally flows from the Sacramento valley sides towards the valley axis. In the vicinity of the LEHR site, regional ground water generally flows east from the Coast Ranges towards the Sacramento River (Dames & Moore, 1990).

At various depths beneath the valley floor, fresh water gives way to saline water as a result of entrapment during the deposition of sediments in a marine environment. The depth to the base of fresh water in the Sacramento Valley varies from 400 ft to over 3,000 ft, and is 2600 to 3100 ft bgs at Davis (California Department of Oil & Gas, 1982).

The uppermost distinct aquifer beneath the LEHR site has been divided into two hydrostratigraphic units (HSUs), based on the stratigraphy of the sediments at the site, and the associated ground water flow and contaminant migration characteristics (Dames & Moore, 1994). HSU-1 consists predominantly of fine-grained sediments and extends from the water table down to approximately 80 ft bgs. HSU-2 consists of cobbles and gravel and extends from 80 to 135 ft bgs. Well drillers' logs indicate that a 90-foot-thick clay unit separates HSU-2 from a second aquifer (or third HSU) below (Dames & Moore, 1994).

Ground water levels in 1995 varied from approximately 28 ft bgs in winter to 48 ft bgs in summer. Generally, there is a 20- to 30-foot seasonal fluctuation in the depth-to-ground water beneath the LEHR site caused predominantly by the net agricultural extraction in the summer.

The lateral gradient across the LEHR site varies from approximately 0.0001 to 0.0015 ft/ft, and is predominantly northeast. Representative values of HSU-1 horizontal hydraulic conductivity are available from slug tests. The lateral gradient across the site within HSU-2 typically ranges from 0.0004 ft/ft to 0.0015 ft/ft and is predominantly northeast, although it can occasionally be east-southeast. Horizontal hydraulic conductivities are also available from slug tests.

Ground water in HSUs 1 and 2 has been impacted by site activities (where here the "site" means both UCD and DOE OUs).

Surface Water - The east-flowing South Fork of the Putah Creek borders the southern portion of the LEHR site and is separated from the site by the north levee of the creek. In 1948, the U.S. Army Corps of Engineers modified the South Fork and dammed the North Fork, so that all water in Putah Creek now flows in the South Fork. Putah Creek is a "losing" stream in the LEHR vicinity. Therefore Putah Creek water may impact shallow ground water beneath the site, but not vice-versa. (DOE, 1996).

Flow in the South Fork of Putah Creek is regulated by releases from Monticello Dam at Lake Berryessa and from the Putah Diversion Dam, located about 18 and 14 miles west of the LEHR site, respectively. Based on data from 1980 through 1991, flows several miles upstream from the LEHR site typically range from 0.1 cubic ft per second (cfs) to about 3 cfs, although flows as high as 15,500 cfs (in March 1983) have been reported (Dames & Moore, 1994). In the reach bordering the LEHR site, flow in the South Fork of Putah Creek is supplemented by discharge from the UC Davis Wastewater Treatment Plant. Based on data from the gauge near Old Davis Road, flow rates for the reach bordering the LEHR site ranged from 0.17 to 148 cfs from 1989 to 1993. Flows have not changed substantially since 1993 (personal communication, 1996, Roland Sanford, Solano County Water Resources Agency).

As shown on federal flood maps, the 100-year flood is confined within the Putah Creek levees at the southern boundary of the LEHR site. The LEHR site lies in the Federal Emergency Management Administration (FEMA) Zone C, the area expected to experience minimal flooding.

2.2.2 Exposure Scenarios

Three exposure scenarios will be evaluated in the risk evaluation. These three scenarios were first presented in the September 1996 RPM meeting at the LEHR site, and again at the January 1997 RMP meeting. They are:

- Scenario 1: Onsite worker. This scenario assumes that the site will continue to be used similarly to its current use for the forseeable future.

- Scenario 2: East residential farm scenario. This scenario assumes a residential farm located immediately east of the UCD property boundary. This location represents the nearest reasonable downgradient (with respect to ground water) location for an offsite receptor.

- Scenario 3. South residential farm scenario. This scenario assumes a residential farm located immediately south of the UCD property boundary and Putah Creek. This location represents the nearest reasonable downwind location for an offsite receptor.

The locations of receptors for these three scenarios was shown in Figure 1-1.

2.2.3 Exposure Pathway Analysis

Figures 2-4, 2-5, and 2-6 show the exposure pathways that have been identified as potentially complete for Scenarios 1, 2, and 3, respectively, along with the rationale for inclusion or exclusion of each possible pathway.

2.2.4 Fate and Transport Approach to Determine Ratio Between Onsite and Offsite Concentrations

Onsite soil is the medium of concern for the DOE OUs, and as such represents the source term for every exposure pathway to be evaluated. Transport of particulates via the air pathway represents the mechanism by which contaminants may be present in onsite air, and at offsite receptor locations in air and surface soils. A fate and transport analysis will be conducted to determine the ratio of exposure point concentrations of contaminants to onsite soils concentrations of contaminants, in order to relate exposure point concentrations to the onsite source. Specifically, fate and transport analysis will be used to determine:

- The concentration of contaminants in onsite air (particulate loading) as a function of fugitive dust emissions from onsite soil;

- The concentration of contaminants in onsite air as a function of volatilization loss from onsite soil. Volatiles will not be considered of concern at offsite locations based on the available air monitoring data at the

site that indicates no significant concentrations of volatiles at any of the LEHR perimeter monitoring stations.

- The concentration of contaminants in offsite air as a function of fugitive dust emissions from onsite soil; and

- The concentration of contaminants in offsite surface soils as a function of wind erosion loss from onsite soil followed by deposition at the offsite receptor location.

In each case, the starting point will be a default contaminant concentration of 1 mg/kg. For non-volatiles, the exposure point concentrations are always linearly related to the source concentration, allowing the results to be used for all COCss by applying for appropriate ratio.

The particulate emission factor or particulate mass loading onsite will be estimated following the method of Cowherd (1985) using site-specific data for source area size, wind speed, surface cover, and particle size distribution (if the latter is available from grain size distribution data from previous investigations). This method is consistent with the EPA Region IX PRGs.

The volatilization factor approach taken from the EPA Region IX PRG guidance method will be used to relate soil concentrations to onsite air concentrations of volatiles.

To estimate exposure point concentrations for volatiles in air, one of two models will be used, depending on the availability of meteorological input data. The first option is the area source algorithm of the current version of the ISC3 model, and EPA-recommended model from the Office of Air Quality Planning and Standards. This model takes as input an emission rate, the source size, and site-specific hourly meteorological data to estimate concentrations in air at specified receptor locations. The use of this model in the deposition mode will also allow the estimation of particulate deposition, and therefore soil concentration, at the two offsite receptor locations. The selection of this model for use will be dependent upon the availability of an hourly meteorological data set representative of the site, including data for precipitation necessary to run the deposition algorithm.

The second option is the EPA-recommended Fugitive Dust Model (FDM). According to the EPA User's Manual, FDM is "specifically designed for computing concentration and deposition impacts from fugitive dust sources." The model runs in both concentration and deposition mode with either pre-processed hourly meteorological data or annual Stability Array (STAR) format data, and does not require the precipitation data necessary to run ISC in the deposition mode. Similar to ISC, FDM takes as input an emission rate, the source size, and site-specific hourly meteorological data to estimate concentrations in air and deposition at specified receptor locations. FDM calculates gravitational settling velocity and depositional velocity for particulates based on user-specified particle size classification data.

Similarly to the air pathway, site soils are the potential source for impacts to ground water. While a significant amount of ground water data is available at the site, there is currently no established mechanism to relate ground water contaminant concentrations to contaminants

present in DOE OUs. Therefore, the fate and transport analysis to be conducted for the ground water pathway will have the following objectives:

- Identify those constituents in DOE OUs that could move through the vadose zone and result in ground water contamination at the source location above state Maximum Contaminant Levels (MCLs) for drinking water;
- For those contaminants, establish a ratio between ground water concentration and site soils concentrations; and
- If necessary, establish a ratio between on site concentration and receptor concentration.

Figure 2-3 outlined the process by which potential COCs for the ground water pathway will be identified. It relies on the same approach as taken in the *Draft Final One Dimensional Vadose Zone Modeling* for the LEHR site (WA, 1997), using the NUFT model with site specific data to evaluate transport from the vadose zone to ground water. The results of that analysis indicate that only nitrate, of the five indicator compounds selected for analysis, is likely to impact ground water at levels above the MCL. However, not all contaminants present (no matter what the frequency or concentration in DOE OUs) were screened, and it is possible that additional indicators will need to be analyzed to definitively determine whether any contaminants are of potential concern in the ground water pathway, with respect to the DOE OUs.

Should contaminants of potential concern be identified, a simple, conservative one or two-dimensional modeling approach may be used to model transport in the saturated zone from the onsite ground water to the offsite East Side Residential Scenario. Alternatively, site specific ground water monitoring data will be used to establish a site-specific dilution attenuation factor (DAP) that will be used to determine the relationship between concentration at off site and on site locations.

2.2.5 Exposure Parameter Values

Tables 14 and 15 are a compilation of the key exposure parameters that are proposed for use for each scenario. In general, site-specific values have been used whenever available. Site specific parameters are shown in Table 15, to the extent they have been established In general, EPA default values will be used for intake and exposure-related parameters. These values have been compiled from EPA Region IX PRG guidance, CAL-DTCS Preliminary Endangerment Assessment Guidance, and RAGs and its supplemental guidance documents.

To the extent that RESRAD uses equivalent parameters, but with different units, these values will be used in RESRAD also. RESRAD also requires a number of additional exposure-related parameters, which will be set at RESRAD default values whenever site specific data is not available.

2.2.6 Toxicological and Physical Constant Data

2.2.6.1 Chemical Constituents

Toxicological and physical constant data for COCs will be taken from data included in EPA Region IX's most current (August 1996) *Region 9 Preliminary Remediation Goals (PRGs)* 1996. The toxicological data contained therein reflects the most current reference doses (RfDs) and cancer slope factors (CSFs) available from IRIS through July 1996, HEAST through May 1995, and the EPA's National Center for Environmental Assessment (NCEA, formerly ECAO). Where appropriate, the toxicological data used in this assessment with reflect the "CAL-modified" values included in the PRG tables, taken from the most recent CAL-EPA Office of Environmental Health Hazard Assessment *California Cancer Potency Factors: Update* (1995). Chemical-specific physical constant data and chemical-specific data related to intake (e.g. skin adsorption factors) will also be taken whenever possible from the current PRG tables.

2.2.6.2 Radionuclides

Toxicological and physical constant data for COCss will be taken from the database included with the most recent version of RESRAD (V5.62). These data reflect the most current EPA dose conversion factors (EPA FGR Nos. 11 and 12). Physical constant data will be taken from the RESRAD v5.62 data tables.

The risk per mrem/yr conversion assumed will be consistent with current EPA guidance on the risk coefficient for external radiation (7.6×10^{-7}/mrem), and current EPA dose conversion factors and slope factors for radiation intake.

2.3 Calculation of Action Levels for Radionuclides

Single-radionuclide action levels will be calculated using the most recent version of RESRAD (v5.62) at input dose levels equivalent to 3×10^{-4} risk, 1×10^{-4} risk, and 1×10^{-6} risk, for those complete exposure pathways identified above for each scenario.

To calculate onsite soil action levels for the two offsite exposure scenarios, RESRAD will first be run for a hypothetical residential farm located on the LEHR site. RESRAD does not include built-in fate and transport modeling to adjust for the fact that the receptors are actually at an offsite location - in other words, RESRAD can *only* assume that the receptor is at the site of interest. Therefore, to make the adjustment the results of the fate and transport modeling described above will be used. The fate and transport results will provide a ratio of the onsite concentration in soil to the offsite concentration in soil at each receptor location, based on site-specific dispersion and deposition. The RESRAD-generated action levels assuming that the receptor is onsite will be multiplied by the ratio of the default dust concentration for an onsite residence (C) to the concentration estimated for the offsite residence (X). Action levels corrected in this manner represent the onsite concentration of each radionuclide, at the input mrem/year radiation dose limit above background for each input risk level, at the off-site location.

The results will be tabulated for each scenario as single-radionuclide action levels representing the $3x10^{-4}$, 10^{-4}, and 10^{-6} excess cancer risk levels.

2.4 Calculation of Action Levels for Chemicals

Single-chemical action levels will be calculated using the RAGS Part A equations for each complete exposure pathway for each scenario. An initial default value of 1 mg/kg in soil will be input to the equations, with inputs for other source-term concentrations (meat, fish, air, etc.) being input as a ratio of the default input value. For each scenario, the initial output will be total risk per chemical based on the initial default input value. An iterative approach will be used to establish the input value for each chemical that results in the excess risk level of concern. Risk levels of 10^{-4} and 10^{-6} will be considered, and the level of concern will be set at a hazard index of 1.0 for noncarcinogens.

Similar to the RESRAD approach, onsite soil action levels will be calculated for the two off-site exposure scenarios by using the fate and transport results to provide a ratio of onsite to offsite source concentrations.

2.5 Risk Characterization

Figure 1-3 shows the methodology for risk characterization for the DOE OUs. For each OU, the ratio between the OU-specific soil RME and the calculated action level will be calculated for each COCs. The sum of the ratios will then be multiplied by the risk level at which the action level was established, as a rough indicator of total risk for that OU. This procedure will be completed separately for chemical constituents and radionuclides, with the chemical constituents further grouped into carcinogens and noncarcinogens.

This approach will allow:

- Identification of chemicals NOT of significant concern at a given risk level within each OU (e.g. those chemicals with RME/action level ratios << 1).
- Identification of chemicals that drive the risk at a given risk level for each OU (represented by those chemicals with RME/action level ratios close to or greater than 1).
- Relative risk ranking of the DOE OUs, which may be used to make decisions regarding removal and/or remedial actions.

3. ECOLOGICAL RISK EVALUATION PROTOCOL

As part of the Risk Assessment for the LEHR site, an evaluation of the actual or potential effects of COCs from the site on plants and animals other than domesticated species will be conducted. The ecological evaluation will follow the current CAL-EPA DTCS Guidance for Ecological Risk Assessment (July 1996). This section includes the technical approach to conduct the scoping assessment portion of the ecological evaluation. In general, environmental data from the site will be evaluated to identify contaminants of potential concern in ecologically significant media. Based on this evaluation, conceptual environmental fate and transport models will be developed to identify probable migration process of the COCs from release sites and source media to exposure points in an exposure pathway assessment. Once the site characterization, biological characterization, and pathway assessment are complete, the scoping assessment will be complete, and decision criteria will be applied regarding the need to move to Phase I Predictive Assessment.

As necessary, in the Phase I Predictive Assessment, assessment endpoints will be selected using exposure pathway/food web analyses, biological characterization results, and the evaluation of the COCs. Measurement endpoints will be selected when assessment endpoints are not directly measurable. Functional groups and representative species may be used, where appropriate, in lieu of an evaluation of individual species. Finally, ecological impact and hazard on the selected assessment endpoints will be evaluated. The general approach to the Phase I Predictive Assessment is included below also.

A final baseline assessment, including both the Scoping Assessment and the Phase I Predictive Study, if necessary, will evaluate potential present or future ecological risks associated with environmental contamination, assuming that no cleanup or remediation activities will take place at the site. The results of this assessment may be utilized to evaluate the need for remediation and the potential environmental impacts from remediation activities.

3.1 Scoping Assessment

3.1.1 Site Characterization

3.1.1.1 Identification of Media of Environmental Concern

The data set to be used for the ecological evaluation will be the same as that used in the human health evaluation, with the exception that radionuclides will not be included in the ecological evaluation. Sampling data for each investigative area will be separated by environmental medium (i.e. ground water, surface/storm water, surface soil and subsurface soil).

Environmental media will be considered as ecologically significant if biota can be exposed to the media through direct contact, or if contaminants in that media have the potential to transfer to other media with which biota can come in contact. Data from the sampling of ground water, surface water, storm water, surface soil and subsurface soil represent the primary source of information concerning contamination at the site. Of these environmental media, surface/storm water, surface soil and shallow subsurface soil are considered as ecologically significant. Ground water will not be considered significant for the following reasons:

- Ground water levels at the LEHR site have been recorded to vary from 28 ft below ground surface (bgs) in winter to 48 ft bgs in summer (DOE, 1996). Due to the depth to ground water, it is not likely that direct uptake by native plants will be a significant exposure route.

- Putah Creek is a "losing" stream in the vicinity of the LEHR site therefore ground water beneath the site does not influence or discharge to the creek (DOE, 1996). Therefore, there is no complete exposure pathway for ground water to ecological receptors.

Surface water sample data is based on surface water sampling of Putah Creek. Surface water samples were collected from two sampling points in Putah Creek; one located upstream from the site and one located downstream. Surface water samples are also collected at the UCD treatment plant outfall.

Storm water sample data is based on the sampling of two storm water sampling points. Storm water sampling point SWL-1 is a lift station collection point on the west side of the site which discharges to Putah Creek. As this storm water discharges directly to Putah Creek, it will be considered in the assessment of surface water as a potential media of concern. A second storm water sampling point SWL-2 is a collection point which collects storm water from the central portion of the site from which it is routed to the SWL-1 lift station. As storm water from the central portion of the site, including the eastern side of the Animal Hospital Building and the area near the Wester Dog Pens, is routed to the lift station, storm water itself will not be considered as a potential media of concern for this ecological risk assessment. However, since stormwater runoff represents the source term for contaminants from the site transporting to Putah Creek, it will be used to identify COCs in the creek, as described in Section 2.

Media of concern will be defined as environmental media containing COCss to which biota may be exposed or COCss in that media have the potential to transfer to other media with which biota may come in contact. The media of concern will be considered in the fate and transport analysis and the exposure pathway analysis.

The screening methodology for surface soil will be similar to that conducted from a human exposure standpoint. Surface soil is defined as the soil at ground surface (0 ft) to a depth of 3 ft below ground surface (bgs). This screening methodology will consist of determining a frequency of detection of all contaminants followed by an analysis of the background concentration of inorganic constituents in surface soil.

For subsurface soil, all substances detected in shallow subsurface soil samples collected from boreholes will be evaluated. Shallow subsurface soil is defined as 3 to 12 ft bgs; the portion of the soil column which is considered to be potentially accessible to biological receptors. The frequency of detection approach proposed for the screening of shallow soil samples is not considered appropriate for the evaluation of subsurface soil as combining contaminated and uncontaminated boreholes to estimate exposure potential might give an unreasonably low estimate of exposure. Similarly, an evaluation of all substances detected in surface/storm water samples will be conducted.

The RME concentrations of COCs detected in ecologically significant media at the site will be determined identically to the methodology in the human health evaluation.

If no organic COCss are identified and concentrations of inorganic constituents are at or below background concentrations for a particular media, that media will be dropped from further consideration in the exposure pathway assessment for ecological receptors for that OU.

3.1.1.2 Identification of Potential COCs by Media

The next step of the ecological risk assessment will be to identify those contaminants that may be of potential concern from an ecological perspective within each media. Ecologically significant contaminants are those contaminants that may pose a risk to nonhuman endpoints, such as vegetation and wildlife.

In the screening for ecological contaminants of potential concern, we will use the results developed for human exposure whenever possible. However, because direct exposure to ecological endpoints from the ecologically significant media is possible, all contaminants detected in these media will be screened. The screening for contaminants of ecological concern in environmental media will include not only the presence/absence of the contaminant in the medium but also the concentration of the substance, the spatial distribution of the substance in the media (e.g. whether contamination is present over an area large enough for reasonable occurrence of significant contact with biota) and whether the substance occurred in more than one ecologically significant media, thus increasing the chance of exposure of biota to the substance.

A list of potential COCs (COCss) will be developed based analytical data for various environmental media collected at the site including:

- Surface water
- Surface soil [0 to 3 ft. below ground surface (bgs)], and
- Shallow subsurface soil (3 to 12 ft bgs).

Information regarding potential COCss will be presented including the: 1) basis for inclusion as a COCs, 2) contaminated or potentially contaminated environmental media, and 3) potentially affected habitat.

If no organic chemicals of ecological concern in any media are identified and concentrations of inorganic constituents are at or below background concentrations for any environmental media in all OUs, a Scoping Assessment report will be prepared discussing these findings and conclusions and the ecological risk assessment process will be considered as concluded for the site, upon approval of the regulatory agencies. If organic COCss are identified and/or concentrations of inorganic constituents are identified at concentrations which are at or above background concentrations established for the site, the ecological risk assessment will proceed as discussed below.

3.1.1.3 Physical Setting

The physical and ecological characteristics of the LEHR site and vicinity will be evaluated and discussed to provide a basis for various components of the ecological risk assessment (i.e. biological characteristics, evaluation of potential fate and transport mechanisms, food web analysis, etc.)

The physical setting was described in section 2 above. Salient features to the ecological assessment have been reiterated or included below.

Topography and Drainage

The LEHR site is situated on gently sloping terrain with an average elevation of 50 ft above mean sea level. The land surface slopes to the east/northeast at approximately 5 ft/mile with a site-wide relief of about 2 ft (DOE, 1996).

In the western portions of the LEHR site, surface runoff drains to the south-southwest. Storm water from the paved area west of the dog pens and the southwest portion of the site, including both the Radium and Strontium Treatment Systems area and Southwest Trenches is collected in the storm water drainage system. The storm water is routed to the LEHR site storm water lift station and discharged to unlined ditches which flow to Putah Creek. Storm water in the eastern portion of the LEHR site, where the landfills and other UC Davis disposal units are located, percolates into the soil (DOE, 1996), with the exception of a stormwater ditch at the eastern edge of Landfill #3, which discharges to Putah Creek.

In the vicinity of the site, Putah Creek is a "losing" stream or a stream whose channel lies above the water table and contributes water to the zone of saturation. Therefore, water from Putah Creek may impact shallow ground water beneath the site, but not vice-versa (DOE, 1996).

The LEHR site lies outside the 100-year flood plain, which is bounded on the north by the Putah Creek levee.

3.1.2 Biological Characterization

3.1.2.1 Preliminary Evaluation

The LEHR site and adjacent areas lie within the Californian Floristic biotic province (Munz and Keck, 1968). A biotic province is defined as an area which "covers a considerable and continuous geographic area and is characterized by the occurrence of one or more important ecological associations that differ, at least in proportional area covered, from the ecological associations of adjacent provinces. In general, biotic provinces are characterized also by peculiarities of vegetation type, ecological climax, flora, fauna, climate, physiography, and soil" (Dice, 1943). The Californian biotic province encompasses the area of California west of the Sierra Nevada and the southern mountains. It includes the interior valleys and surrounding hills in the central and northern parts of the state, the southern coastal area, and the Coast Ranges south of San Francisco Bay (Munz and Keck, 1968).

Within each biotic province, a number of generalized habitats are present. Habitats are defined as assemblages of natural features of the landscape that are characterized by similar ecological factors such as vegetation, hydrology, pedology, and climate (Cheatham and Haller, 1975). For the purposes of this ecological risk assessment, vegetation will be used to delineate habitats.

Habitat types that have been described in the general vicinity of the LEHR site include agricultural crop and pasture land, ruderal/annual grassland, valley-foothill riparian woodland, riverine (South Fork of Putah Creek), and urban ornamental (UC Davis, 1996). The LEHR site lies mainly within grassland habitats with scattered oak woodland habitats.

Although no streams, wetlands, or vernal pools have been identified on the LEHR site, Putah Creek is an adjacent, high-quality riparian habitat which provides important nesting and foraging areas for raptors, deer , and other wildlife (DOE, 1996). Putah Creek is one of the largest streams draining the east Coast Range within the Sacramento River drainage. The South Fork of Putah Creek is located directly adjacent to the southern boundary of the LEHR site. In this reach of the stream, Putah Creek is a warmwater, intermittent stream (UC Davis, 1996). The riparian areas of the Yolo Basin serve as critical wildlife habitat for a number of special-status plant and animal species (DOE, 1996).

A biological characterization of the terrestrial and aquatic biological resources on and near the site will be conducted. A preliminary list of habitats, as well as plant and animal species known or suspected to occur in the vicinity of the site, will be compiled through a review of the following information sources:

- California Natural Diversity Data Base,
- California Native Plant Society's inventory of rare and endangered vascular plants of California,
- UC Davis Long Range Development Plan - Environmental Impact Report (EIR),

- UC Davis Wastewater Treatment Plant Replacement Project (WTPRP) EIR,
- Individuals knowledgeable about the site and surrounding areas, and
- Other appropriate and relevant literature.

The U.S. Fish and Wildlife Service and California Department of Fish and Game will be consulted for information regarding special status habitats and plant and animal species likely to be encountered in the vicinity of the site.

3.1.2.2 Identification of Potentially Impacted Habitat and Actual or Potential Ecological Receptors

A site field survey will be conducted to characterize and describe aquatic and terrestrial habitats and actual or potential ecological receptors at the site including:

- Identification of site-specific terrestrial and wetland habitats and their relative extent,
- Evaluation of off-site habitats within one mile that may be affected by site-related contamination or remediation activities
- Identification of wildlife areas, preserves, parks etc. within 1 mile of site.
- Identification of species and/or signs of species activity at the site (i.e. tracks, nests, burrows, etc.)
- Identification of special status species and habitats observed at or near the site
- Identification of types of communities present
- Identification of species indicative of normal functioning of ecosystem potentially present onsite

The survey will be conducted by walking parallel transects over the 12-acre site in accordance with DOE guidelines for a 100% pedestrian survey. The survey of terrestrial biological resources will be conducted by a botanist and vegetation/wetlands ecologist from Botanical Consulting Services, and wildlife biologist from Biosearch Wildlife Surveys. Adjacent lands will be surveyed to characterize the habitats present. All terrestrial and wetland habitats will be mapped and dominant species noted. Special-status plant and wildlife species will be searched for and if present, populations size will be enumerated and mapped. Both day and night-time wildlife surveys will be conducted.

A survey of aquatic habitats will be conducted in order to determine the potential for the occurrence of all target special-status fish and invertebrate species. Data recorded at the time of the survey will include creek flow volumes, substrate composition, channel stability, vegetative over-hang and other pertinent data.

The Environmental Assessment prepared for building D&D activities, as well as the UC Davis WTPRP EIR, indicated that no sensitive, rare, threatened, or endangered plants were observed at the LEHR site. However, a number of sensitive biological resources that may potentially be present at the site include: the valley oak, the valley elderberry, longhorn beetle, the giant garter snake, Swainson's hawk, the Northern harrier, the American white pelican, tricolored blackbird, the sandhill crane, the Long-billed curlew, the white-faced ibis, the great egret, the western snowy plover, and the burrowing owl. (PNNL, 1995). This information will be verified through the site survey.

Special-status species will be given particular consideration during the site biological survey and in the ecological risk assessment as a whole. Special-status species are defined for the purposes of this risk assessment as plants and animals that are legally protected under state and federal Endangered Species Acts , and species that are considered sufficiently rare by the scientific community to qualify for such a listing.

Special-status plants are species that fall in the following categories:

- Plants listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (50 Code of Federal Regulations (CFR) 17.12 listed plants and other proposed species notices in the Federal Registrar (FR);
- Plants that are candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (61 FR 40, Feb. 28, 1996);
- Plants listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 California Code of Regulations (CCR) 670.5);
- Plants listed under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 et seq.);
- Plants that meet the definitions of rare or endangered under CEQA (CEQA Guidelines Section 15380);

Special-status animals are species that fall in the following categories:

- Animals that are listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (50 CFR 17.11 listed animals and other proposed species notices in the FR;
- Animals that are candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (61 FR 40, Feb. 28, 1996);
- Species of concern to the U.S. Fish and Wildlife Service;

- Migratory nongame birds of management concern to the U.S. Fish and Wildlife Service;
- Animals listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 California Code of Regulations (CCR) 670.5);
- Animals that meet the definitions of rare or endangered under CEQA (CEQA Guidelines Section 15380);
- Animal fully protected in California under the California Fish and Game Code, Section 3511 (birds), 4700 (mammals), and 5050 (reptiles and amphibians).

3.1.2.3 Ecosystem Characterization

The results of the biological characterization will be used to characterize the ecosystems present on or near the LEHR site. This ecological characterization will include:

- Identification and evaluation of plant communities and habitats,
- Identification and evaluation of invertebrate and vertebrate animal populations and communities,
- Characterization of spatial and temporal distribution of ecological components (i.e. habitat distribution, home range areas, seasonal migration habits etc.),
- Assessment of ecosystem attributes influencing distribution and nature of contamination, and
- Evaluation of area activities unrelated to the site contamination with a potential to affect ecosystem components (i.e. domesticated animal grazing, development, etc.).

The ecosystem characterization will provide the basis for the ecological assessment.

3.1.3 Exposure Pathway Assessment

The objective of the exposure pathway assessment is to identify the potential for contact between environmental receptors and COCs in any medium and by any exposure route (DTSC, 1996). Both indirect and direct exposure pathways will be considered. All media (soil, water, and biota) will be considered unless it has been demonstrated that:

1. There are no contaminants of COCs in that media.

2. There is no transport mechanism for the contaminant to a point of exposure.

3. No point of contact exists for the contaminant and potential receptors; and/or

4. No exposure route exists at the point of contact.

An assessment of fate and transport mechanisms will be conducted for all contaminants of ecological concern in order to develop conceptual environmental fate and transport models. These conceptual models will be used to identify probable migration process of the COCs from release sites and source media to exposure points.

Potential contaminant migration processes will be delineated based on site characterization information and knowledge of chemical and physical properties specific to a particular environmental media and the particular contaminant of concern. For the COCss identified, physical and chemical parameters such as water solubility, volatility, and persistence, as wells as the toxicity of potential degradation products and the potential for bioaccumulation will be considered.

This assessment will be used to develop conceptual models to identify the probable migration processes of the COCss from the release sites and source media to selected exposure points. An exposure point is defined as a location where biological receptors may come in contact with one or more contaminated media. An exposure point will be presented as an assumption for each conceptual migration process to define a destination for contaminant transport.

If the chemical release site differs from the exposure point, a conceptual model will be used to address the potential intermedia migration processes at the site. The fundamental assumption that will be incorporated into the conceptual model(s) is that the COCss may migrate from the release media or other affected media. For example, COCss in soil may migrate to the atmosphere via resuspension of contaminated soil particles.

3.1.3.1 Identification of Potentially Complete Exposure Pathways

An exposure pathway includes, by definition: 1) a source and mechanism of chemical release to the environment, 2) an environmental transport media, 3) an exposure point, and 4) an exposure route. The potential for exposure for all biota which are present or potentially present at the site, as identified in the biological characterization, will be evaluated, with particular emphasis on rare and endangered species. To evaluate potential exposure , the following factors will be considered:

- Organisms that are actually or potentially exposed to contaminants at the site.
- Significant routes of exposure.

- Spatial and temporal scales of exposure (i.e. frequency and duration of exposure, seasonal and climatic variations in site conditions which might affect exposure).
- Site-specific geophysical, physical and chemical conditions affecting exposure.
- Physical and chemical characteristics of COCs which influence fate and transport.

Ideally, each species identified at the site would be individually considered in the exposure pathway analysis. However, the number of plant and animal species identified at or near the site are too numerous to make this approach practical. Therefore, the biota will be organized into major ecological functional groups for the purpose of exposure pathway analysis as discussed in Section 3.2.

The following potential exposure pathways by which biota may be exposed to contaminants of potential concern in environmental media will be evaluated, as appropriate:

Direct exposure pathways including:

- Uptake, accumulation, and transpiration of contaminants of potential concern by plants,
- Dermal contact with contaminated soil, sediment, or water,
- Ingestion of contaminated water,
- Ingestion of contaminated soil or sediment,
- Inhalation of contaminated airborne particles, and
- Inhalation of contaminated vapors present in surface and subsurface air by wildlife.

Indirect exposure pathways including:

- Ingestion of contaminants through food-chain links (i.e. vegetation or prey items containing COCs) (DTSC, 1996).

For indirect exposure routes, such as exposure through consumption of food items, particular consideration will be given to COCs with physical parameters which indicate a potential for persistence, bioaccumulation, and toxicity.

The potential significance of the various exposure pathways will be determined by comparing the areas of the site identified as containing COCss in environmental media to known plant or animal habitats.

A summary of the exposure pathway analysis for each habitat type identified on or near the site will be provided which identifies the most significant exposure pathway for the COCs and potential ecological receptors.

3.1.3.2 Food Web Analysis and Development of the Conceptual Site Model

A conceptual site model will be developed to determine how the COCss may affect ecological components of the site (NRC, 1986; U.S. EPA, 1992). The conceptual model will include descriptions of the ecosystem potentially at risk and the relationship between measurement and assessment endpoints (U.S. EPA, 1992).

In order to evaluate this relationship, as well as the potential for wildlife to be exposed to COCs as a result of food-chain links, a generalized food web will be constructed for the site. The food web will describe the structure of the biological community in terms of primary producers and multiple levels of consumers which describes the transfer of material and energy within the community (DTSC, 1996). Species may be combined into functional groups for the purposes of the food web analysis. The web will be constructed using the information obtained during the biological characterization using the methods in Cohen (1978).

The significant exposure pathways at the site for the major ecological functional groups, as well as the ecological significance of the COCs will be considered in selecting a portion of the food web for quantitative modeling of ecological exposure and hazard.

During the development of the site conceptual model, a preliminary analysis of the ecosystem, characteristics of the COCss and ecological effects will be used to define possible exposure scenarios. As suggested by U.S. EPA guidance (1992), each exposure scenario will be defined in terms of the following factors:

- The stressor (in this case, the contaminants of ecological concern),
- The type of biological system and principal ecological components,
- How the COCss will contact or interact with the ecosystem, and
- Temporal and spatial scales.

Temporal and spatial scales used to evaluate the stressor (COCss) will be compatible with the characteristics of the ecological component of interest.

As the stressors are chemical in nature, development of exposure scenarios will take into consideration the source of contamination, environmental transport mechanisms, partitioning of the COCss among various environmental media, chemical/biological transformation or speciation processes, and identification of potential routes of exposure (U.S. EPA, 1992).

In the conceptual site model, the significant exposure routes will be indicated with the site-specific representatives of the different functional groups associated with decomposers, primary producers, primary consumers and upper level consumers (DTSC, 1996).

By integrating the potentially complete exposure pathways with the potentially exposed ecological receptors, the conceptual site model will be used to focus the ecological risk assessment on critical ecological components and functions (DTSC, 1996).

3.1.4 Scoping Results and Decision Criteria

The steps outlined in the section above complete the Scoping Assessment. Based upon the results of the scoping assessment, a decision will be made as to whether a Phase I Predictive Assessment will be necessary. That decision will be made in conjunction with the RPMs for the site. According to CAL-EPA DTSC guidance, "it may not be necessary to conduct an assessment beyond the Scoping Phase if either of the following conditions are met:

1. The scoping assessment demonstrates that both the site and areas actually or potentially impacted by the site are not significantly utilized by biota and do not contain significant wildlife habitats, or

2. There are no actually or potentially complete exposure pathways."

Otherwise, a Phase I Predictive Assessment will be completed.

3.2 Phase I Predictive Assessment

Based on the amount of data available from earlier studies and the preliminary results of the biological survey, discussed in section 3.1 above, DOE believes it possible that the results of the scoping phase will indicate that a Phase I Predictive Assessment will be necessary. Therefore, included below is the methodology that will be followed to complete the analysis.

3.2.1 Estimation of Ecological Exposure Point Concentrations

Based on the evaluation of potential intermedia transport processes and ecological exposure media for potential ecological receptors, we will identify potential and/or actual ecological exposure points. The ecological exposure point concentrations will be estimated for each exposure pathway at the point of exposure . The exposure point concentrations will then be used to estimate the magnitude of exposure to contaminants in the risk assessment as discussed below. The RMEs for the contaminants of potential concern in surface water, surface soil, and subsurface soil will be considered as the exposure point concentration for incidental/direct ingestion by wildlife.

3.2.2 Selection of Assessment Endpoints

Endpoints are characteristics of an ecological component that may be affected by exposure to a stressor (i.e. COCs) (U.S. EPA, 1992). An assessment endpoint is an explicit expression of the actual environmental values that are to be protected (U.S. EPA, 1989a, 1992).

The assessment endpoints selected will meet the following criteria as specified by the U.S. EPA guidance (1989a, 1992):

- Have societal relevance
- Have biological or ecological relevance
- Have an unambiguous operational definition
- Be measurable or predictable, and
- Be susceptible to hazard.

In ecological assessments where endangered species are not involved, plants and animals are typically not valued biologically as individuals, therefore the assessment endpoints are often entire populations or communities (U.S. EPA, 1989a). Populations are particularly relevant assessment endpoints as they are the building blocks for higher biological organizational units such as communities and ecosystems (Pianka, 1983). Thus impacts on populations may be translatable to impacts on communities and ecosystems. Populations and their attributes are more easily measured and predicted based on the component individuals compared to communities and ecosystems (U.S. EPA, 1989a). The most appropriate assessment endpoints are often valued populations such as crops, trees, fish, birds or mammals (U.S. EPA, 1989a). For these reasons, populations that meet the criteria discussed above may be selected as assessment endpoints. Other populations that are not socially valued may be included in the ecological assessment if it is demonstrated that they are particularly susceptible are linked to valued species or other valued environmental attributes (U.S. EPA, 1989a). Endangered species and economically important species are particularly valued by society, therefore individuals may be considered as the assessment endpoint.

Each assessment endpoints selected will have an operational definition so they can be related to a measurable effect or measurement endpoint. The assessment endpoints will specify an entity (e.g. a particular vertebrate population) and a characteristic (e.g. reduction in population abundance) (U.S. EPA, 1989a). Finally, the assessment endpoint(s) will be selected based on the exposure pathway/food web analysis, the conceptual site model, the determination of the presence of threatened or endangered species, and the evaluation of the ecological significance of the contaminants of potential concern.

3.2.3 Evaluation and Selection of Functional Groups and Representative Species

As it may not be practical to individually evaluate the effects of COCss on every potentially affected species, functional groups may be used to represent various species which may be exposed to contamination at the site (DTSC, 1996). If utilized, these functional groups will be based on function within the ecosystem, potential for exposure to various media, and physiologic and taxonomic similarities (DTSC, 1996). Representative species may be selected to represent the functional groups being evaluated.

As suggested by DTSC guidance (1996), the criteria used to select the representative species will include:

- Sensitivity of the representative species to the COCss
- Availability of data for the representative species
- Relationship of the representative species to the assessment endpoint(s)
- Consistency of the exposure scenarios with the species or functional group being evaluated.
- Availability of toxicity data
- Societal value
- Species status (threatened or endangered).

Additional factors that will be considered in evaluating potential functional groups and representative species for aquatic biota include:

- The type of contaminated media present in the aquatic environment which could present a potential threat to aquatic organisms.
- Ecological niche of the aquatic biota present at the site. Both benthic and pelagic organisms, as well as aquatic plants, will be considered in the evaluation and selection of representative species.
- Physiological, behavioral and/or developmental endpoints will be considered in addition to mortality in the evaluation of toxic endpoints.

3.2.4 Selection of Measurement Endpoints

Although assessment endpoints are the ultimate focus in risk characterization, in most cases, the assessment endpoint is not directly measurable. Therefore, a measurement endpoint may be selected that can be related either qualitatively or quantitatively to the assessment endpoint.

A measurement endpoint is defined as a quantitative expression of an observed or measured effect of a stressor (U.S. EPA, 1989a). It is a measurable response to a stressor that is related to the valued characteristic chosen as an assessment endpoint (U.S. EPA, 1992). As specified by the U.S. EPA (1989a, 1992), the measurement endpoints selected for use in the ecological risk assessment will:

- Correlate to or be predictive of an assessment endpoint,
- Be consistent with assessment endpoint exposure scenarios
- Be readily measured,
- Be appropriate to the scale of the site,
- Be appropriate to the exposure pathway,
- Be appropriate to the temporal dynamics,
- Have low natural variability,
- Be diagnostic of the pollutants of interest,
- Be broadly applicable,
- Be standardized, and
- Utilize existing data.

The ecological risk assessment for the LEHR site will be based primarily on the single effect and exposure value comparison approach or "Quotient Method" as described by Barnthouse *et al.*, (1986). In this approach, single values selected from ARARs or toxicity criteria data for the representative species will be compared to predicted or measured levels of the COCss to derive toxicity and hazard quotients which will be used to evaluate ecological risk. If endangered species are identified as potential ecological receptors for the site, individuals of the species may be considered as both the measurement and assessment endpoint, if appropriate. In this case, hazard or toxicity quotients would relate directly to the assessment endpoint.

Possible measurement endpoints may include hazard quotients (HQs) and hazard indices (HIs) (U.S. EPA, 1989b) for potential terrestrial receptors and toxicity quotients (TQs) (Barnthouse et al., 1986, Burmaster et al., 1991) for potential aquatic receptors.

The hazard quotient is used to represent a ratio between an estimated dose from ecological COCs to individuals within a given population and a reference dose or the dose above which an adverse effect is likely to occur which is derived from toxicological studies. A hazard index is the sum of the chemical-specific hazard quotients or the sum of the hazard quotients for chemicals acting by a similar mechanism or having the same target organism (DTSC, 1996).

The use of HI as a measurement endpoint for vertebrate populations is particularly advantageous. By carefully selecting the reference dose, the HI estimated for an individual can be qualitatively related to the assessment endpoint as reference doses can be selected to reflect potentially adverse affects (i.e. reduction in growth or fecundity) at the population level. Using site-specific data on contaminants of potential concern and values from literature concerning biological attributes of the assessment endpoints, exposure to the COCss can be estimated. By varying the frequency of contact with contaminants and the time spent in each area of contamination, spatial and temporal scales can be considered. The major disadvantage to the use of the HI is the sensitivity of the estimated HI to the assumptions concerning the individual organisms and the COCss.

A toxicity quotient (TQ) is defined, for the purposes of this assessment, as the direct ratio between a measured concentration of an ecological contaminant of potential concern in an abiotic environmental media (i.e. surface water) to a defined toxicological benchmark concentration for that media which is related to a specific biological effect (i.e. ambient water quality criteria or reference concentration) (Barnthouse et al., 1986, Burmaster et al., 1991).

For both a TQ and HI, a ratio above one indicates the potential for an adverse effect. The calculations of HQs, TQs, and HIs are discussed further in Section 3.8.1.1.2.

3.2.4.1 Review ARARs for Applicable or Relevant Numerical Criteria for COCss

A review will be conducted of available ARARs to determine if there are applicable or relevant numerical criteria for the ecological COCss. Ambient water quality criteria (AWQC) have been developed by the U.S. EPA for a number of COCs for aquatic systems (U.S. EPA, 1986). These criteria were developed to be protective of aquatic populations, as well as the populations which feed on these organisms to account for bioaccumulation (U.S. EPA, 1989c). These AWQC will be reviewed for applicability to selected aquatic representative species.

3.2.4.2 Selection and Use of Toxicity Data/Criterion

In the event that ARARs are not available for COCss for the representative species selected to evaluate the site, a review of applicable toxicity criteria for the representative species will be assessed. Applicable toxicity criteria to be reviewed will include Reference Concentrations and Reference Doses as discussed in Sections 3.7.2.1. and 3.7.2.2. The sources of these criteria selected and a discussion of the scientific basis for the criteria selected from the available data will be included (DTSC, 1996).

Available toxicity data will be evaluated relative the following factors:

- Relevance to assessment endpoints
- Data appropriateness
- Appropriate to exposure pathway
- Diagnostic of pollutants of interest (COCss)

- Sensitivity and response time
- Consideration of indirect effects
- Availability of existing data

The duration of exposure and the toxicity criterion will be matched as closely as possible, such as comparing chronic exposures to chronic toxicity endpoints (DTSC, 1996).

In the event that no data is available for the selected representative species and members of the same taxonomic families, a "surrogate" species may be selected from which to develop toxicity or exposure data. Data will be selected based on a balance of taxonomic and physiolgical similarities, quality of the data, and expected mode of toxic action (DTSC, 1996). The surrogate species data will be used to estimate the No Observable Adverse Effects Level (NOAEL) in the representative species.

The assumption is made that adequate ARARs or toxicity criteria will be available for the representative species selected to evaluate ecological risk without conducting bioassays or toxicological studies for the site.

Selection of Reference Concentrations for Aquatic Receptors

As suggested in DTSC guidance, a review of Reference Concentrations (RfC) based on chronic exposure for aquatic species will conducted from which appropriate RfCs will be selected for representative aquatic species. A RfC approach is generally used to evaluate exposure of aquatic receptors to contaminated water or sediment (DTSC, 1996). A reference concentration is defined a concentration in a specified medium, expressed in mg/kg, mg/L or mg/m^3 that is not expected to adversely affect biota exposed to that medium by all actual and potential pathways when biota are exposed for an extended period of time (DTSC, 1996).

The following DTSC recommended sources will be reviewed to determine RfCs for representative aquatic species:

- California Regional Water Quality Control Board-Central Valley Basin Plan.
- U.S. EPA Ambient Water Quality Criteria for Protection of Aquatic Life.
- National Oceanic and Atmospheric Administration (NOAA) Sediment Criteria.
- California DTSC Applied Action Levels for protection of aquatic life.

In addition, a review of the AQUIRE RfC database will be conducted.

In the absence of an established RfC for a particular COCs in an environmental medium, RfCs for other medium may be adapted to the medium of concern by utilizing the partition

coefficient between the two media (DTSC, 1996). If criterion for another medium is not available, the RfC may be derived either from published toxicity data to develop the toxicity criterion (DTSC, 1996). Uncertainty factors will be used to adjust for deficiencies in the available toxicity database. These deficiencies, as outlined by DTSC (1996), may include:

- The RfC is based on studies which do not consider exposure via the food chain when that pathway would contribute significantly to total exposure.
- The RfC is based on studies which are of insufficient duration to have achieved the maximum tissue concentration and/or toxic effect.
- The RfC is based on data from a range of species which does not include the species or closely related species, to which it is to be applied.
- The RfC is based on studies which do not evaluate sufficiently sensitive endpoints (i.e. the utilization of a mortality endpoint rather than a reproductive endpoint).
- The RfC is based on studies which lack adequate control and documentation of exposure.

Selection of Reference Doses for Terrestrial Receptors

A review of Reference Doses (RfD) based on exposure for terrestrial representative species will conducted from which appropriate RfDs will be selected for representative aquatic species. A reference dose is defined as a daily dose, expressed in mg/kg, that is not expected to adversely affect biota (DTSC, 1996). The RfD methodology is considered as appropriate for terrestrial species due to the potential for multi-media, multi-pathway exposure for terrestrial biotic receptors (DTSC, 1996). Through careful selection of the RfD, the hazard estimated for an individual terrestrial representative species can be qualitatively related to the assessment endpoint.

Depending on the availability of data from which to assess the effects of contaminants on terrestrial aquatic receptors, human health literature may be used to develop appropriate RfDs for vertebrate wildlife populations. In this case, the mean lowest observable adverse effects levels (LOAELs), and when available, no observable adverse effects levels (NOAELs), will be used as a benchmark for determining when hazards to biological receptors may exist. The U.S. EPA IRIS (Integrated Risk Information System) database and the U.S. EPA HEAST (Health Effects Assessment Summary Tables) will be reviewed for appropriate studies citing LOAELs and NOAELs. When possible, studies will be selected which consider reproductive and developmental effects.

If terrestrial plants are identified as potential ecological receptors, a RfC approach, rather than the RfD approach, will be used to evaluated hazard.

3.2.5 Ecological Risk Characterization

The risk characterization will compare estimated exposure via all pathways with the selected toxicity criteria including discussion of uncertainty and the probability of adverse effects at the calculated exposure level (DTSC, 1996).

3.2.5.1 Assessment of Ecological Risk

In order to assess ecological risk, the results of the measurement endpoint analysis will be qualitatively evaluated to determine the potential hazard to the assessment endpoints by calculating hazard or toxicity quotients and hazard indices. The relationship between the measurement endpoints and the assessment endpoints will be discussed. When an assessment endpoint can be directly measured, the measurement and assessment endpoint are the same (U.S. EPA, 1992).

A hazard quotient or toxicity quotient will be calculated for each complete exposure pathway for each representative species under evaluation (DTSC, 1996). A toxicity quotient (TQ) is defined, for the purposes of this assessment, as the direct ratio between a measured concentration of an ecological contaminant of potential concern in an abiotic environmental media (i.e. surface water) to a defined toxicological benchmark concentration for that media which is related to a specific biological effect (i.e. ambient water quality criteria or RfC) (Barnthouse et al., 1986, Burmaster et al., 1991). A TQ above one indicates the potential for an adverse effect.

A chemical-specific TQ will be calculated for aquatic species using the RME concentration of a contaminant of concern in surface water and the RfCs as follows:

TQ = RME concentration of COCs in surface water/AWQC or RfC.

A chemical specific HQ for each exposure pathway will be calculated using the exposure results and the RfDs (SWRI 6-65) as follows:

HQ = chemical-specific total intake by specific media pathway (TDE_i = total daily exposure for pathway i)/RfD

In order to estimate the total exposure to wildlife species from the COCss, the general equation to be used is:

$$TDE_i = \frac{[Cem * Ir * Fab * Fte]}{BW}$$

where

TDE_i = total daily exposure for pathway i (oral or inhalation pathway in mg/kg•d,

Cem = concentration of COCs in exposure media (in mg/m3, or mg/kg),

Ir = intake rate of exposure media (in m3/d, mg/d or L/d) (Daily intake rates for various exposure media (air, food, water, and soil) will be obtained from appropriate literature).

F_{ab} = fraction of contaminant intake which is absorbed (to be used if data shows that absorption by the exposure route in question is a fraction of that by the route for which the RfD was determined).

Fte = fraction of time animal is in contact with exposure media (approximated as the ratio of the home range area to the area of the site-specific appropriate habitat.);

BW = body weight (in kg).

Hazard quotients for each COCs for all exposure pathways will be added to determine a hazard index (HI) for each species. Hazard indices are considered to be additive between chemicals when the chemicals have a mechanism of action or target organ in common (DTSC ,1996). Since hazard indices are intended to be a conservative estimate of potential hazard, HIs of less than one for each chemical mechanism of action or target organ are fairly good indications that adverse effects on assessment endpoints are unlikely (DTSC ,1996). Where the HI exceeds one, the species will be evaluated for potential population effects from the COCss.

3.2.5.2 Relationship of measurement endpoints to assessment endpoints

Where the assessment endpoint is not directly measurable, the qualitative or quantitative relationship between measurement endpoint and assessment endpoint will be discussed.

In certain instances, such as for special-status species where the individual may be considered as both measurement and assessment endpoint, the calculate HI relates directly to the assessment endpoint. As there is evidence in the literature documenting the hazard to aquatic populations when the federal AWQCs are exceeded (U.S. EPA, 1986; 1989c), the toxicity quotient is considered to be reasonably predictive of the assessment endpoint. Where the measurement endpoint and assessment endpoint are not considered as the same, the relationship will be evaluated and discussed.

3.2.5.3 Description of Ecological Risk

The description of ecological risk will include a summary of the ecological risk and uncertainties analysis. The interpretation of ecological significance will describe the magnitude of the identified risk to the assessment endpoint(s) (U.S. EPA, 1992). A summary of the results of the risk estimation as well as the uncertainties associated with the problem formulation, analysis and risk characterization will be presented (U.S. EPA, 1992).

An interpretation of the ecological significance will be presented which relates the risk estimates to the types and extent of anticipated effects including a discussion of:

- Nature and magnitude of effects,
- Spatial and temporal patterns of effects, and

- Recovery potential.

As the risk assessment is likely to involve evaluating the effects of COCss on several ecosystems on or near the site, the types of effects associated with each ecosystem and where the greatest impact is likely to occur will be discussed. The magnitude of the effect will also be evaluated within the context of the ecosystem component affected and the likelihood of the effect occurring (U.S. EPA, 1992).

The spatial distribution (extent of the area where the stressor is likely to occur) and the temporal distribution (duration of the effect due to the persistence of the stressor and how often it is likely to occur in the environment) of the effect will be evaluated relative to ecological significance.

If appropriate, an discussion of recovery potential or ability of the ecosystem to recover from the effects of the stressor (COCss) will be included.

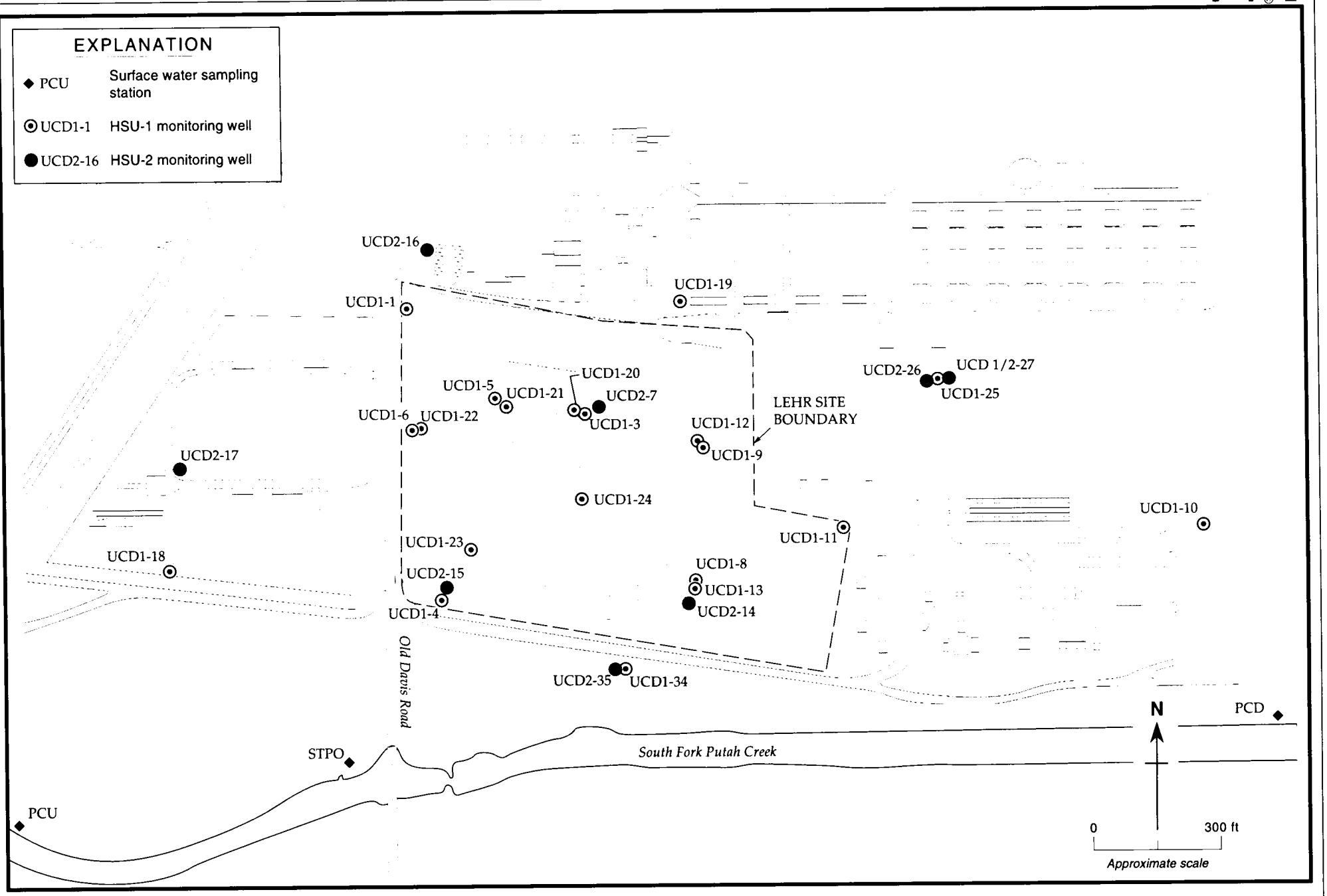

Figure 1-2. Monitoring Well and Surface Water Monitoring Locations, LEHR Site, Davis, California

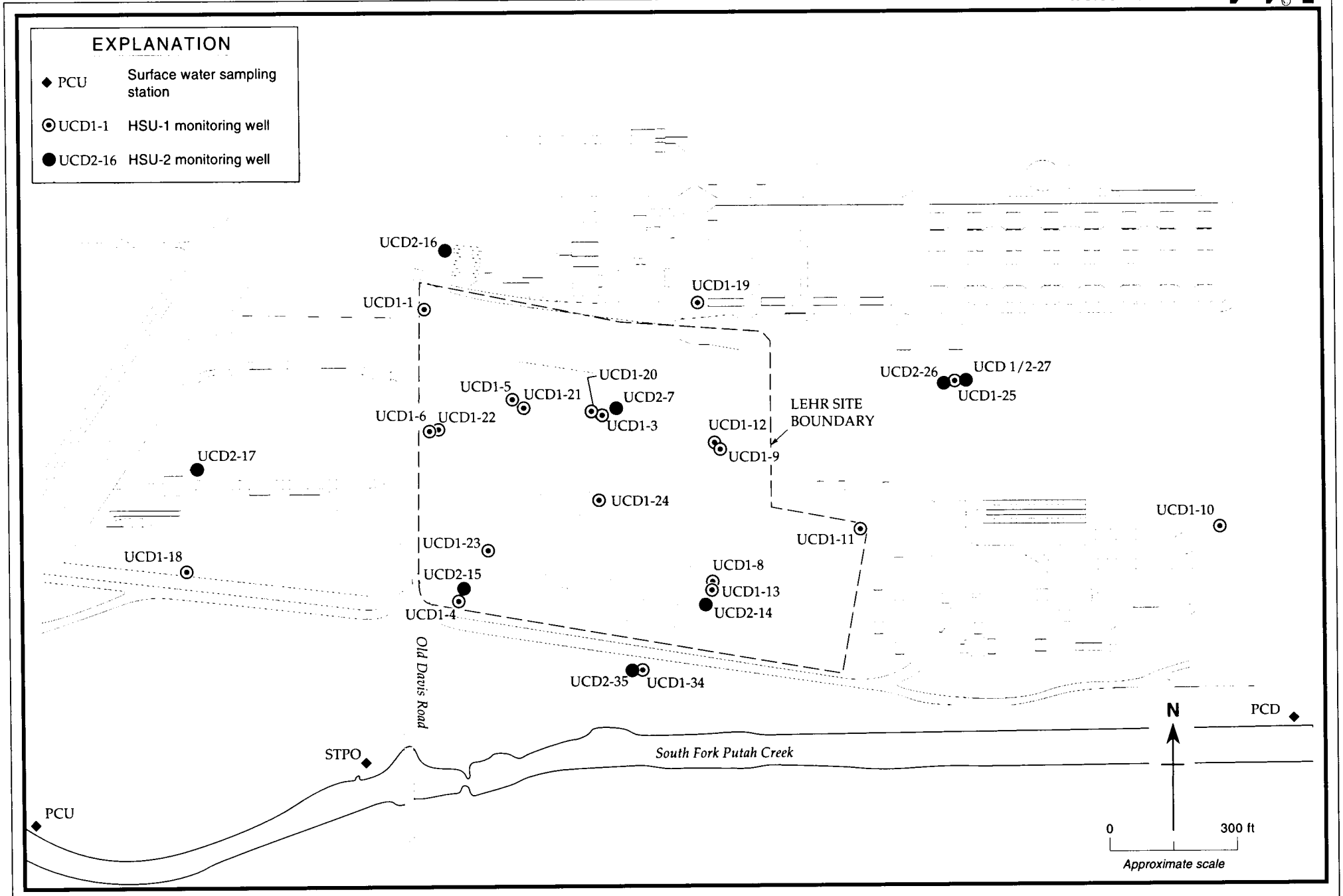

Figure 1-2. Monitoring Well and Surface Water Monitoring Locations, LEHR Site, Davis, California

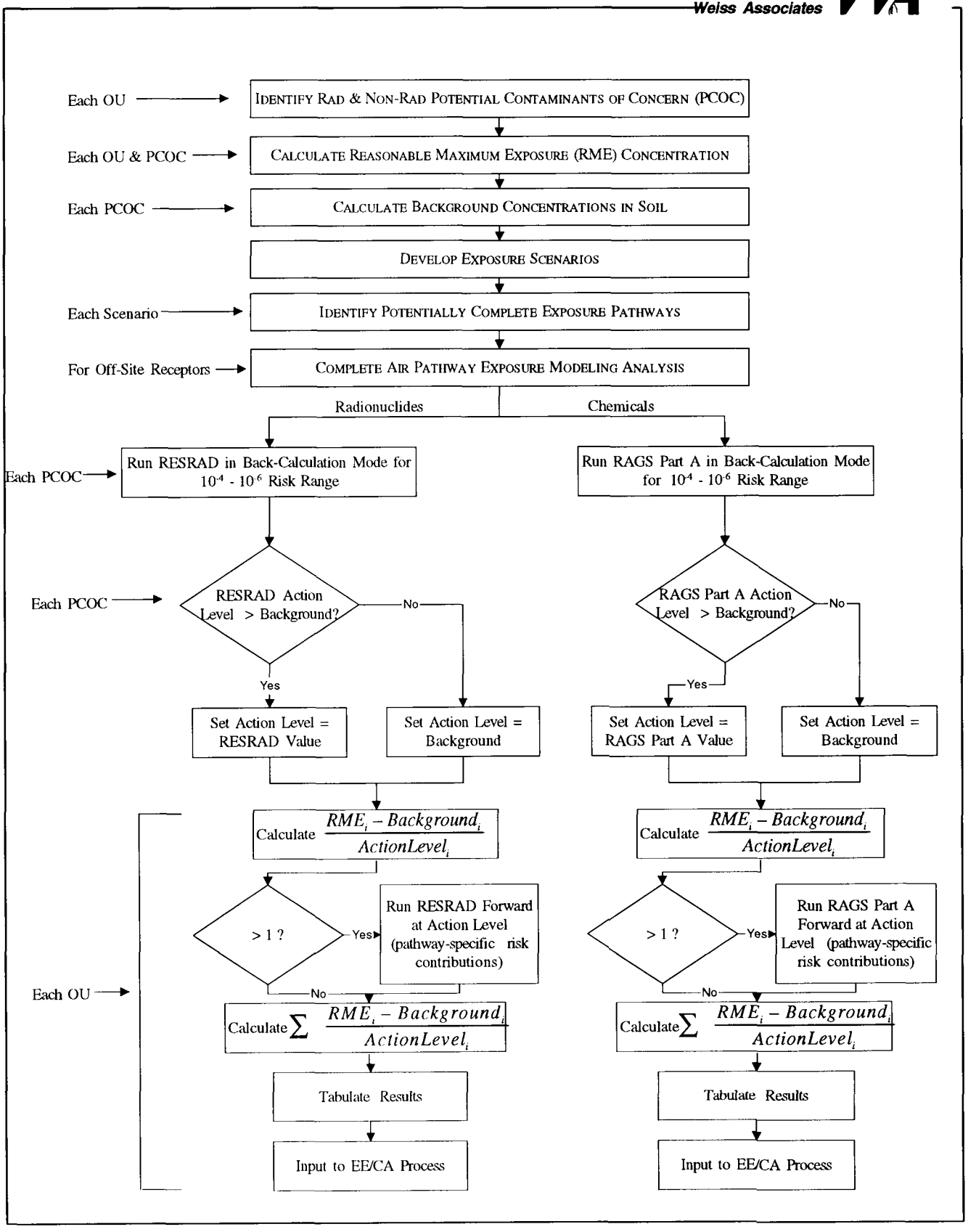

FIGURE 1-3. DOE LEHR SITE GENERAL APPROACH TO DEVELOP SOIL ACTION LEVELS FOR RADIONUCLIDES & CHEMICAL CONSTITUENTS

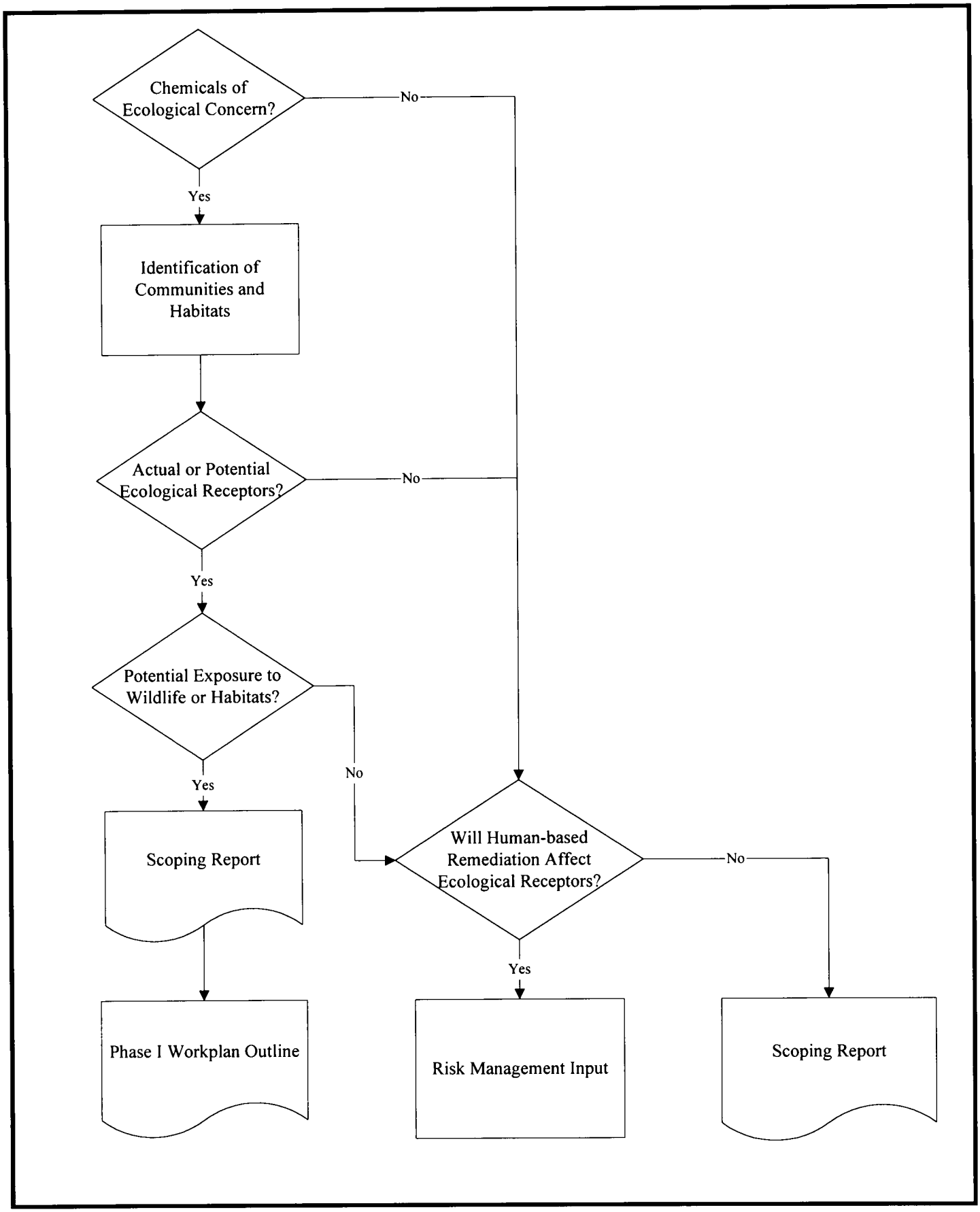

Figure 1-4 Ecological Scoping Assessment Flowchart, LEHR Facility, Davis, CA.

Source: Guidance for Ecological Risk Assessment CAL-EPA July 1996.

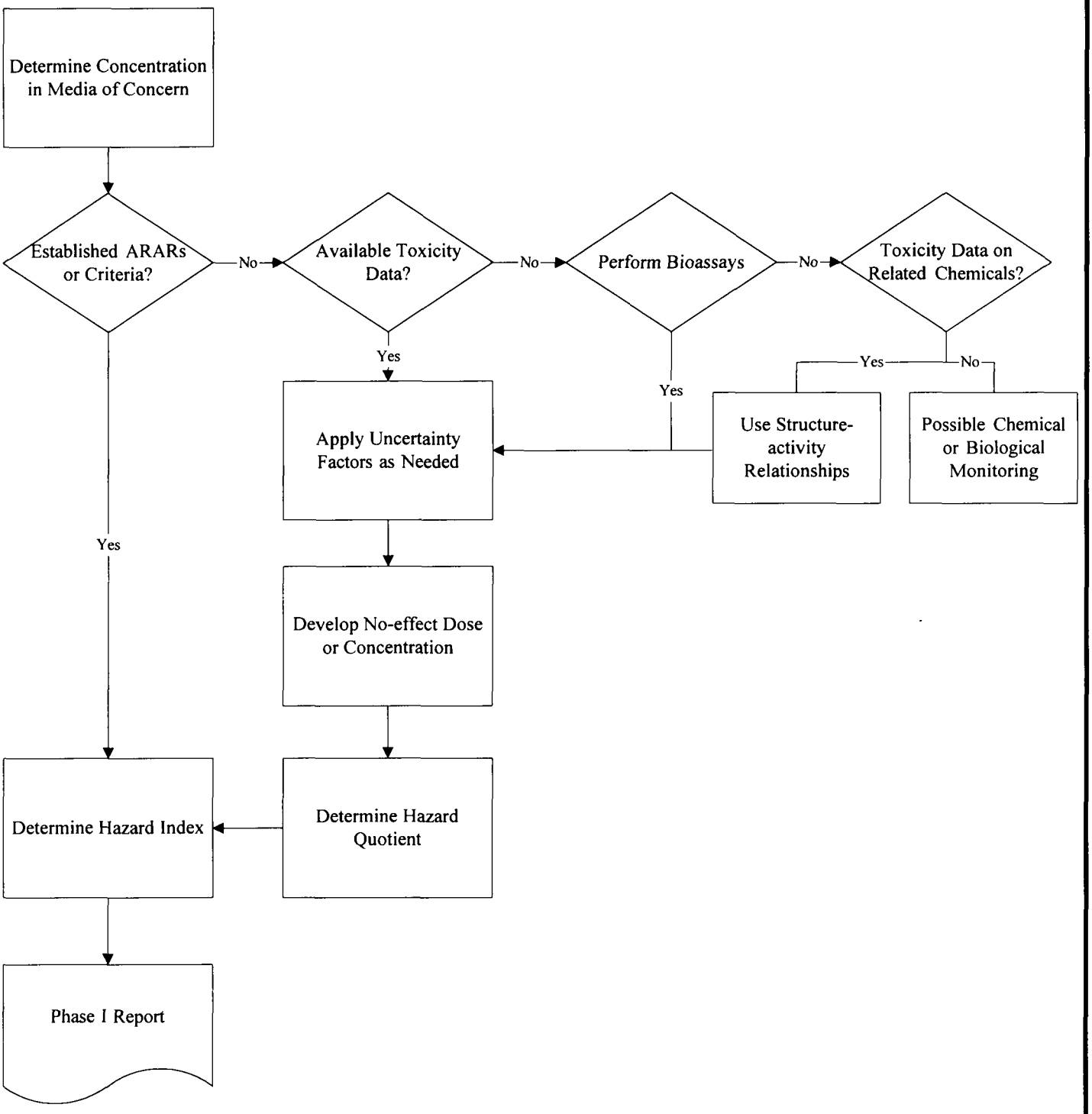

Figure 1-5 Phase I Predictive Assessment Flowchart. LEHR Facility, Davis CA.

Source: CAL-EPA July 1996.

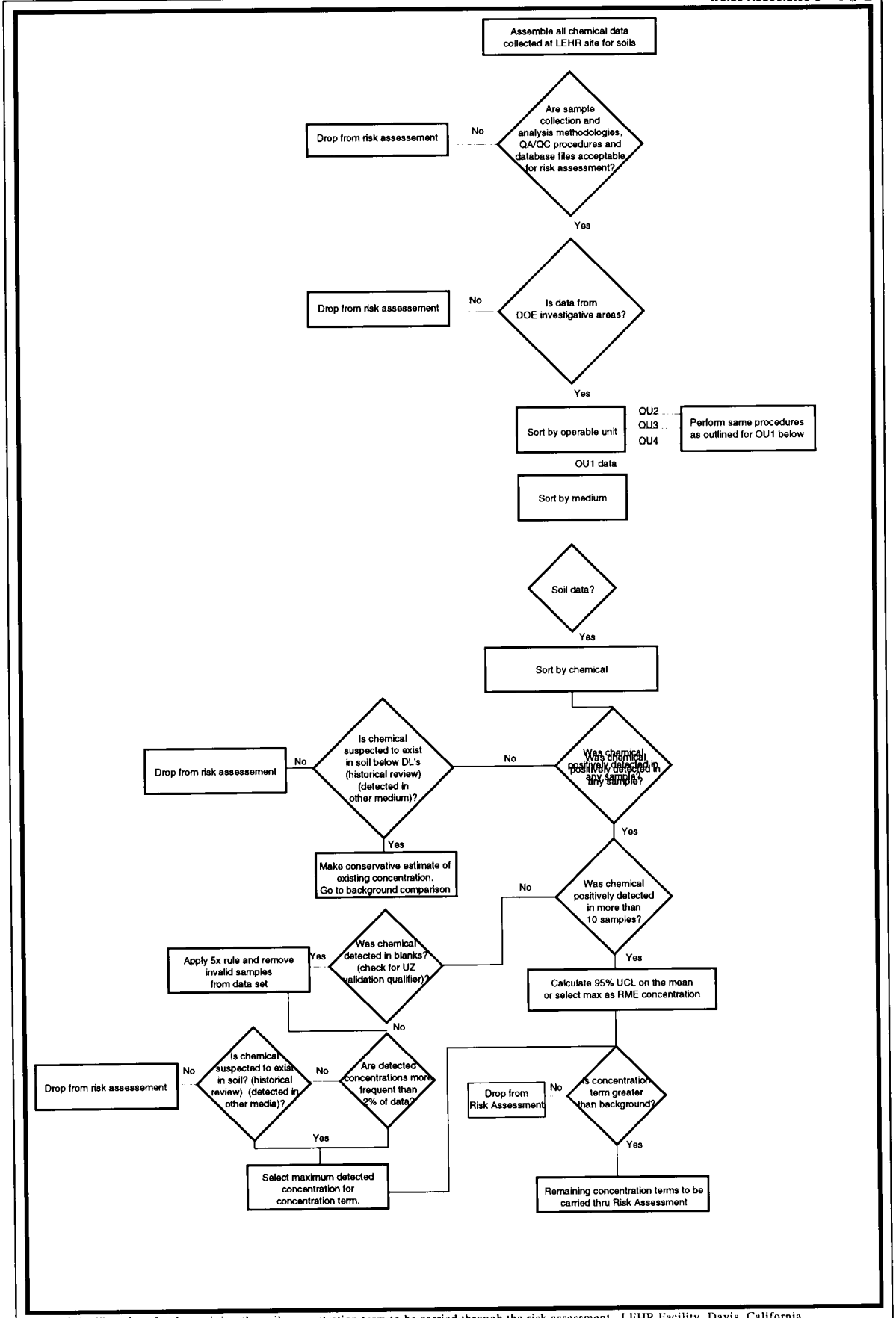

Figure 2-1. Flowchart for determining the soil concentration term to be carried through the risk assessment. LEHR Facility, Davis, California.

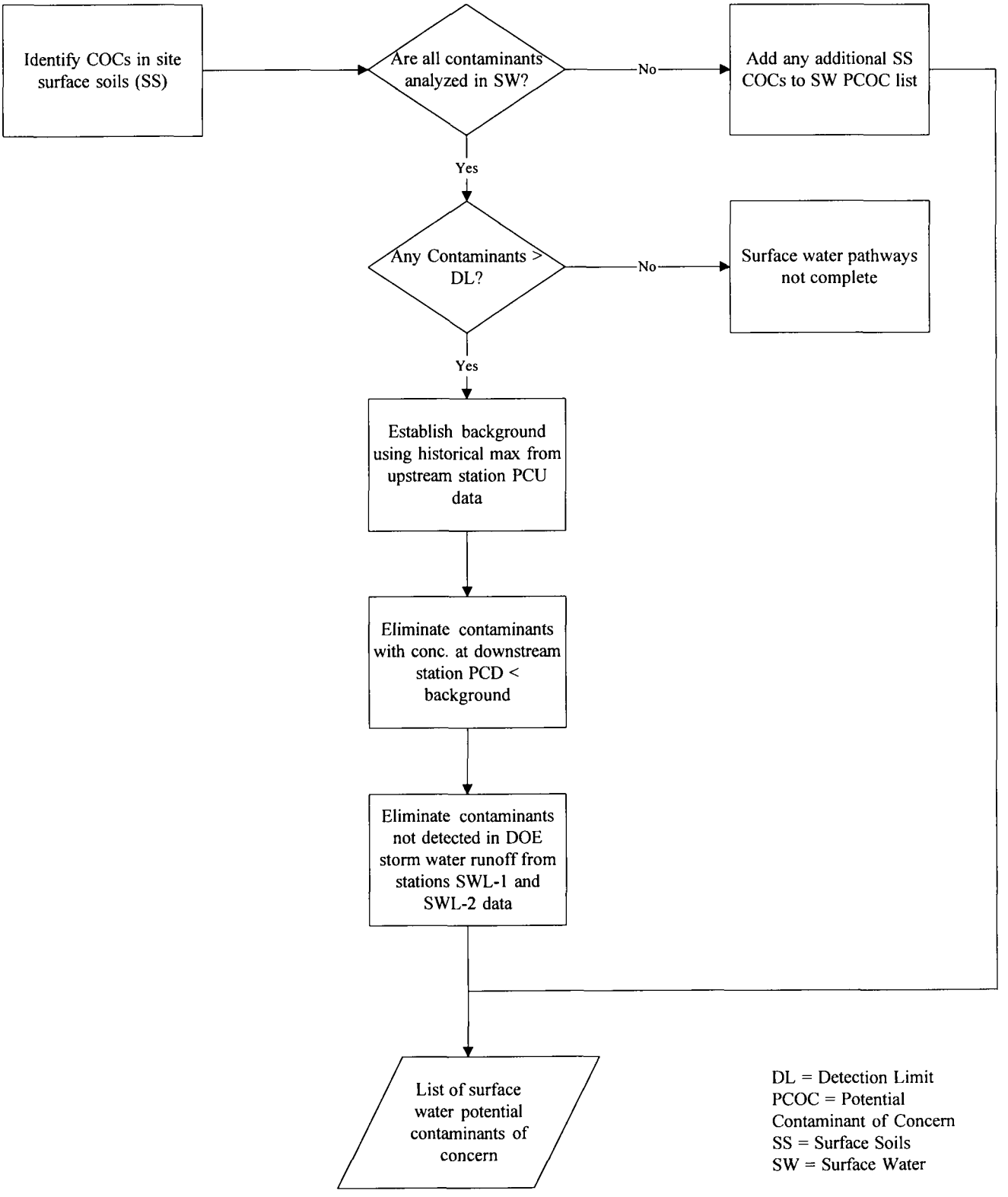

Figure 2-2. Flowchart to Identify Surface Water Potential Contaminants of Concern (PCOCs)

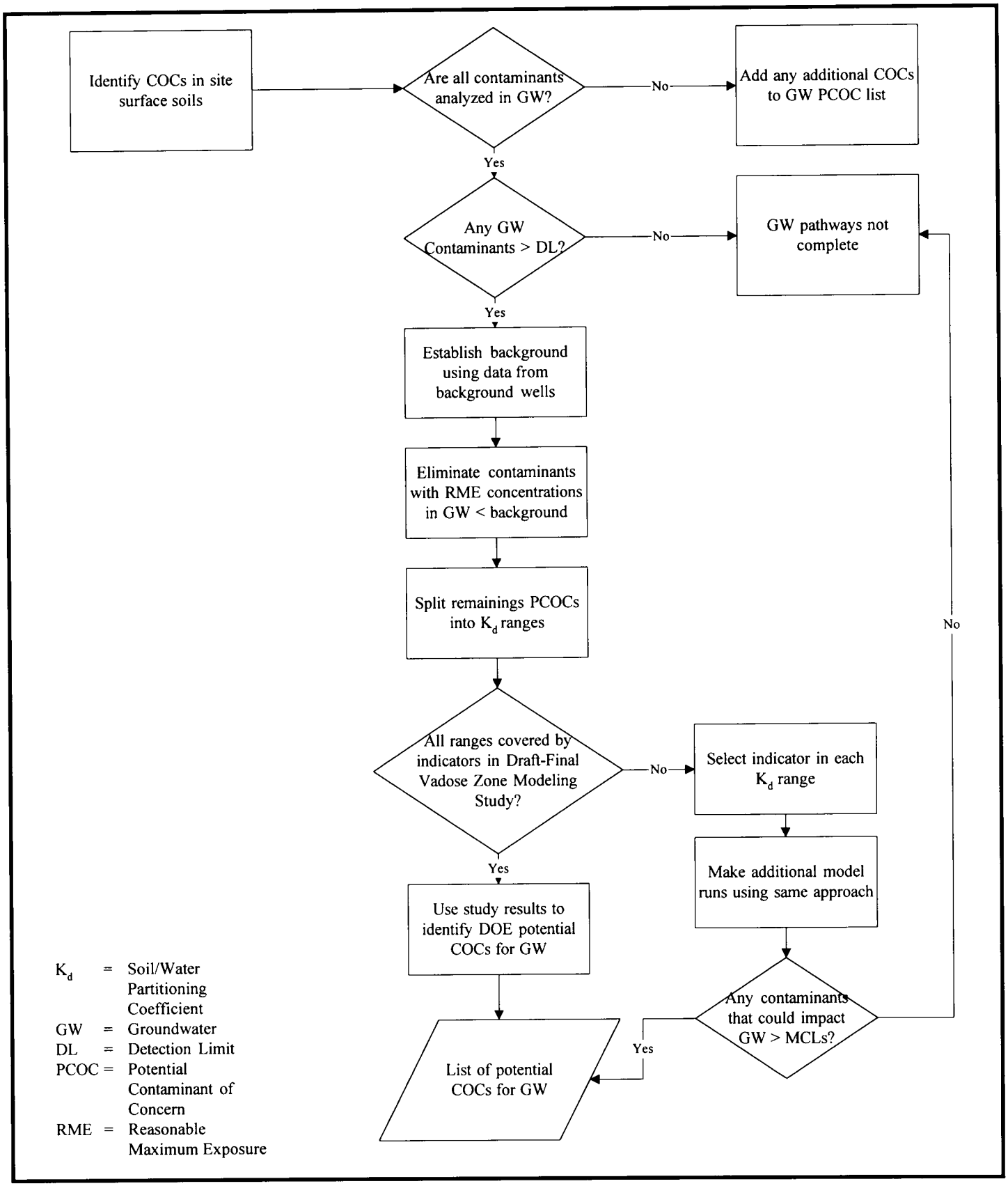

Figure 2-3. Flowchart to Identify Groundwater Potential Contaminants of Concern. LEHR Facility, Davis, CA.

Figure 2-4. Exposure Pathways Analysis
Scenario #1: Research Scenario

Source	Transport Mechanism	Exposure Route	Pathway Complete?	Rationale
Soil Contamination	Direct Contact	Dermal Exposure	Yes	Assumed dermal exposure to soil.
		Direct Ingestion	Yes	Assumed direct ingestion of soil.
	Via Saturated/ Unsaturated Zone	Groundwater Ingestion	No	Workers assumed not to ingest water from impacted wells (municipal drinking water supply, no onsite wells).
	Via Subsurface Diffusion/Volatilization	Inhalation of VOC's	Yes	Assumed volatilization of subsurface volatiles to surface.
	Via Air Pathway	Inhalation of Particulates	Yes	Assumed inhalation of particulates.
		Deposition with Dermal Exposure/Direct Ingestion	No	Evaluated under direct contact above.
		Deposition with Impacted Food Ingestion.	No	Workers assumed not to ingest food obtained through farming activities at the site.
	Via Surface Runoff	Ingestion Via Surface Water	No	Workers assumed not to ingest water from Putah Creek or other surface water.
		Dermal Exposure Via Surface Water	No	Workers assumed not to contact surface water for research activities.
		Aquatic Food Ingestion	No	Workers assumed not to ingest aquatic food from Putah Creek.
Direct Surface Water Contamination	Direct contact	Surface Water Ingestion	No	Workers assumed not to ingest water from Putah Creek or other surface water.
		Surface Water Dermal Exposure	No	Workers assumed not to contact surface water for research activities.
	Via Volatilization and Air Transport	Inhalation of VOC's	No	Workers not in direcct proximity to Putah Creek.

Figure 2-4. Exposure Pathways Analysis
Scenario #1: Research Scenario

Source	Transport Mechanism	Exposure Route	Pathway Complete?	Rationale
Ground Water Contamination	Saturated Zone Transport to Wells	Drinking Water Ingestion	No	Workers assumed not to ingest water from wells that may be impacted (municipal drinking water supply).
	Diffusion and Volatilization upward from Saturated Zone	Inhalation of VOC's	No	Inhalation of volatiles from the subsurface driven by soil concentration, not ground water.
	Saturated Zone Transport to Surface Water	Direct Recreational Contact	No	Workers assumed to spend recreational (non-working) hours away from LEHR site.
		Food Ingestion	No	Workers not assumed to ingest food (plants, milk, meat, fish) obtained from the site.
		Incidental Ingestion	No	Workers not in direct contact with Putah Creek.

Notes:
Yes = Pathway is Complete
No = Pathway is Incomplete
NA = Not Applicable

Figure 2-5. Exposure Pathways Analysis
Scenario #2: East Residential Farm Scenario

Source	Transport Mechanism	Exposure Route	Pathway Complete?	Rationale
Soil Contamination	Direct Contact	Dermal Exposure	No	Resident assumed not to cross LEHR site boundary and contact source soil directly.
		Direct Ingestion	No	Resident assumed not to cross LEHR site boundary and ingest source soil directly.
	Via Saturated/ Unsaturated Zone	Groundwater Ingestion	Yes	Groundwater ingestion from residential well assumed. Pathway complete ONLY for those chemicals present in groundwater, present in DOE OU site soils, and which could impact groundwater at concentration > MCLs (see Figure 2-3).
	Via Subsurface Diffusion/Volatilization	Inhalation of VOC's	No	Off-site deposition of particulates will result in surficial soil contamination only. Air monitoring at perimeter monitoring stations has not shown any significant levels of volatiles.
	Via Air Pathway	Inhalation of Particulates	Yes	Assumed off-site transport of particulates generated on-site.
		Deposition with Dermal Exposure/Direct Ingestion	Yes	Assumed off-site transport and deposition of particulates followed by direct exposure. Pathway not complete for volatiles.
		Deposition with Impacted Food Ingestion	Yes	Assumed off-site transport and deposition of particulates, followed by food pathway uptake. Pathway not complete for volatiles.
	Via Surface Runoff	Incidental Ingestion of Surface Water	Yes	Incidental ingestion while swimming assumed possible. All SW pathways complete only for those contaminants present downstream of LEHR site at concentrations greater than upstream, AND present in stormwater runoff from DOE OUs(see Figure 2-2).
		Dermal Exposure to Surface Water	Yes	Dermal contact during swimming assumed. This would represent a worst case for fishing exposure.
		Aquatic Food Ingestion	Yes	Residents assumed to ingest aquatic food from Putah Creek.

Figure 2-5. Exposure Pathways Analysis
Scenario #2: East Residential Farm Scenario

Source	Transport Mechanism	Exposure Route	Pathway Complete?	Rationale
Direct Surface Water Contamination	Direct contact	Surface Water Ingestion	No	Surface water potentially impacted via surface runoff only - evaluated above.
		Aquatic Food Ingestion	No	Surface water potentially impacted via surface runoff only - evaluated above.
		Surface Water Dermal Exposure	No	Surface water potentially impacted via surface runoff only - evaluated above.
	Via Volatilization and Air Transport	Inhalation of VOC's	No	Surface water potentially impacted via surface runoff only - evaluated above.
Ground Water Contamination	Saturated Zone Transport to Wells	Drinking Water Ingestion	Yes	Assumed drinking water well located at residence. Pathway complete only for those chemicals present in groundwater and DOE OU soils above background levels, and that could impact groundwater above MCLs (see Figure 2-3).
	Diffusion and Volatilization upward from Saturated Zone	Inhalation of VOC's	Maybe	Initial review indicates saturated zone transport, if significant, will occur in HSU2. Therefore, overlying HSU1 and soils may serve to mitigate upward volatilization to < significant levels.
	Saturated Zone Transport to Surface Water	Direct Contact	No	Putah Creek is a "losing" stream (WA 1997); therefore groundwater impacts (if any) will not impact surface water.
		Food Ingestion	No	Putah Creek is a "losing" stream (WA 1997); therefore groundwater impacts (if any) will not impact surface water.
		Incidental Ingestion	No	Putah Creek is a "losing" stream (WA 1997); therefore groundwater impacts (if any) will not impact surface water.

Notes:
Yes = Pathway is Complete
No = Pathway is Incomplete
NA = Not Applicable

Figure 2-6. Exposure Pathways Analysis
Scenario #3: South Residential Farm Scenario

Source	Transport Mechanism	Exposure Route	Pathway Complete?	Rationale
Soil Contamination	Direct Contact	Dermal Exposure	No	Resident assumed not to cross LEHR site boundary and contact source soil directly.
		Direct Ingestion	No	Resident assumed not to cross LEHR site boundary and ingest source soil directly.
	Via Saturated/ Unsaturated Zone	Groundwater Ingestion	No	Receptor located upgradient of site and across Putah Creek, which is a losing stream. Hydrology dictates no groundwater impacts from the site will occur at this location.
	Via Subsurface Diffusion/Volatilization	Inhalation of VOC's	No	Off-site deposition of particulates will result in surficial soil contamination only. Air monitoring at perimeter monitoring stations has not shown any significant levels of volatiles.
	Via Air Pathway	Inhalation of Particulates	Yes	Assumed off-site transport of particulates generated on-site.
		Deposition with Dermal Exposure/Direct Ingestion	Yes	Assumed off-site transport and deposition of particulates followed by direct exposure. Pathway not complete for volatiles.
		Deposition with Impacted Food Ingestion	Yes	Assumed off-site transport and deposition of particulates, followed by food pathway uptake. Pathway not complete for volatiles.
	Via Surface Runoff	Ingestion Via Surface Water	Yes	Incidental ingestion while swimming assumed possible. All SW pathways complete only for those contaminants present downstream of LEHR site at concentrations greater than upstream, AND present in stormwater runoff from DOE OUs(see Figure 2-2).
		Dermal Exposure to Surface Water	Yes	Dermal contact during swimming with surface water from Putah Creek assumed.
		Aquatic Food Ingestion	Yes	Residents assumed to ingest aquatic food from Putah Creek.

Figure 2-6. Exposure Pathways Analysis
Scenario #3: South Residential Farm Scenario

Source	Transport Mechanism	Exposure Route	Pathway Complete?	Rationale
Direct Surface Water Contamination	Direct contact	Surface Water Ingestion	No	Surface water potentially impacted via surface runoff only - evaluated above.
		Aquatic Food Ingestion	No	Surface water potentially impacted via surface runoff only - evaluated above.
		Surface Water Dermal Exposure	No	Surface water potentially impacted via surface runoff only - evaluated above.
	Via Volatilization and Air Transport	Inhalation of VOC's	No	Surface water potentially impacted via surface runoff only - evaluated above.
Ground Water Contamination	Saturated Zone Transport to Wells	Drinking Water Ingestion	No	Putah Creek is a "losing" stream (WA 1997); and groundwater flow is in the opposite direction, thererore no GW impacts at this location.
	Diffusion and Volatilization upward from Saturated Zone	Inhalation of VOC's	No	As above.
	Saturated Zone Transport to Surface Water	Direct Contact	No	Putah Creek is a "losing" stream (WA 1997); therefore groundwater impacts (if any) will not impact surface water.
		Food Ingestion	No	Putah Creek is a "losing" stream (WA 1997); therefore groundwater impacts (if any) will not impact surface water.
		Incidental Ingestion	No	Putah Creek is a "losing" stream (WA 1997); therefore groundwater impacts (if any) will not impact surface water.

Notes:
Yes = Pathway is Complete
No = Pathway is Incomplete
NA = Not Applicable

Table-1. Contaminants of Concern in Surface Soils, OU-1, LEHR Facility, Davis, California

Chemical	# Sampled	# Detected	Max []	Min []	Background	95% UCL	RME	UNITS
4,4'-DDD	6	3	240	19	NC	NC	240	UG/KG
Acetone	6	1	3	3	NC	NC	3	UG/KG
Alpha-Chlordane	6	5	800	21	NC	NC	800	UG/KG
Antimony	8	3	0.38	0.25	0.74a	NC	< BKG	mg/kg
Arsenic	8	8	7.2	1.7	10.5	NC	< BKG	mg/kg
Barium	8	8	200	39	284	NC	< BKG	mg/kg
Beryllium	8	7	0.47	0.24	0.78	NC	< BKG	mg/kg
Bis(2-Ethylhexyl)phthalate	8	2	100	23	NC	NC	100	UG/KG
Cadmium	8	1	0.28	0.28	0.46a	NC	< BKG	mg/kg
Chromium	8	8	230	24	223	NC	230	mg/kg
Chromium, Hexavalent (+6)	8	2	0.22	0.053	0.147	NC	0.22	mg/kg
Cobalt	8	8	24	4.4	33	NC	< BKG	mg/kg
Copper	8	8	62	8.3	60	NC	62	mg/kg
Formaldehyde	7	1	1.6	1.6	NC	NC	1.6	mg/kg
Gamma-Chlordane	6	5	740	25	NC	NC	740	UG/KG
Iron	8	8	40000	6300	45000	NC	< BKG	mg/kg
Lead	8	8	21	1.8	11.5	NC	21	mg/kg
Manganese	8	8	880	150	785	NC	880	mg/kg
Mercury	8	8	0.57	0.22	1.09	NC	< BKG	mg/kg
Molybdenum	8	3	0.88	0.47	2.0b	NC	< BKG	mg/kg
Nickel	8	8	300	46	423	NC	< BKG	mg/kg
Selenium	8	1	0.84	0.84	1.48	NC	< BKG	mg/kg
Vanadium	8	8	72	12	81	NC	< BKG	mg/kg
Zinc	8	8	130	21	94	NC	130	mg/kg

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment B

a = twice the maximum detected value from the background data set.

b = detection limit of background data set (no concentrations detected).

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

< BKG = Site concentration is lower than background.

NOTE: RADIONUCLIDE COCs NOT YET REDUCED INTO THIS FORMAT.

Table-2. Contaminants of Concern in Subsurface Soils, OU-1, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95% UCL	RME	Units
2-Butanone (Methyl Ethyl Ketone)	49	4	6	3	NC	NC	6	UG/KG
2-Hexanone	49	1	75	75	NC	NC	75	UG/KG
2-Methylnaphthalene	57	3	1900000	160	NC	NC	1900000	UG/KG
4,4'-DDD	56	23	140	0.48	NC	NC	140	UG/KG
4,4'-DDE	56	11	14	0.69	NC	NC	14	UG/KG
4,4'-DDT	56	6	3.7	2.2	NC	NC	3.7	UG/KG
Acenaphthene	57	3	3300000	440	NC	NC	3300000	UG/KG
Acetone	49	25	820	3	NC	NC	820	UG/KG
Alpha-Chlordane	56	37	1700	0.56	NC	195	195	UG/KG
Anthracene	57	3	1500000	420	NC	NC	1500000	UG/KG
Antimony	56	11	1.3	0.25	0.74a	0.61	< BKG	mg/kg
Arochlor-1260	13	1	1000	1000	NC	NC	1000	UG/KG
Arsenic	55	55	9.7	0.84	10.47	6.8	< BKG	mg/kg
Barium	55	55	270	13	284	NC	< BKG	mg/kg
Benzene	64	1	1	1	NC	NC	1	UG/KG
Benzo(a)anthracene	57	3	660000	240	NC	NC	660000	UG/KG
Benzo(a)pyrene	57	3	140000	60	NC	NC	140000	UG/KG
Benzo(b)fluoranthene	57	3	96000	54	NC	NC	96000	UG/KG
Benzo(g,h,i)perylene	57	1	490	490	NC	NC	490	UG/KG
Benzo(k)fluoranthene	57	3	36000	84	NC	NC	36000	UG/KG
Beryllium	55	50	0.54	0.26	0.78	0.40	< BKG	mg/kg
Bis(2-Ethylhexyl)phthalate	57	10	3500	22	NC	1050	1050	UG/KG
Cadmium	56	5	7.1	0.27	0.46a	NC	7.1	mg/kg
Carbazole	57	3	410000	99	NC	NC	410000	UG/KG
Carbon Tetrachloride	49	1	4	4	NC	NC	4	UG/KG
Chromium	55	55	250	7.1	223	149	< BKG	mg/kg
Chromium, Hexavalent (+6)	56	3	0.08	0.035	0.147	NC	< BKG	mg/kg
Chrysene	57	4	630000	19	NC	NC	630000	UG/KG
Cobalt	55	55	29	0.66	33	NC	< BKG	mg/kg
Copper	55	55	890	7.4	60	83	83	mg/kg
Dibenzo(a,h)anthracene	57	2	18000	360	NC	NC	18000	UG/KG
Dibenzofuran	57	3	2100000	340	NC	NC	2100000	UG/KG
Dieldrin	56	7	70	0.41	NC	NC	190	UG/KG
Endosulfan I	56	7	2	0.2	NC	NC	2	UG/KG
Endosulfan Sulfate	56	1	11	11	NC	NC	11	UG/KG
Ethyl Benzene	64	1	1200	1200	NC	NC	1200	UG/KG
Fluoranthene	57	4	4000000	31	NC	NC	4000000	UG/KG
Fluorene	57	3	3100000	540	NC	NC	3100000	UG/KG
Formaldehyde	54	1	1.4	1	NC	NC	1.4	mg/kg
Gamma-Chlordane	56	37	1900	0.67	NC	222	222	UG/KG
Heptachlor	56	7	96	1.3	NC	NC	96	UG/KG
Heptachlor Epoxide	56	1	1.3	1.3	NC	NC	1.3	UG/KG
Indeno(1,2,3-cd)pyrene	57	2	27000	700	NC	NC	27000	UG/KG
Iron	55	55	46000	2800	45000	36000	< BKG	mg/kg
Lead	55	55	49	4.7	11.5	10.7	< BKG	mg/kg
Manganese	55	55	1000	39	785	676	< BKG	mg/kg
Mercury	55	51	5.2	0.11	1.09	0.67	< BKG	mg/kg

Table-2. Contaminants of Concern in Subsurface Soils, OU-1, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95% UCL	RME	Units
Methoxychlor	56	5	1.1	1.1	NC	NC	1.1	UG/KG
Methylene Chloride	49	1	4	4	NC	NC	4	UG/KG
Molybdenum	55	45	5.9	0.25	2.0b	0.8	< BKG	mg/kg
Naphthalene	57	3	2600000	120	NC	NC	2600000	UG/KG
Nickel	55	55	420	7	423	247	< BKG	mg/kg
Pentachlorophenol	57	1	660	660	NC	NC	660	UG/KG
Phenanthrene	57	4	9500000	26	NC	NC	9500000	UG/KG
Pyrene	57	5	3900000	23	NC	NC	3900000	UG/KG
Selenium	55	15	1.5	0.63	1.48	1.03	< BKG	mg/kg
Silver	55	2	2.7	0.2	0.52a	NC	< BKG	mg/kg
Styrene	49	1	800	800	NC	NC	800	UG/KG
Thallium	55	1	0.26	0.26	1.36a	NC	< BKG	mg/kg
Toluene	64	3	490	1.7	NC	NC	490	UG/KG
Vanadium	55	55	82	2.6	81	63	< BKG	mg/kg
Xylenes (Total)	49	1	6200	6200	NC	NC	6200	UG/KG
Zinc	55	55	730	15	94	116	116	mg/kg

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment ___

a = twice the maximum detected value from the background data set.

b = detection limit of background data set (no concentrations detected).

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

< BKG = Site concentration is lower than background.

Table-3. Contaminants of Concern in Surface Soils, OU-2, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95 % UCL	RME	Units
Acetone	4	2	0.006	0.004	NC	NC	0.006	mg/kg
Bis(2-Ethylhexyl)phthalate	2	1	0.031	0.031	NC	NC	0.031	mg/kg
Chromium	4	4	230	150	223	NC	230	mg/kg

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment ___

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

Table-4. Contaminants of Concern in Subsurface Soil, OU-2, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95% UCL	RME	Units
2-Butanone	58	5	8	6	NC	NC	8	UG/KG
2-Methylnaphthalene	58	1	440	440	NC	NC	440	UG/KG
4,4'-DDD	10	1	0.32	0.32	NC	NC	0.32	UG/KG
4,4'-DDT	10	1	1.8	1.8	NC	NC	1.8	UG/KG
Acenaphthene	58	1	5800	5800	NC	NC	5800	UG/KG
Acetone	58	37	63	4	NC	17	17	UG/KG
Anthracene	58	3	5600	21	NC	NC	5600	UG/KG
Arsenic	10	10	8	2.9	10.5	6.5	< BKG	mg/kg
Barium	10	10	220	120	284	NC	< BKG	mg/kg
Benzene	58	6	5	4	NC	NC	5	UG/KG
Benzo(a)anthracene	58	5	25000	22	NC	NC	25000	UG/KG
Benzo(a)pyrene	58	3	22000	29	NC	NC	22000	UG/KG
Benzo(b)fluoranthene	58	2	15000	130	NC	NC	15000	UG/KG
Benzo(g,h,i)perylene	58	2	8800	44	NC	NC	8800	UG/KG
Benzo(k)fluoranthene	58	2	20000	27	NC	NC	20000	UG/KG
Beryllium	10	10	0.51	0.21	0.78	0.43	< BKG	mg/kg
Bis(2-Ethylhexyl)phthalate	58	31	7800	19	NC	820	820	UG/KG
Carbazole	58	1	2400	2400	NC	NC	2400	UG/KG
Chromium	58	58	300	50	223	125	< BKG	mg/kg
Chrysene	58	6	28000	38	NC	NC	28000	UG/KG
Cobalt	10	10	25	9.2	33	NC	< BKG	mg/kg
Copper	10	10	160	21	60	89	89	mg/kg
Di-n-Butylphthalate	58	1	1200	1200	NC	NC	1200	UG/KG
Di-n-Octylphthalate	58	1	21	21	NC	NC	21	UG/KG
Dibenzo(a,h)anthracene	58	2	1900	52	NC	NC	1900	UG/KG
Dibenzofuran	58	1	600	600	NC	NC	600	UG/KG
Diethyl Phthalate	58	1	120	120	NC	NC	120	UG/KG
Fluoranthene	58	5	35000	26	NC	NC	35000	UG/KG
Fluorene	58	1	1000	1000	NC	NC	1000	UG/KG
Indeno(1,2,3-cd)pyrene	58	2	8500	45	NC	NC	8500	UG/KG
Iron	10	10	40000	20000	45000	NC	< BKG	mg/kg
Lead	10	10	10	3	11.5	NC	< BKG	mg/kg
Manganese	10	10	870	450	785	700	< BKG	mg/kg
Mercury	10	6	0.19	0.11	1.09	NC	< BKG	mg/kg
Molybdenum	10	10	0.65	0.26	2.0b	NC	< BKG	mg/kg
Naphthalene	58	1	1100	1100	NC	NC	1100	UG/KG
Nickel	10	10	180	72	423	139	< BKG	mg/kg
Phenanthrene	58	5	17000	26	NC	NC	17000	UG/KG
Pyrene	58	6	43000	23	NC	NC	43000	UG/KG
Toluene	58	1	4	4	NC	NC	4	UG/KG
Vanadium	10	10	75	40	81	65	< BKG	mg/kg
Xylenes (Total)	58	1	3	3	NC	NC	3	UG/KG
Zinc	10	10	360	38	94	160	160	mg/kg

Table-4. Contaminants of Concern in Subsurface Soil, OU-2, LEHR Facility, Davis, California

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment ___

a = twice the maximum detected value from the background data set.

b = detection limit of background data set (no concentrations detected).

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

< BKG = Site concentration is lower than background.

Table-5. Contaminants of Concern in Surface Soils, OU-3, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95% UCL	RME	Units
4,4'-DDE	11	1	1.3	1.3	NC	NC	1.3	ug/Kg
Acetone	2	1	4	4	NC	NC	4	ug/Kg
Alpha-BHC	11	1	11	11	NC	NC	11	ug/Kg
Alpha-Chlordane	11	4	230	40	NC	NC	230	ug/Kg
Arsenic	11	11	8.4	4.2	10.47	8.01	< BKG	mg/Kg
Barium	11	11	205	89.6	284	NC	< BKG	mg/Kg
Beryllium	11	10	0.52	0.23	0.78	0.44	< BKG	mg/Kg
Bis(2-Ethylhexyl)phthalate	2	2	45	37	NC	NC	45	ug/Kg
Chlordane	15	15	15000	14	NC	3,008	3,008	ug/Kg
Chromium	11	11	218	72	223	149	< BKG	mg/Kg
Chromium, Hexavalent (+6)	16	15	0.16	0.034	0.147	0.097	< BKG	mg/Kg
Cobalt	11	11	23.4	11.7	33	NC	< BKG	mg/Kg
Copper	11	11	44.1	18	60	NC	< BKG	mg/Kg
Delta-BHC	11	1	1.4	1.4	NC	NC	1.4	ug/Kg
Di-n-Butylphthalate	2	2	130	130	NC	NC	130	ug/Kg
Gamma-BHC	11	1	1.8	1.8	NC	NC	1.8	ug/Kg
Gamma-Chlordane	11	4	260	37	NC	NC	260	ug/Kg
Heptachlor	11	1	6.6	6.6	NC	NC	6.6	mg/Kg
Iron	11	11	42200	21000	45000	NC	< BKG	mg/Kg
Lead	11	11	10.8	4.1	11.5	NC	< BKG	mg/Kg
Manganese	11	11	882	499	785	703	< BKG	mg/Kg
Mercury	11	8	1	0.1	1.09	NC	< BKG	mg/Kg
Nickel	11	11	301	109	423	250	< BKG	mg/Kg
Selenium	11	2	0.62	0.49	1.48	NC	< BKG	mg/Kg
Vanadium	11	11	64.9	34.7	81	59	< BKG	mg/Kg
Zinc	11	11	130	49.3	94	82	< BKG	mg/Kg

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment ___

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

< BKG = Site concentration is lower than background.

Table-6. Contaminants of Concern in Subsurface Soils, OU-3, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95 UCL	RME	Units
4,4'-DDE	21	1	1.2	0	NC	NC	1.2	ug/Kg
Acetone	2	1	32	0	NC	NC	32	ug/Kg
Arsenic	21	21	8.8	5.5	10.5	8.0	< BKG	mg/Kg
Barium	21	21	219	75.6	284	NC	< BKG	mg/Kg
Beryllium	21	21	0.55	0.26	0.78	0.47	< BKG	mg/Kg
Bis(2-Ethylhexyl)phthalate	2	2	65	51	NC	NC	65	ug/Kg
Chromium	21	21	262	53.7	223	139	< BKG	mg/Kg
Chromium, Hexavalent (+6)	26	26	0.29	0.034	0.147	0.16	0.16	mg/Kg
Cobalt	21	21	27.9	16.2	33	NC	< BKG	mg/Kg
Copper	21	21	46.8	19.3	60	NC	< BKG	mg/Kg
Di-n-Butylphthalate	2	2	160	150	NC	NC	160	ug/Kg
Iron	21	21	46600	22600	45000	41,300	< BKG	mg/Kg
Lead	21	21	8.9	5.1	11.5	NC	< BKG	mg/Kg
Manganese	21	21	1010	379	785	706	< BKG	mg/Kg
Mercury	21	7	0.26	0	1.09	NC	< BKG	mg/Kg
Nickel	21	21	280	62.9	423	224	< BKG	mg/Kg
Selenium	21	8	0.72	0	1.48	NC	< BKG	mg/Kg
Vanadium	21	21	77.5	48.8	81	65	< BKG	mg/Kg
Zinc	21	21	100	42.8	94	75	< BKG	mg/Kg

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment ___

a = twice the maximum detected value from the background data set.

b = detection limit of background data set (no concentrations detected).

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

< BKG = Site concentration is lower than background.

Table-7. Contaminants of Concern in Subsurface Soils, OU-4, LEHR Facility, Davis, California

Analyte	# Sampled	# Detected	Max [ ]	Min [ ]	Background	95% UCL	RME	Units
Acetone	7	3	11	3	NC	NC	11	UG/KG
Arsenic	7	7	8.6	7.6	10.47	NC	< BKG	mg/kg
Barium	7	7	270	170	284	NC	< BKG	mg/kg
Beryllium	7	7	0.45	0.36	0.78	NC	< BKG	mg/kg
Chromium	7	7	120	96	223	NC	< BKG	mg/kg
Cobalt	7	7	27	23	33	NC	< BKG	mg/kg
Copper	7	7	60	53	60	NC	60	mg/kg
Formaldehyde	7	1	2.2	2.2	NC	NC	2.2	mg/kg
Iron	7	7	39000	32000	45000	NC	< BKG	mg/kg
Lead	7	7	9.3	7.8	11.5	NC	< BKG	mg/kg
Manganese	7	7	790	560	785	NC	790	mg/kg
Mercury	7	2	0.35	0.14	1.09	NC	< BKG	mg/kg
Molybdenum	7	7	0.51	0.29	2.0b	NC	< BKG	mg/kg
Nickel	7	7	260	220	423	NC	< BKG	mg/kg
Vanadium	7	7	66	57	81	NC	< BKG	mg/kg
Zinc	7	7	110	75	94	NC	110	mg/kg

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Background concentration calculations presented in attachment ___

a = twice the maximum detected value from the background data set.

b = detection limit of background data set (no concentrations detected).

NC = Not calculated.

RME = Reasonable maximum exposure concentration.

95% UCL = 95% upper confidence level of the mean of detected data, assuming normal distribution.

< BKG = Site concentration is lower than background.

Table-8. Summary of Maximum Concentrations, Putah Creek, LEHR Facility, Davis, California

Chemical	PCU Upstream Max Conc	STPO UCD Treatment Max Conc	PCD Downstream Max Conc	USEPA Water Qual. Criteria	UNITS
4,4'-DDD	**0.018**	**0.051**	**0.093**	None	ug/L
4,4'-DDE	**0.005**	**0.012**	**0.005**	None	ug/L
4,4'-DDT	**0.013**	**ND <0.012**	**ND <0.012**	**0.001**	ug/L
Acetone	3.9	36	18	None	ug/L
Aldrin	ND <0.004	0.011	0.037	None	ug/L
Alpha-BHC	0.055	0.031	0.038	0.08	ug/L
Alpha-Chlordane	**ND <0.01**	**0.017**	**ND <0.01**	**0.0043**	ug/L
Antimony	0.09	0.11	0.07	30	mg/L
Arsenic	0.0065	0.0074	0.0074	190	mg/L
Barium	0.11	0.147	0.12	None	mg/L
Beryllium	0.004	0.006	0.006	5.3	mg/L
Beta-BHC	ND <0.006	0.042	0.008	0.08	ug/L
Bis(2-Chloroisopropyl)Ether	ND <5.7	5.7	3.6	None	ug/L
Bis(2-Ethylhexyl)phthalate	13	13.3	12.6	360	ug/L
Bromochloromethane	ND <1	0.98	ND <1	None	ug/L
Bromodichloromethane	7.1	13	5.8	None	ug/L
Cadmium	0.002	0.002	0.002	1.1	mg/L
Calcium	42.2	21.3	41.2	None	mg/L
Chloroform	19	33	14	1240	ug/L
Chromium	0.06	0.11	0.08	210	mg/L
Chromium, Hexavalent (+6)	0.043	0.045	0.042	11	mg/L
Cobalt	0.0075	0.002	0.0012	None	mg/L
Copper	0.04	0.03	0.05	12	mg/L
Delta-BHC	0.055	**0.095**	0.012	**0.08**	ug/L
Di-n-Butylphthalate	3.41	4.6	4.4	9.4	ug/L
Dibromochloromethane	2.7	4.8	3.4	None	ug/L
Dieldrin	**0.015**	**0.007**	**0.043**	**0.0019**	ug/L
Endosulfan I	**0.103**	ND <0.01	**0.062**	**0.056**	ug/L
Endosulfan II	0.007	0.004	ND <0.004	0.056	ug/L
Endrin Aldehyde	ND <0.02	ND <0.02	0.041	None	ug/L
Formaldehyde	ND <0.05	2.1	0.37	None	mg/L
Gamma-BHC	0.026	0.066	0.019	0.08	ug/L
Heptachlor	**0.026**	**0.012**	**0.032**	**0.0038**	ug/L
Iron	0.301	0.506	0.317	1000	mg/L
Lead	0.0073	0.0112	0.01	3.2	mg/L
Magnesium	44000	23700	41900	None	ug/L
Manganese	0.0064	0.0218	0.008	None	mg/L
Mercury	0.0004	0.00063	0.00027	0.012	mg/L
Methylene Chloride	ND <2	13	3	5500	ug/L
Molybdenum	0.06	0.11	0.05	None	mg/L

Table-8. Summary of Maximum Concentrations, Putah Creek, LEHR Facility, Davis, California

Chemical	PCU Upstream Max Conc	STPO UCD Treatment Max Conc	PCD Downstream Max Conc	USEPA Water Qual. Criteria	UNITS
Nickel	0.05	0.13	0.31	160	mg/L
Potassium	16300	56900	11200	None	ug/L
Selenium	ND <0.003	0.039	0.0038	5	mg/L
Silver	ND <0.01	0.03	ND <0.01	0.12	ug/L
Sodium	147000	286000	143000	None	ug/L
Thallium	0.09	0.1	0.08	40	mg/L
Toluene	ND <1.0	ND <1.0	1.7	None	ug/L
Vanadium	0.0134	0.012	0.02	None	mg/L
Zinc	0.05	0.1	1.19	110	mg/L

Notes

USEPA Water Qual. Criteria = US Environmental Protection Agency Water Quality Criteria for the Protection of Aquatic Life. Office of Water Regulations and Standards.

Table-9. Putah Creek Downstream, LEHR Facility, Davis, California

Chemical	# Sampled	# Detected	% Detected	Max [ ]	Min [ ]	UNITS
4,4'-DDD	17	2	12	0.093	0	ug/L
4,4'-DDE	17	1	6	0.005	0	ug/L
Acetone	7	5	71	18	0	ug/L
Aldrin	17	2	12	0.037	0	ug/L
Alpha-BHC	17	5	29	0.038	0	ug/L
Ammonia-Nitrogen	7	6	86	0.6	0	mg/L
Antimony	18	10	56	0.07	0	mg/L
Arsenic	18	6	33	0.0074	0	mg/L
Barium	18	18	100	0.12	0.03	mg/L
Beryllium	18	2	11	0.006	0	mg/L
Beta-BHC	17	1	6	0.008	0	ug/L
Bis(2-Chloroisopropyl)Ether	10	1	10	3.6	0	ug/L
Bis(2-Ethylhexyl)phthalate	17	5	29	12.6	0	ug/L
Bromodichloromethane	17	5	29	5.8	0	ug/L
Cadmium	18	3	17	0.002	0	mg/L
Calcium	18	18	100	41.2	13.7	mg/L
Chloroform	17	12	71	14	0	ug/L
Chromium	18	10	56	0.08	0	mg/L
Chromium, Hexavalent (+6)	17	3	18	0.042	0	mg/L
Cobalt	18	1	6	0.0012	0	mg/L
Copper	18	8	44	0.05	0	mg/L
Delta-BHC	17	1	6	0.012	0	ug/L
Di-n-Butylphthalate	17	4	24	4.4	0	ug/L
Dibromochloromethane	17	2	12	3.4	0	ug/L
Dieldrin	17	2	12	0.043	0	ug/L
Endosulfan I	17	2	12	0.062	0	ug/L
Endrin Aldehyde	17	1	6	0.041	0	ug/L
Formaldehyde	17	2	12	0.37	0	mg/L
Gamma-BHC	17	2	12	0.019	0	ug/L
Heptachlor	17	1	6	0.032	0	ug/L
Iron	7	5	71	0.317	0	mg/L
Lead	18	6	33	0.01	0	mg/L
Magnesium	18	18	100	41900	7360	ug/L
Manganese	2	2	100	0.008	0.002	mg/L
Mercury	18	1	6	0.00027	0	mg/L
Methylene Chloride	17	5	29	3	0	ug/L
Molybdenum	18	9	50	0.05	0	mg/L
Nickel	18	8	44	0.31	0	mg/L
Potassium	18	18	100	11200	1960	ug/L
Selenium	18	1	6	0.0038	0	mg/L
Sodium	18	18	100	143000	23600	ug/L
Thallium	18	4	22	0.08	0	mg/L
Toluene	17	1	6	1.7	0	ug/L
Vanadium	18	8	44	0.02	0	mg/L
Zinc	18	15	83	1.19	0	mg/L

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

% Detected = Percent of samples with detected concentrations.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Table-10. Putah Creek Upstream, LEHR Facility, Davis, California

Chemical	# Sampled	# Detected	% Detected	Max [ ]	Min [ ]	UNITS
4,4'-DDD	17	2	12	0.018	0	ug/L
4,4'-DDE	17	1	6	0.005	0	ug/L
4,4'-DDT	17	1	6	0.013	0	ug/L
Acetone	7	2	29	3.9	0	ug/L
Alpha-BHC	17	3	18	0.055	0	ug/L
Antimony	18	8	44	0.09	0	mg/L
Arsenic	18	5	28	0.0065	0	mg/L
Barium	18	18	100	0.11	0.03	mg/L
Beryllium	18	3	17	0.004	0	mg/L
Bis(2-Ethylhexyl)phthalate	17	7	41	13	0	ug/L
Bromodichloromethane	17	1	6	7.1	0	ug/L
Cadmium	18	3	17	0.002	0	mg/L
Calcium	18	18	100	42.2	10.8	mg/L
Chloroform	17	4	24	19	0	ug/L
Chromium	18	8	44	0.06	0	mg/L
Chromium, Hexavalent (+6)	17	5	29	0.043	0	mg/L
Cobalt	18	1	6	0.0075	0	mg/L
Copper	18	8	44	0.04	0	mg/L
Delta-BHC	17	2	12	0.055	0	ug/L
Di-n-Butylphthalate	17	2	12	3.41	0	ug/L
Dibromochloromethane	17	1	6	2.7	0	ug/L
Dieldrin	17	1	6	0.015	0	ug/L
Endosulfan I	17	2	12	0.103	0	ug/L
Endosulfan II	17	1	6	0.007	0	ug/L
Gamma-BHC	17	4	24	0.026	0	ug/L
Heptachlor	17	1	6	0.026	0	ug/L
Iron	7	4	57	0.301	0	mg/L
Lead	18	4	22	0.0073	0	mg/L
Magnesium	18	18	100	44000	5970	ug/L
Manganese	2	2	100	0.0064	0.0015	mg/L
Mercury	18	1	6	0.0004	0	mg/L
Molybdenum	18	5	28	0.06	0	mg/L
Nickel	18	10	56	0.05	0	mg/L
Potassium	18	18	100	16300	1020	ug/L
Sodium	18	18	100	147000	14400	ug/L
Thallium	18	5	28	0.09	0	mg/L
Vanadium	18	7	39	0.0134	0	mg/L
Zinc	18	14	78	0.05	0	mg/L

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

% Detected = Percent of samples with detected concentrations.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Table-11. Putah Creek, UCD Outfall, LEHR Facility, Davis, California

STPO

Chemical	# Sampled	# Detected	% Detected	Max [ ]	Min [ ]	UNITS
4,4'-DDD	18	3	17	0.051	0	ug/L
4,4'-DDE	18	2	11	0.012	0	ug/L
Acetone	7	4	57	36	0	ug/L
Aldrin	18	2	11	0.011	0	ug/L
Alpha-BHC	18	4	22	0.031	0	ug/L
Alpha-Chlordane	7	1	14	0.017	0	ug/L
Antimony	19	7	37	0.11	0	mg/L
Arsenic	19	7	37	0.0074	0	mg/L
Barium	19	15	79	0.147	0	mg/L
Beryllium	19	1	5	0.006	0	mg/L
Beta-BHC	18	2	11	0.042	0	ug/L
Bis(2-Chloroisopropyl)Ether	11	1	9	5.7	0	ug/L
Bis(2-Ethylhexyl)phthalate	18	10	56	13.3	0	ug/L
Bromochloromethane	7	1	14	0.98	0	ug/L
Bromodichloromethane	18	6	33	13	0	ug/L
Cadmium	19	3	16	0.002	0	mg/L
Calcium	19	19	100	21.3	13.7	mg/L
Chloroform	18	18	100	33	3.1	ug/L
Chromium	19	10	53	0.11	0	mg/L
Chromium, Hexavalent (+6)	18	7	39	0.045	0	mg/L
Cobalt	19	2	11	0.002	0	mg/L
Copper	19	11	58	0.03	0	mg/L
Delta-BHC	18	5	28	0.095	0	ug/L
Di-n-Butylphthalate	18	5	28	4.6	0	ug/L
Dibromochloromethane	18	1	6	4.8	0	ug/L
Dieldrin	18	2	11	0.007	0	ug/L
Endosulfan II	18	1	6	0.004	0	ug/L
Formaldehyde	18	3	17	2.1	0	mg/L
Gamma-BHC	18	5	28	0.066	0	ug/L
Heptachlor	18	1	6	0.012	0	ug/L
Iron	7	6	86	0.506	0	mg/L
Lead	19	7	37	0.0112	0	mg/L
Magnesium	19	2	11	23700	17700	ug/L
Manganese	2	2	100	0.0218	0.0081	mg/L
Mercury	19	19	100	0.00063	0	mg/L
Methylene Chloride	18	12	67	13	0	ug/L
Molybdenum	19	11	58	0.11	0	mg/L
Nickel	19	7	37	0.13	0	mg/L
Potassium	19	19	100	56900	5770	ug/L
Selenium	19	2	11	0.039	0	mg/L
Silver	19	1	5	0.03	0	mg/L
Sodium	19	19	100	286000	32200	ug/L
Thallium	19	4	21	0.1	0	mg/L
Vanadium	19	8	42	0.012	0	mg/L
Zinc	19	18	95	0.1	0	mg/L

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

% Detected = Percent of samples with detected concentrations.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Table-12. Storm Water Runoff, LEHR Facility, Davis, California

SWL-1, SWL-2

LAB_CHEM	# Sampled	# Detected	% Detected	Max [ ]	Min [ ]	UNITS
4-Nitrophenol	4	1	25	0.8	0	ug/L
Acetone	4	4	100	17	4.6	ug/L
Alpha-Chlordane	4	1	25	0.015	0	ug/L
Antimony	4	4	100	0.156	0.0501	mg/L
Arsenic	4	1	25	0.0016	0	mg/L
Barium	4	4	100	0.0072	0.0033	mg/L
Benzyl Butyl Phthalate	4	3	75	2	0	ug/L
Bis(2-Ethylhexyl)phthalate	4	3	75	2	0	ug/L
Calcium	4	4	100	1.71	0.573	mg/L
Chromium	4	2	50	0.0023	0	mg/L
Chromium, Hexavalent (+6)	4	1	25	0.0035	0	mg/L
Copper	4	4	100	0.0045	0.0022	mg/L
Di-n-Butylphthalate	4	4	100	8	2	ug/L
Gamma-Chlordane	4	1	25	0.013	0	ug/L
Iron	4	3	75	0.0692	0	mg/L
Lead	4	4	100	0.0384	0.0104	mg/L
Magnesium	4	4	100	708	126	ug/L
Nickel	4	3	75	0.0027	0	mg/L
Potassium	4	3	75	1490	0	ug/L
Pyrene	4	1	25	0.7	0	ug/L
Sodium	4	4	100	3660	275	ug/L
Toluene	4	1	25	0.99	0	ug/L
Vanadium	4	2	50	0.0012	0	mg/L
Zinc	4	4	100	0.0965	0.0608	mg/L

notes:

Sampled = Number of samples in data set.

Detected = Number of samples in data set containing concentrations above the detection limit.

% Detected = Percent of samples with detected concentrations.

Max [] = Maximum detected concentration in data set.

Min [] = Minimum detected concentration in data set.

Table 13. Background Values for Chemical Constituents in Soil.

Parameter	Units	Regional Background Min	Regional Background Max	1995 Background Min	1995 Background Max	1995 Background 95th quantile
Arsenic	mg/kg	N/A	N/A	6.4	11.9	10.5
Barium	mg/kg	500.00	700.00	107	308	284
Beryllium	mg/kg	<1	1.00	0.27	0.88	0.78
Cadmium	mg/kg	-1.00	N/A	nd	0.23	N/A
Chromium	mg/kg	70.00	100.00	59.6	251.	223
Chromium VI	mg/kg	N/A	N/A	0.023	0.25	0.15
Cobalt	mg/kg	10.00	70.00	12.6	32.9	33
Copper	mg/kg	30.00	50.00	20.1	59.5	60
Iron	mg/kg	N/A	N/A	20600.	46300.	45000
Lead	mg/kg	15.00	300.00	3.4	11.9	11.5
Manganese	mg/kg	N/A	N/A	437.	870.	785
Mercury	mg/kg	N/A	N/A	0.12	1.6	1.1
Molybdenum	mg/kg	<3	3.00	nd	nd	N/A
Nickel	mg/kg	15.00	300.00	78.6	404.	423
Selenium	mg/kg	<0.1	0.30	0.21	1.4	1.5
Silver	mg/kg	N/A	N/A	nd	0.26	N/A
Thallium	mg/kg	N/A	N/A	nd	0.68	N/A
Vanadium	mg/kg	100.00	500.00	37.1	78.7	81
Zinc	mg/kg	74.00	510.00	37.6	101.	94

N/A = Not applicable, inadequate data to calculate statistics.
nd - Not detected.

Table 14. Exposure Parameters

Symbol	Definition (units)	Scenarios 2 and 3 Residential	Scenario 1 Worker	Reference
Chemical -specific values				
CSFo	Cancer slope factor oral (mg/kg-d)-1	chemical-specific	chemical-specific	IRIS, HEAST, or NCEA
CSFi	Cancer slope factor inhaled (mg/kg-d)-1	chemical-specific	chemical-specific	IRIS, HEAST, or NCEA
RfDo	Reference dose oral (mg/kg-d)	chemical-specific	chemical-specific	IRIS, HEAST, or NCEA
RfDi	Reference dose inhaled (mg/kg-d)	chemical-specific	chemical-specific	IRIS, HEAST, or NCEA
VFs	Volatilization factor for soil (m^3/kg)	chemical-specific	chemical-specific	Soil Screening Guidance (EPA 1996a,b)
sat	Soil saturation concentration (mg/kg)	chemical-specific	chemical-specific	Soil Screening Guidance (EPA 1996a,b)
CDF	Radionuclide dose conversion factors	chemical-specific	chemical-specific	EPA FGR no 11+12
Exposure parameters				
BWa	Body weight, adult (kg)	70	70	RAGS (Part A), EPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)	15	15	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03)
ATc	Averaging time - carcinogens (days)	25550	25550	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)	ED*365	ED*365	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
SAa	Surface area, adult (cm^2/day)	5000	5000	Dermal Assessment, EPA 1992 (EPA/600/8-91/011B)
SAc	Surface area, child (cm^2/day)	2000	2000	Dermal Assessment, EPA 1992 (EPA/ 600/8-9/011B)
AF	Adherence factor (mg/cm^2)	0.2	0.2	Dermal Assessment, EPA 1992 (EPA/ 600/8-9/011B)
ABS	Skin absorption (unitless):			
	-- organics	0.1	0.1	PEA, Cal-EPA (DTSC, 1994)
	--Inorganics	0.01	0.01	PEA, Cal-EPA (DTSC, 1994)
SAwc	skin surface area for water contact (cm**2)	23000	23000	PEA, Cal-EPA (DTSC, 1994)
IRAa	Inhalation rate - adult	20	20	Exposure Factors , EPA

Symbol	Definition (units)	Scenarios 2 and 3 Residential	Scenario 1 Worker	Reference
	(m^3/day)			1991 (OSWER No. 9285.6-03)
IRAc	Inhalation rate - child (m^3/day)	10	10	RAGS (Part A), EPA 1989 (EPA/540/1-89/002)
IRWa	Drinking water ingestion - adult (L/day	2	Not used	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
IRWc	Drinking water ingestion - child (L/day)	1	Not used	PEA, Cal-EPA (DTSC, 1994)
IRsw	Incidental water intake during swimming (L/day)	0.13	not used	RESRAD default
IRfish	Aquatic food intake (g/day)	54	Not used	RAGS Part B, EPA 1991
IRSa	Soil ingestion - adult (mg/day)	100	50	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03)
IRSc	Soil ingestion - child (mg/day),	200	not used	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03)
IRv	Plant food intake (g/day)	80	not used	RAGS Part B, EPA 1991
IRmeat	Meat and poultry consumption (kg/day)	0.25	not used	RESRAD default
IRmild	Milk consumption (l/day)	0.17	not used	RESRAD default
EF	Exposure frequency (d/y)	350	250	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03)
EFsw	Exposure Frequency swimming (d/yr)	90	not used	EPA default = 7; site-specific value assumed.
EFfi	Exposure frequency fish consumption (d/yr)	26	not used	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03) assume 2/week for 90 days
ED_{RAD}	Exposure duration for radionuclides (yrs)	30	30	RAGS (Part B)
ED	Exposure duration - (years)	30	25	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03)
EDc	Exposure duration - child (years)	6	6	Exposure Factors , EPA 1991 (OSWER No. 9285.6-03)
EDshower	duration for showering (hr/event)	0.25	not used	PEA, Cal-EPA (DTSC, 1994)
EDswin	duration for swimming (hr/event)	0.5	not used	
EDsoil	duration for soil contact (hr/event)	12	not used	
VFw	Volatilization factor for water (L/m^3)	0.5	not used	RAGS(Part B) , EPA 1991 (OSWER No.

Symbol	Definition (units)	Scenarios 2 and 3 Residential	Scenario 1 Worker	Reference
				9285.7-01B)
Age-adjusted factors for carcinogens:				
IFSadj	Ingestion factor, soils ([mg•yr]/[kg•d])	114	not used	RAGS(Part B) , EPA 1991 (OSWER No. 9285.7-01B)
SFSadj	Skin contact factor, soils ([mg•yr]/[kg•d])	503	not used	By analogy to RAGS (Part B)
InhFadj	Inhalation factor ([m^3•yr]/[kg•d])	11	not used	By analogy to RAGS (Part B)
IFWadj	Ingestion factor, water ([l•yr]/[kg•d])	1.1	not used	By analogy to RAGS (Part B)
Contamination fractions:				
	ingested plant	0.5	not used	
	ingested meat	1	not used	
	ingested milk	1	not used	
	ingested aquatic food	0.5	not used	
	ingested drinking water	1	not used	
	ingested soil	1	not used	
	incidentally (swimming) ingested water	1	not used	
	dermal absorption from swimming	1	not used	
	dermal absorption from shower water	1	not used	
	dermal absorption from soil contact	1	not used	
RESRAD specific factors				
	Shielding factor for groundshine	site-specific calculation	site-specific	RESRAD
	Shielding factor for inhalation	site-specific calculation	site-specific	RESRAD
	Fraction of day in gamm field	1.0	0.33	RAGS (Part B)
	Time fraction outdoors	0.33	0.33	
PEF	Particulate loading (g/m^3)	2.2×10^{-7}	2.2×10^{-7}	RESRAD RAGS (Part B)

Table 15. Table of Site Specific Input Parameters

Parameter	Units	OU-1 SW Trenches	OU-2 Ra/Sr Treatment	OU-3 W. Dog Pens	OU-4 Septic Tanks	Source of Data
Area of Entire OU	m^2	1915	1980	1325	0	(Weiss Associates, 1997a)
Area of contaminated zone	m2	970	510	1300	0	(Weiss Associates, 1997a)
Thickness of contaminated zone	m	4.4	4.6	0.9	0	(Weiss Associates, 1997a)
Length parallel to aquifer flow	m	28	25	130	0	(Weiss Associates, 1997a)
Density of contaminated zone	g/cm3	1.65	1.92	1.65	1.65	Dry Bulk Dens. (DBS, 1996)
Contaminated zone total porosity	v/v	0.339	0.293	0.339	0.339	Calculated Porosity (DBS)
Contaminated zone effective porosity	v/v					
Contaminated zone hydraulic conductivity	m/yr	5.80E-08	4.70E-03	4.70E-03	4.70E-03	(DBS, 1996)
Precipitation (1993-1996 Average)	m/yr	0.46	0.46	0.46	0.46	(Weiss Associates, 1997a)
Precipitation (1908-1990 Mean)	m/yr	0.418	0.418	0.418	0.418	(Dames & Moore, 1993)
Irrigation	m/yr	none	none	none	none	
Density of saturated zone	g/cm3	1.7	1.7	1.7	1.7	(Dames & Moore, 1993)
Saturated zone total porosity	v/v	0.35	0.35	0.35	0.35	(Dames & Moore, 1993)
Saturated zone effective porosity	v/v					
Sat. zone hydraulic conductivity (horiz)	m/yr	67 to 385	67 to 385	67 to 385	67 to 385	(Dames & Moore, 1993)
Sat. zone hydraulic conductivity (vert)	m/yr	24	24	24	24	(Dames & Moore, 1993)
Sat. zone hydraulic conductivity (horiz)	m/yr	158	158	158	158	(Weiss Associates, 1997a)
Saturated zone hydraulic gradient	m/m	0.0001 to 0.0015	0.0001 to 0.0015	0.0001 to 0.0015	0.0001 to 0.0015	(Weiss Associates, 1997a)
Water table drop rate	m/yr				NOT ESTABLISHED	
Number of unsaturated zone strata		4	4	2	3	(Weiss Associates, 1997b)
Unsaturated zone thickness	m	4.74	4.54	8.24	9.14	(Weiss Associates, 1997b)
Unsaturated zone soil density	g/cm3	1.70	1.51	1.51	1.51	(DBS, 1996)
Unsaturated zone total porosity	v/v	0.379	0.436	0.436	0.436	Calculated Porosity (DBS)
Unsaturated zone effective porosity	v/v					
Unsaturated zone soil-specific b parameter	v/v					
Unsaturated zone hydraulic conductivity	m/yr	1.10E-08	6.70E-05	6.70E-05	6.70E-05	(DBS, 1996)

Weiss Associates, 1997a, Draft Final Site Characterization Report
Weiss Associates, 1997b, Draft Vadose Zone Modeling Report
Daniel B. Stephens & Associates, Inc., 1996, Hydraulic Properties of LEHR/UC Davis Soil Samples
Dames & Moore, 1993, Phase II Characterization

Table of Site Specific Input Parameters (continued)

Parameter	Assumptions
Area of contaminated zone	Area of entire OU Ra/Sr includes Imhoff, but not AH-1 or AH-2.
Thickness of contaminated zone	-
Length parallel to aquifer flow	Assume flow is to N45E (Weiss Associates (1997a) states that it is generally to the northeast).
Density of contaminated zone	Based on samples from the contaminated zone only, Most conservative value taken for OUs-3 & 4.
Contaminated zone total porosity	This is calculated porosity. Most conservative for OUs-3 & 4.
Contaminated zone effective porosity	Effective to be estimated by correlation.
Contaminated zone hydraulic conductivity	Based on samples in the contaminated zone only, most conservative values used for OUs-3 & 4.
Precipitation (1993-1996 Average)	Weiss, 1997a.
Precipitation (1908-1990 Mean)	-
Irrigation	No available data; default to be used.
Density of saturated zone	Based on value for HSU-1 used for modeling in the Phase II Characterization.
Saturated zone total porosity	Assume this is total porosity per Phase II modeling.
Saturated zone effective porosity	See above.
Sat. zone hydraulic conductivity (horiz)	-
Sat. zone hydraulic conductivity (vert)	-
Sat. zone hydraulic conductivity (horiz)	-
Saturated zone hydraulic gradient	-
Water table drop rate	-
Number of unsaturated zone strata	Based on generalized soil borings used for vadose zone modeling.
Unsaturated zone thickness	30 ft (9.14 m) water depth minus the contaminated zone thickness.
Unsaturated zone soil density	Based on samples below the contaminated zone only, most conservative values taken for OUs-3 & 4.
Unsaturated zone total porosity	Samples below the contam. zone only, most conserv for OUs-3 & 4.
Unsaturated zone effective porosity	-
Unsaturated zone soil-specific b parameter	-
Unsaturated zone hydraulic conductivity	Based on samples below the contaminated zone only, most conservative values taken for OUs-3 & 4.

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LIST OF ACRONYMS

ALARA	As Low as Reasonably Achievable
ANL	Argonne National Laboratory
CERCLA	Comprehensive Environmental Response, Compensation and Liabilities Act
CFR	Code of Federal Regulations
DOE	U. S. Department of Energy
EPA	U.S. Environmental Protection Agency
g	Gram
I	Iodine
Kg	Kilogram
L	Liter
LEHR	Laboratory for Energy-Related Health Research
m	Meter
mrem	Millirem
NCRCPD	National Conference of Radiation Control Program Directors
NPL	National Priorities List
pCi/g	Picocurie per Gram
PNNL	Pacific Northwest National Laboratory (Battelle)
RESRAD	Residual Radioactive Material Guideline computer program
RME	Reasonable Maximum Exposure
SARA	Superfund Amendments and Reauthorization Act
UCD	University of California at Davis
Yr	Year

ATTACHMENT A

RISKCALC/RESRAD COMPARISON FOR CS-137 AND SR-90.

Attachment A

Comparison of RESRAD Soil Action Levels and Associated Cancer Risk with Values Calculated Using RISKCALC for Residential and Commercial land-use Scenarios

	RISKCALC - Commercial Scenario					RISKCALC - Residential Scenario				
	Risk at PRG Concentration in Soil					Risk at PRG Concentration in Soil				
Radionuclide	Ingestion	Inhalation	External	Total	PRG (pCi/g)	Ingestion	Inhalation	External	Total	PRG (pCi/g)
Cs-137 + D	7.1E-10	3.7E-14	1.0E-06	1.0E-06	7.2E-02	8.0E-10	1.3E-14	1.0E-06	1.0E-06	2.0E-02
Sr-90 + D	9.70E-07	1.10E-10	0.0E+00	9.70E-07	5.7E+01	9.8E-07	3.4E-11	0.0E+00	9.8E-07	1.4E+01

Source: Risk Comparison for Radionuclides in Soil, USEPA Regin IX, December 18, 1996

	RESRAD - Commercial Scenario					RESRAD - Residential Scenario				
	Risk at PRG Concentration in Soil					Risk at PRG Concentration in Soil				
Radionuclide	Ingestion	Inhalation	External	Total	PRG (pCi/g)	Ingestion	Inhalation	External	Total	PRG (pCi/g)
Cs-137 + D	3.6E-10	1.8E-14	7.7E-07	7.7E-07	1.1E-01	1.0E-09	1.7E-14	9.2E-07	9.2E-07	2.5E-02
Sr-90 + D	6.1E-07	6.5E-11	0.0E+00	6.1E-07	3.5E+01	1.7E-06	5.7E-11	0.0E+00	1.7E-06	2.4E+01

Source: RESRAD runs by F. Eidson, IT Corporation for Weiss Associates, March 1997 as included in this attachment

INTERNATIONAL TECHNOLOGY CORPORATION

To: Carolyn Atwood
Weiss Associates

Date: March 15, 1997

From: Arthur F. Eidson
IT Corporation

Subject: Development of Radiation Dose Limits for use in RESRAD

NOTE: Minor editorial changes by WA, March 14, 1997.

In our meeting with representatives from the Department of Energy (DOE) Oakland Office, and regulatory agencies, we were directed to perform calculations of soil action levels for radionuclides site using two risk assessment programs and compare the results. One program is the RESRAD program Version 5.62 developed at Argonne National Laboratories which calculates soil action levels that correspond to an annual radiation dose limit specified by the user. RESRAD will also calculate the cancer risk associated with exposure to radionuclides in soil according to user specified land-use scenarios. The other program is the RISKCALC program developed by U. S. Environmental Protection Agency (EPA) Region 9 office. The RISKCALC program calculates soil action levels relative to a target risk of 1E-06 for a cancer incidence and is based on land-use scenarios as specified in EPA guidance (Ref. 1).

The purpose of this exercise is compare soil action levels, and their associated risks, for cesium-137 and strontium-90 using the RISKCALC program input parameters (Ref. 1) and using a radiation dose limit in RESRAD that corresponds to a cancer risk of 1E-06. The expectation is that the two programs will calculate comparable soil action levels.

This memo describes the development of radiation dose limits used in the RESRAD calculations. Radiation risk coefficients and slope factors were taken from EPA sources.

The risk coefficient used for external radiation was 7.6E-07 $mrem^{-1}$ (Ref. 2). The radiation dose corresponding to 1E-06 cancer risk is then:

1E-06 / 7.6E-07 $mrem^{-1}$ = 1.3 mrem.

The dose rate delivered over a 30 year exposure period in a residential scenario would be:

1.3 mrem / 30 years = 0.043 mrem/year

and over a 25 year exposure period in a commercial scenario,

1.3 mrem / 25 years = 0.052 mrem/year.

The EPA has proposed a radiation dose limit of 15 mrem/year averaged over 30 years, which corresponds to a risk of approximately 3E-04 (Ref. 3).

The annual dose rate corresponding to a risk of 1E-06 would be:

(1E-06 / 3E-04) x 15 mrem/year = 0.05 mrem/year.

Thus, the annual dose limit for external radiation exposures was taken as 0.05 mrem/year for RESRAD calculations of external gamma whole-body exposures for both the residential and commercial land-use scenarios.

Sr-90

The RESRAD program differs from the RISKCALC program in its assessment of radiation dose associated with internal emitters. By analogy to the risk assessment approach used for chemicals (Ref. 1), the RISKCALC program calculates a radionuclide intake in units of pCi and applies a cancer slope factor, given in units of 1/pCi, developed for the the exposure pathway in question. This approach does not include a calculation of radiation dose assiciated with the radionuclide intake (Ref. 1).

The RESRAD program uses a dose conversion factor (DCF) developed to describe the annual radiation dose delivered to a target organ by each of the exposure pathways. This DCF value represents the annual committed effective dose equivalent that results from an annual unit radionuclide intake (Ref. 4). The target organ for cancer risk from ingestion or inhalation of strontium-90 is bone tissue. The DCF for strontium-90 ingestion is 2.28E-05 mrem/pCi of intake and, in RESRAD, is multiplied by a fraction describing the amount of strontium uptake from the gut.

The risk associated with strontium-90 ingestion is described in RESRAD by the same ingestion slope factor used in the RISKCALC program (5.60E-11 1/pCi).

Because the intake of strontium-90 by the ingestion pathway predominates over intake by inhalation, the annual radiation dose limit for cancer induction by strontium-90 was estimated using the DCF and slope factors for ingestion as follows:

Risk = (5.60E-11 1/pCi / 2.28E-05 mrem/pCi) = 2.5E-06 $mrem^{-1}$.

The annual radiation dose corresponding to1E-06 cancer risk is then approximated as:

1E-06 / 2.5E-06 mrem-1 = 0.4 mrem.

Thus, the annual dose limit was taken as 0.4 mrem/year for RESRAD calculations of internal exposures to strontium-90 for both the residential and commercial land-use scenarios.

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INTERNATIONAL TECHNOLOGY CORPORATION

By OTE Date 3/12/97 Subject RESRAD INPUT PARAMETERS Sheet No. 1 of 6
Chkd. By ____ Date ____ CORRESPONDING TO RSKCALC Proj. No. 770529

CALCULATION of RESRAD INPUT PARAMETERS CORRESPONDING TO EPA RAGS PART B VALUES!

RAGS PART B:

EF 250 days/yr Commercial

350 days/yr Residential

RESRAD: Expresses EF as fraction of time spent outdoors (on site) and fraction of time spent indoors.

From EF, Total fraction of time spent on site is:

$$\text{Com Fin} + \text{Com Fout} = \frac{250 \text{ days/yr}}{365 \text{ days/yr}} = 0.685 \quad \text{Commercial}$$

$$\text{Res Fin} + \text{Res Fout} = \frac{350 \text{ days/yr}}{365 \text{ days/yr}} = 0.959 \quad \text{Residential}$$

RAGS Part B does not discriminate between time spent indoors and outdoors in the calculation of dust inhalation, therefore, the shielding factor for inhalation variable in RESRAD will not be used (s.f. = 1).

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By GTE Date 3/12/97 Subject _____ Sheet No. 2 of 6

Chkd. By ____ Date _____ Proj. No. 770529

RESRAD includes a gamma shielding factor expressed as the ratio of gamma level indoors to the level outdoors. Thus, the RAGS Part B value of a 20% reduction gives the RESRAD value of

S = indoors/outdoors = 0.8.

RAGS Part B expresses a shielding factor from building structures and terrain as a 20% reduction in the gamma level and does not discriminate between indoor and outdoor exposures.

RAGS Part B includes a parameter (Te) to express the fraction of a day that a person is located at the site in the gamma field.

The Te values are:

Te = 0.333 Commercial

Te = 1.0 Residential

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By GTE Date 3/12/97 Subject _____ Sheet No. 3 of 6

Chkd. By ____ Date _____ Proj. No. 770529

γ Exposure RAGS = $ED \times D \times SD \times (1-Se) \times Te$

$= ED \times K \times (1-Se) \times Te$

where; K (D, SD) is a function describing the strength of the field, D x SD, which are the same values used in RESRAD

SFe = , HEAST, 1995, which is the same value used in RESRAD

γ Exposure RESRAD = $(1-Se) Fin + Fout \times ED \times$ Gamma field strength $\times 0.685$

γ Exposure RESRAD = γ Exposure RAGS

$(1-Se) Fin + Fout \times ED y \times Gamma = ED y \times (1-Se) \times Te \times Gamma$

$(1-Se) Fin + Fout = (1-Se) \times Te$ $\quad Fin + Fout = Te$

$(1-Se) Fin + (Te - Fin) = (1-Se) Te$

$(1-Se) Fin + Te - Fin = (1-Se) Te$

$Fin [(1-Se) - 1] = Te [(1-Se) - 1]$

$Fin = Te$

$Fout = 0$

For Residential Scenario, $Te = 1$, $Fin = 0.959$

Commercial Scenario, $Te = 0.333$ $\quad Fin = 0.333 \times 0.685 = 0.228$

For Commercial Scenario ingestion and inhalation exposures, Te does not apply, and $Fin = \frac{250 \text{ dy}}{365 \text{ dy}} = 0.685$

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By GFZ Date 3/12/97 Subject _____ Sheet No. 4 of 6

Chkd. By ____ Date ____ Proj. No. 770529

Soil Ingestion - Commercial

RAGS Part B: $IF_{soil} = 50\ mg/day$
(RISKCALC)

RESRAD: Express IF_{soil} in units of g/yr

$$IF_{soil} = 50\ mg/day \times 10^{-3}\ \frac{g}{mg} \times 365\ \frac{day}{yr} = 18.3\ g/yr$$

For Residential Scenario

RAGS Part B: $IF_{soil/adj} = 3600\ \frac{mg\text{-}yr}{day}$ for $ED = 30\ yr$
(RISKCALC)

RESRAD: Express IF_{soil} in units of g/year and $ED = 30\ yr$ in RESRAD

$$IF_{soil/adj} = 3600\ \frac{mg\text{-}yr}{day} \times \frac{1}{30\ yr} \times 365\ \frac{days}{yr} \times 10^{-3}\ \frac{g}{mg}$$

$$= 43.8\ g/yr$$

This agrees with Eq 12 of RAGS Part B:

$$IF_{soil/adj} = \left[\left(200\ \frac{mg}{day} \times \frac{6\ yr}{30\ yr}\right) + \left(100\ mg \times \frac{24\ y}{30\ y}\right)\right] \times 365\ \frac{day}{yr} \times 10^{-3}\ \frac{g}{mg}$$

$$= 43.8\ g/yr$$

INTERNATIONAL TECHNOLOGY CORPORATION

By GFZ Date 3/12/97 Subject _____ Sheet No. 5 of 6

Chkd. By ____ Date _____ Proj. No. 770529

Inhalation Rate - Commercial

RAGS Part B: $IR_{air} = 20\ m^3/day$
(RISKCALC)

RESRAD: Expressed IR in units of m^3/yr

$$IR_{air} = 20\ m^3/day \times 365\ days/yr$$
$$= 7.3 \times 10^3\ m^3/yr$$

For the Residential Scenario

RAGS Part B: $IR_{air} = 15\ m^3/day$
(RISKCALC)

RESRAD: $IR_{air} = 15\ m^3/day \times 365\ days/yr = 5.475 \times 10^3\ m^3/yr$

INTERNATIONAL TECHNOLOGY CORPORATION

By GFZ Date 3/12/97 Subject _____ Sheet No. 6 of 6

Chkd. By ____ Date _____ Proj. No. 220529

Particulate Emission Factor

RAGS Part B: PEF = 4.63×10^9 m^3/kg
(RISKCALC)

RESRAD Default: Mass Loading for Inhalation Factor

$$ML = 2 \times 10^{-4} \ g/m^3$$

The ML variable is the air/soil concentration of contaminated soil particles and takes into account short periods of high mass loading and sustained periods of normal activity on a typical farm (RESRAD Manual 5.0, pg 142).

The PEF is a factor derived from the EPA report EPA/600/8-85/002, 1985. These two approaches are quite different in concept. However, they are applied in this exercise in the following manner:

1. The default PEF = 4.63×10^9 m^3/kg was converted to the units of the mass loading for inhalation variable, ML:

$$\frac{1}{4.63 \times 10^9 \ m^3/kg} \times \frac{10^3 g}{kg} = 2.2 \times 10^{-7} \ g/m^3$$

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RESRAD, Version 5.62 T½ Limit = 0.5 year 03/12/97 01:15 Page 2
Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Cs137 RESIDENTIAL
File : RESCS1.DAT

Dose Conversion Factor (and Related) Parameter Summary
File: RESCALC.BIN

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

RESRAD, Version 5.62 T½ Limit = 0.5 year 03/12/97 01:15 Page 3
Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Cs137 RESIDENTIAL
File : RESCS1.DAT

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.070E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	5.000E-02	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.530E-02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.430E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.000E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	7.120E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	4.300E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.700E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	3.076E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	3.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	7.750E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT

R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

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Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Cs137 RESIDENTIAL
File : RESCS1.DAT

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.902E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	5.475E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.200E-07	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	0.000E+00	3.000E+00	---	LM
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	9.590E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	0.000E+00	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.000E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR

C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	---	STOR_T(2)
STOR	Milk	not used	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	---	STOR_T(4)
STOR	Fish	not used	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	---	STOR_T(6)
STOR	Well water	not used	1.000E+00	---	STOR_T(7)
STOR	Surface water	not used	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average annual wind speed (m/sec)	not used	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active

2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed

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Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Sr90 RESIDENTIAL
File : RESSR1.DAT

Dose Conversion Factor (and Related) Parameter Summary
File: RESCALC.BIN

0 Menu	Parameter	Current Value	Parameter Default	Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Sr-90+D	2.280E-05	1.530E-04	DCF3(1)
D-34	Food transfer factors:			
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(1,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(1,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Sr90 RESIDENTIAL
File : RESSR1.DAT

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.070E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E-01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.387E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.430E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.000E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	7.120E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	4.300E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.700E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	3.076E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	3.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	7.750E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT

R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.300E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	5.475E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.200E-07	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	0.000E+00	3.000E+00	---	LM
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	9.590E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	0.000E+00	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.000E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR

C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	---	STOR_T(2)
STOR	Milk	not used	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	---	STOR_T(4)
STOR	Fish	not used	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	---	STOR_T(6)
STOR	Well water	not used	1.000E+00	---	STOR_T(7)
STOR	Surface water	not used	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average annual wind speed (m/sec)	not used	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active

3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed

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Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Sr90 COMMERCIAL
File : COMSR1.DAT

Dose Conversion Factor (and Related) Parameter Summary
File: COMCALC.BIN

0 Menu	Parameter	Current Value	Parameter Default	Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Sr-90+D	2.280E-05	1.530E-04	DCF3(1)
D-34	Food transfer factors:			
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(1,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(1,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Sr90 COMMERCIAL
File : COMSR1.DAT

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.070E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E-01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Sr-90	3.457E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.430E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.000E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	7.120E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	4.300E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.700E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	3.076E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	3.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	7.750E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT

R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.300E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.200E-07	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.850E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	0.000E+00	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.830E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.000E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR

C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	---	STOR_T(2)
STOR	Milk	not used	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	---	STOR_T(4)
STOR	Fish	not used	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	---	STOR_T(6)
STOR	Well water	not used	1.000E+00	---	STOR_T(7)
STOR	Surface water	not used	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average annual wind speed (m/sec)	not used	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active

3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed

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Dose Conversion Factor (and Related) Parameter Summary
File: RISKCALC.BIN

0 Menu	Parameter	Current Value	Parameter Default	Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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Summary : LEHR SOIL CALCULATIONS COMPARISON W/ RISKCALC - Cs137 COMMERCIAL
File : COMCS1.DAT

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.070E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	5.000E-02	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.067E-01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.430E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.000E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	7.120E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	4.300E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.700E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	3.076E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	3.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	7.750E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT

R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.902E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.200E-07	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	2.280E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	0.000E+00	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

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File : COMCS1.DAT

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default	(If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.830E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.000E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR

C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	---	STOR_T(2)
STOR	Milk	not used	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	---	STOR_T(4)
STOR	Fish	not used	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	---	STOR_T(6)
STOR	Well water	not used	1.000E+00	---	STOR_T(7)
STOR	Surface water	not used	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average annual wind speed (m/sec)	not used	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active

3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed

ATTACHMENT B -

BACKGROUND CALCULATIONS

Attachment B: Calculation of Background Concentrations

Methodology

Statistical methods were used for characterizing background metals concentrations, calculating background cutoff values, and estimating the uncertainties in these cutoff values. Soil sampling results from operations areas of the LEHR site will be compared to the background cutoff concentrations determined here. A 95th quantile (or percentile) statistical approach was selected to determine the background cut off values when sufficient data were available.

Background metals concentration data were tested to decide whether the underlying population can be modeled by the lognormal distribution[1]. The data were log transformed and tested by the Shapiro-Wilk *W* test (Gilbert, 1987) to establish normality of the transformed data. The transformed data sets that passed the *W* test with a reasonable significance level were assumed to be drawn from a lognormal population.

Two sample statistics of the transformed data, the sample mean, $\bar{X}$, and the sample standard deviation, S_x, were calculated. These statistics were used to estimate quantiles (or percentiles) of the untransformed lognormal population distribution by the following formula:

$$\hat{X}p = \exp(\bar{X} + Z_p S_x)$$

where Z_p cuts off 100(1-p)% of the upper tail of the normal distribution.

The 95th percentile was selected to establish the cutoff value for background metals concentrations because it presents a reasonably low probability of making decision errors. Concentrations of metals in operation area soil samples that are greater than the 95th percentile cutoff value will be falsely concluded to be above background about five percent of the time (called a "type I error" in statistical hypothesis testing). The Z_p value cutting off 95% of the upper tail of the normal distribution is 1.645.

Sample data were used to estimate the true 95th percentile of the background metals distributions. Transformed data fitting the normal model, were used to calculate the upper confidence limit (UCL) on the estimated 95th percentile by use of the following formula (Gilbert, 1987):

---

[1] The histograms of naturally-occurring metals concentrations in soil can likely be modeled by lognormal density functions (USEPA, 1992), which are used to model many types of environmental data (Ellgas, 1996).

$$UC\,L_1 - \frac{\alpha}{2}(\hat{X}\,p) = \bar{X} + S_x K_1 - \frac{\alpha}{2}, p$$

where

$\alpha = 5\%$

$p = 95\%$

$K_1 - \frac{\alpha}{2}, p$ = estimating factor for specified x, p from Table A3 (Gilbert, 1987)

The lower confidence limit (LCL) on the estimated 95th percentile was approximated by assuming that, at the tail of the normal distribution, interpolation and extrapolation are approximately linear; therefore,

$$LC\,L_1 - \frac{\alpha}{2}(\hat{X}\,p) = \hat{X}\,p - [\exp(\bar{X} + S_x K_1 - \frac{\alpha}{2}, p) - \hat{X}\,p] = 2\,\hat{X}\,p - \exp(\bar{X} + S_x K_1 - \frac{\alpha}{2}, p)$$

Converting these transformed confidence limits back into the original untransformed space introduces a bias into the statistics. The approximate bias factor is (Gilbert, 1987):

$$\exp(\frac{S_x^2}{2_n})$$

where

n = sample size

The background data for 20 metals were inspected for outlying data points and non-detect results. Non-detect sample results were assigned a numerical value equal to one half the detection limit if the data contained less than 50% non-detect results (mercury, selenium). One data point was removed from the beryllium data set because the concentration was found to be below the 1% lower percentile of the log transformed data set when modeled by the normal distribution. Two data points were removed from the manganese data set because the data were flagged for concentrations measured above the calibration limits of the laboratory analytical instrument (the accuracy of these two data points is in question).

The 95th percentile was not calculated for antimony, cadmium, molybdenum, silver, and thallium, due to the lack of detected concentrations. Instead, the upper guidance limit was calculated (twice the maximum detected concentration).

All of the remaining data sets were found have reasonable significance levels when tested by the Shapiro-Wilk *W* test on the log transformed data. Log normal distributions were assumed and the 95th percentile was calculated for each.

Supporting data sets and histograms are attached, along with the results.

Background Soil Statistics, LEHR Facility, Davis, California

Compound	Lognormal ? (Y/N)	95'th Quantile (mg/kg)	95 % Lower Confidence Limit on 95'th Quantile (mg/kg)	95 % Upper Confidence Limit on 95'th Quantile (mg/kg)
Antimony	N/A	N/A	N/A	N/A
Arsenic	Borderline	10.47	8.9	12
Barium	Y	284	212	356
Beryllium	Y	0.78	0.59	0.97
Cadmium	N/A	N/A	N/A	N/A
Chromium	Y	223	152	294
Hexavalent Chromium	Y	0.147	0.071	0.223
Cobalt	Y	33	27	39
Copper	Y	60	45	74
Iron	Borderline	45,000	40,000	51,000
Lead	Borderline	11.5	9.4	13.7
Manganese	Y	785	686	884
Mercury	Y	1.09	0.07	2.12
Molybdenum	N/A	N/A	N/A	N/A
Nickel	Y	423	271	574
Selenium	Y	1.48	0.79	2.17
Silver	N/A	N/A	N/A	N/A
Thallium	N/A	N/A	N/A	N/A
Vanadium	Y	81	69	93
Zinc	Y	94	75	112

notes:

N/A = Not Applicable. Not enough data to calculate statistics.

Site ID	Samp ID	Samp Dept	LabChem	CONC		Bin	
BGL00001	SSBG0001	0.00	Antimony	0.37			
BGL00002	SSBG0010	0.00	Antimony	6			
BGL00003	SSBG0019	0.00	Antimony	6			
BGL00004	SSBG0028	0.00	Antimony	6			
BGL00004	SSBG0029	0.00	Antimony	6			
BGL00005	SSBG0038	0.00	Antimony	6			
BGL00006	SSBG0047	0.00	Antimony	6			
BGL00006	SSBG0048	0.00	Antimony	6			
BGL00001	SSBG0002	4.00	Antimony	6			
BGL00002	SSBG0011	4.00	Antimony	6			
BGL00003	SSBG0020	4.00	Antimony	6			
BGL00004	SSBG0030	4.00	Antimony	6			
BGL00005	SSBG0039	4.00	Antimony	6			
BGL00006	SSBG0049	4.00	Antimony	6			
BGL00001	SSBG0005	19.00	Antimony	6			
BGL00002	SSBG0014	19.00	Antimony	6			
BGL00003	SSBG0023	19.00	Antimony	6			
BGL00004	SSBG0033	19.00	Antimony	6			
BGL00005	SSBG0042	19.00	Antimony	6			
BGL00006	SSBG0052	19.00	Antimony	6			
BGL00001	SSBG0009	39.00	Antimony	6			
BGL00002	SSBG0018	39.00	Antimony	6			
BGL00003	SSBG0027	39.00	Antimony	6			
BGL00004	SSBG0037	39.00	Antimony	6			
BGL00005	SSBG0046	39.00	Antimony	6			
BGL00006	SSBG0056	39.00	Antimony	6			

Note: Shaded numbers are non detects treated here as one half the detection limit of 12.

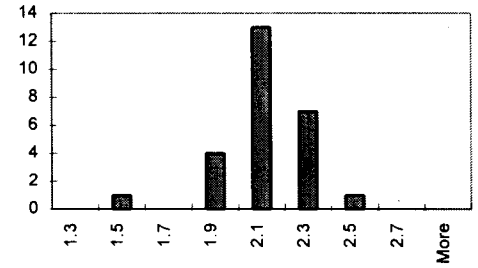
Site ID	Samp ID	Samp De	LabChem	CONC	ln CONC	Ln CONC Ranked
BGL00001	SSBG0001	0.00	Arsenic	7.5	2.015	1.3862944
BGL00002	SSBG0010	0.00	Arsenic	8.5	2.140	1.856298
BGL00003	SSBG0019	0.00	Arsenic	6.5	1.872	1.8718022
BGL00004	SSBG0028	0.00	Arsenic	7.2	1.974	1.8718022
BGL00004	SSBG0029	0.00	Arsenic	7.1	1.960	1.8870696
BGL00005	SSBG0038	0.00	Arsenic	8.6	2.152	1.9459101
BGL00006	SSBG0047	0.00	Arsenic	7.1	1.960	1.9459101
BGL00006	SSBG0048	0.00	Arsenic	7.5	2.015	1.9600948
BGL00001	SSBG0002	4.00	Arsenic	6.4	1.856	1.9600948
BGL00002	SSBG0011	4.00	Arsenic	8	2.079	1.974081
BGL00003	SSBG0020	4.00	Arsenic	7	1.946	1.9878743
BGL00004	SSBG0030	4.00	Arsenic	6.5	1.872	1.9878743
BGL00005	SSBG0039	4.00	Arsenic	7.3	1.988	2.014903
BGL00006	SSBG0049	4.00	Arsenic	7.3	1.988	2.014903
BGL00001	SSBG0005	19.00	Arsenic	7.8	2.054	2.0541237
BGL00002	SSBG0014	19.00	Arsenic	8	2.079	2.0668628
BGL00003	SSBG0023	19.00	Arsenic	6.6	1.887	2.0794415
BGL00004	SSBG0033	19.00	Arsenic	7	1.946	2.0794415
BGL00005	SSBG0042	19.00	Arsenic	7.9	2.067	2.1400662
BGL00006	SSBG0052	19.00	Arsenic	8.5	2.140	2.1400662
BGL00001	SSBG0009	39.00	Arsenic	4	1.386	2.1517622
BGL00002	SSBG0018	39.00	Arsenic	9.1	2.208	2.1747517
BGL00003	SSBG0027	39.00	Arsenic	8.8	2.175	2.2082744
BGL00004	SSBG0037	39.00	Arsenic	9.5	2.251	2.2512918
BGL00005	SSBG0046	39.00	Arsenic	11.9	2.477	2.2617631
BGL00006	SSBG0056	39.00	Arsenic	9.6	2.262	2.4765384

Mean [Ln(conc)]	2.0288191
Std Dev [Ln(conc)]	0.1945994
Z	1.645
95 th Quantile (mg/Kg)	**10.47**
Bias %	0.07 (OK, <5%)

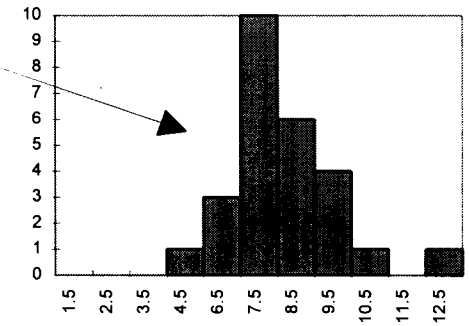
95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**8.9**
95% UL (mg/kg)=	**12.0**

1.1	*Bin*	*Frequency*
1.3	1.3	0
1.5	1.5	1
1.7	1.7	0
1.9	1.9	4
2.1	2.1	13
2.3	2.3	7
2.5	2.5	1
2.7	2.7	0
	More	0



1.5	*Bin*	*Frequency*
2.5	1.5	0
3.5	2.5	0
4.5	3.5	0
6.5	4.5	1
7.5	6.5	3
8.5	7.5	10
9.5	8.5	6
10.5	9.5	4
11.5	10.5	1
12.5	11.5	0
	12.5	1
	More	0



LEHR Facility, Davis, California

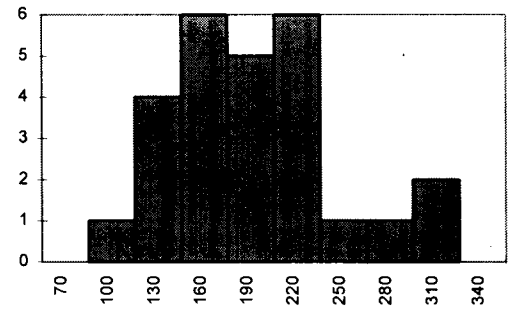
Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i		x_i	$(x_i)^2$	x_i		$a^*(x_{n-i+1} - x_i)$	
(# Samples)	CONC	LN (Conc)	$[LN(Conc)]^2$	Ranked	a stats	(n=26)	**W**
1	7.5	2.015	4.060	1.38629436	0.4407	0.4804705	**0.90509**
2	8.5	2.140	4.580	1.85629799	0.3043	0.123383	
3	6.5	1.872	3.504	1.87180218	0.2533	0.0961247	**d**
4	7.2	1.974	3.897	1.87180218	0.2151	0.0723752	**0.94672**
5	7.1	1.960	3.842	1.88706965	0.1836	0.0528184	
6	8.6	2.152	4.630	1.94591015	0.1563	0.0321747	
7	7.1	1.960	3.842	1.94591015	0.1316	0.0255509	
8	7.5	2.015	4.060	1.96009478	0.1089	0.0195989	
9	6.4	1.856	3.446	1.96009478	0.0876	0.0104548	
10	8	2.079	4.324	1.97408103	0.0672	0.0070802	
11	7	1.946	3.787	1.98787435	0.0476	0.0037598	
12	6.5	1.872	3.504	1.98787435	0.0284	0.0018815	
13	7.3	1.988	3.952	2.01490302	0.0094	0	
14	7.3	1.988	3.952	2.01490302			
15	7.8	2.054	4.219	2.05412373			
16	8	2.079	4.324	2.06686276			
17	6.6	1.887	3.561	2.07944154			
18	7	1.946	3.787	2.07944154			
19	7.9	2.067	4.272	2.14006616			
20	8.5	2.140	4.580	2.14006616			
21	4	1.386	1.922	2.1517622			
22	9.1	2.208	4.876	2.17475172			
23	8.8	2.175	4.730	2.20827441			
24	9.5	2.251	5.068	2.2512918			
25	11.9	2.477	6.133	2.2617631			
26	9.6	2.262	5.116	2.4765384			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		2782.488	107.965				

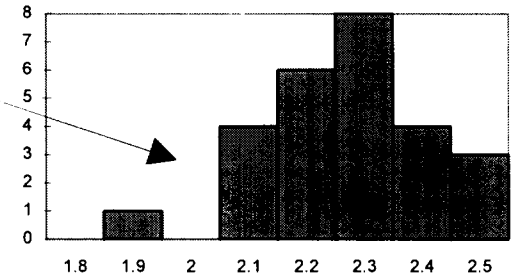
W is less than 0.92.
Cannot assume lognormal distribution.

Site I	Samp ID	Samp Dept	LabChem	CONC	log conc	Ln CONC	Bin
BGL0	SSBG0001	0.00	Barium	146	2.164	4.984	70
BGL0	SSBG0010	0.00	Barium	162	2.210	5.088	100
BGL0	SSBG0019	0.00	Barium	143	2.155	4.963	130
BGL0	SSBG0028	0.00	Barium	136	2.134	4.913	160
BGL0	SSBG0029	0.00	Barium	123	2.090	4.812	190
BGL0	SSBG0038	0.00	Barium	180	2.255	5.193	220
BGL0	SSBG0047	0.00	Barium	152	2.182	5.024	250
BGL0	SSBG0048	0.00	Barium	181	2.258	5.198	280
BGL0	SSBG0002	4.00	Barium	116	2.064	4.754	310
BGL0	SSBG0011	4.00	Barium	233	2.367	5.451	340
BGL0	SSBG0020	4.00	Barium	193	2.286	5.263	
BGL0	SSBG0030	4.00	Barium	107	2.029	4.673	
BGL0	SSBG0039	4.00	Barium	117	2.068	4.762	
BGL0	SSBG0049	4.00	Barium	171	2.233	5.142	1.8
BGL0	SSBG0005	19.00	Barium	147	2.167	4.990	1.9
BGL0	SSBG0014	19.00	Barium	215	2.332	5.371	2
BGL0	SSBG0023	19.00	Barium	155	2.190	5.043	2.1
BGL0	SSBG0033	19.00	Barium	191	2.281	5.252	2.2
BGL0	SSBG0042	19.00	Barium	177	2.248	5.176	2.3
BGL0	SSBG0052	19.00	Barium	199	2.299	5.293	2.4
BGL0	SSBG0009	39.00	Barium	73.1	1.864	4.292	2.5
BGL0	SSBG0018	39.00	Barium	255	2.407	5.541	
BGL0	SSBG0027	39.00	Barium	207	2.316	5.333	
BGL0	SSBG0037	39.00	Barium	285	2.455	5.652	
BGL0	SSBG0046	39.00	Barium	209	2.320	5.342	
BGL0	SSBG0056	39.00	Barium	308	2.489	5.730	

Bin	*Frequency*
70	0
100	1
130	4
160	6
190	5
220	6
250	1
280	1
310	2
340	0
More	0



Bin	*Frequency*
1.8	0
1.9	1
2	0
2.1	4
2.2	6
2.3	8
2.4	4
2.5	3
More	0



Mean [Ln(conc)]	5.1244294
Std Dev [Ln(conc)]	0.3190558
Z	1.645
95 th Quantile (mg/Kg)	**284**
Bias %	0.20 (OK, <5%)
95 % Confidence Limits on 95 th Quantile	
a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**212**
95% UL (mg/kg)=	**356**

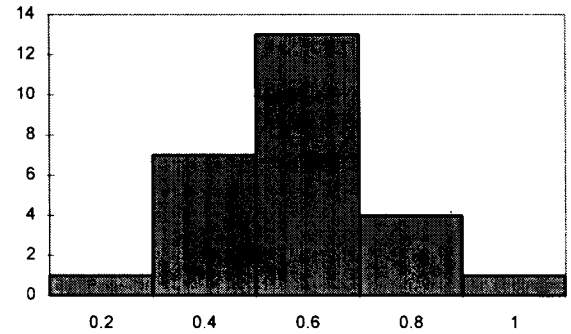
Note: Dotted cell is number that should be disregarded for the 95 UCL calculation because it is in excess of 2 stand. deviations, but it has been included in the above histograms.

Barium

conc	ln(conc)	ln(conc)^2		rank number	ln(conc)rank	a stats	W stat	
146	4.984	24.836		1.000	4.292	0.4407	0.633846	
162	5.088	25.884		2.000	4.673	0.3043	0.298111	
143	4.963	24.630		3.000	4.754	0.2533	0.199518	
136	4.913	24.134		4.000	4.762	0.2151	0.148175	
123	4.812	23.157		5.000	4.812	0.1836	0.102532	
180	5.193	26.967		6.000	4.913	0.1563	0.067159	
152	5.024	25.239		7.000	4.963	0.1316	0.048675	
181	5.198	27.024		8.000	4.984	0.1089	0.033726	
116	4.754	22.597		9.000	4.990	0.0876	0.02385	
233	5.451	29.714		10.000	5.024	0.0672	0.015348	
193	5.263	27.696		11.000	5.043	0.0476	0.007381	
107	4.673	21.835		12.000	5.088	0.0284	0.002992	
117	4.762	22.678		13.000	5.142	0.0094	0.000324	
171	5.142	26.437		14.000	5.176		**1.582**	this is sum for W
147	4.990	24.904		15.000	5.193		**2.502**	this is sq of sum for W
215	5.371	28.844		16.000	5.198			
155	5.043	25.436		17.000	5.252			
191	5.252	27.586		18.000	5.263		**0.983**	**this is W**
177	5.176	26.793		19.000	5.293			**W is > 0.92; assume log normal distribution**
199	5.293	28.019		20.000	5.333			
73.1	4.292	18.420		21.000	5.342			
255	5.541	30.706		22.000	5.371			
207	5.333	28.438		23.000	5.451			
285	5.652	31.951		24.000	5.541			
209	5.342	28.541		25.000	5.652			
308	5.730	32.834		26.000	5.730			
	5.124	**685.299**						
	133.235							
	17751.60893	**2.544914681**	this is the d value					

Site ID	Samp ID	Samp De	LabChem	CONC	Ln CONC	Bin
BGL0000	SSBG000	0	Beryllium	0.53	-0.6348783	0.2
BGL0000	SSBG000	4	Beryllium	0.45	-0.7985077	0.4
BGL0000	SSBG000	19	Beryllium	0.62	-0.4780358	0.6
BGL0000	SSBG000	39	Beryllium	0.32	-1.1394343	0.8
BGL0000	SSBG001	0	Beryllium	0.53	-0.6348783	1
BGL0000	SSBG001	4	Beryllium	0.88	-0.1278334	
BGL0000	SSBG001	19	Beryllium	0.08	N/A	
BGL0000	SSBG001	39	Beryllium	0.53	-0.6348783	
BGL0000	SSBG001	0	Beryllium	0.49	-0.7133499	
BGL0000	SSBG002	4	Beryllium	0.61	-0.4942963	
BGL0000	SSBG002	19	Beryllium	0.7	-0.3566749	
BGL0000	SSBG002	39	Beryllium	0.79	-0.2357223	
BGL0000	SSBG002	0	Beryllium	0.33	-1.1086626	
BGL0000	SSBG002	0	Beryllium	0.37	-0.9942523	
BGL0000	SSBG003	4	Beryllium	0.3	-1.2039728	
BGL0000	SSBG003	19	Beryllium	0.57	-0.5621189	
BGL0000	SSBG003	39	Beryllium	0.44	-0.8209806	
BGL0000	SSBG003	0	Beryllium	0.38	-0.967584	
BGL0000	SSBG003	4	Beryllium	0.27	-1.3093333	
BGL0000	SSBG004	19	Beryllium	0.55	-0.597837	
BGL0000	SSBG004	39	Beryllium	0.47	-0.7550226	
BGL0000	SSBG004	0	Beryllium	0.39	-0.9416085	
BGL0000	SSBG004	0	Beryllium	0.44	-0.8209806	
BGL0000	SSBG004	4	Beryllium	0.42	-0.8675006	
BGL0000	SSBG005	19	Beryllium	0.54	-0.6161861	
BGL0000	SSBG005	39	Beryllium	0.6	-0.5108256	

Bin	*Frequency*
0.2	1
0.4	7
0.6	13
0.8	4
1	1
More	0



N/A = Not Applicable. Data point is below 1% quantile of distribution

Mean [Ln(conc)]	-0.7330142
Std Dev [Ln(conc)]	0.2945547
Z	1.645
95 th Quantile (mg/Kg)	**0.78**
Bias %	0.17 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.372
95% LL (mg/kg) =	**0.59**
95% UL (mg/kg)=	**0.97**

LEHR Facility, Davis, California

Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=25)
1	0.53	-0.635	0.403	-1.309333	0.4450	0.52576748
2	0.45	-0.799	0.638	-1.203973	0.3069	0.29715607
3	0.62	-0.478	0.229	-1.139434	0.2543	0.1990557
4	0.32	-1.139	1.298	-1.108663	0.2148	0.13545864
5	0.53	-0.635	0.403	-0.994252	0.1822	0.09109197
6	0.88	-0.128	0.016	-0.967584	0.1539	0.07029512
7	0.53	-0.635	0.403	-0.941609	0.1283	0.04868852
8	0.49	-0.713	0.509	-0.867501	0.1046	0.02820681
9	0.61	-0.494	0.244	-0.820981	0.0823	0.01685458
10	0.7	-0.357	0.127	-0.820981	0.0610	0.01135224
11	0.79	-0.236	0.056	-0.798508	0.0403	0.00659427
12	0.33	-1.109	1.229	-0.755023	0.0200	0.00240289
13	0.37	-0.994	0.989	-0.71335	0.0000	0
14	0.3	-1.204	1.450	-0.634878		
15	0.57	-0.562	0.316	-0.634878		
16	0.44	-0.821	0.674	-0.634878		
17	0.38	-0.968	0.936	-0.616186		
18	0.27	-1.309	1.714	-0.597837		
19	0.55	-0.598	0.357	-0.562119		
20	0.47	-0.755	0.570	-0.510826		
21	0.39	-0.942	0.887	-0.494296		
22	0.44	-0.821	0.674	-0.478036		
23	0.42	-0.868	0.753	-0.356675		
24	0.54	-0.616	0.380	-0.235722		
25	0.6	-0.511	0.261	-0.127833		

$[SUM (x_i)]^2$	$SUM (x_i^2)$
335.819	15.515

W
0.9860601

W is greater than 0.918.
Cannot rule out lognormal distribution.

d
2.082299

Samp ID	CONC	
SSBG0014	0.08	Removed from calculation Data point is below 1% quantile

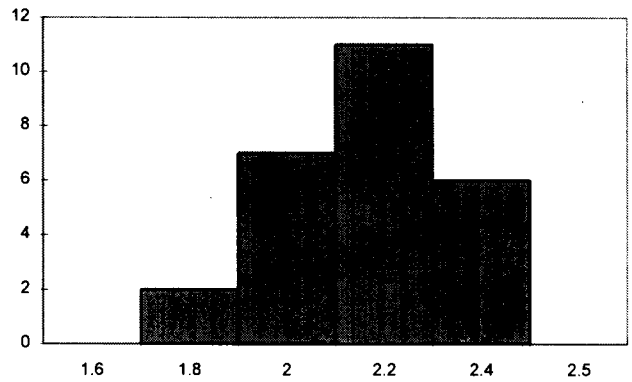
Mean [Ln(conc)]	-0.733
Std Dev [Ln(conc)]	0.29455
Z	-2.33
1% Quantile (mg/Kg)	**0.24188**

Site ID	Samp ID	Samp De	LabChem	CONC		Bin		
BGL0000	SSBG000	0.00	Cadmium	0.23				
BGL0000	SSBG001	0.00	Cadmium	0.50				
BGL0000	SSBG001	0.00	Cadmium	0.50				
BGL0000	SSBG002	0.00	Cadmium	0.50				
BGL0000	SSBG002	0.00	Cadmium	0.50				
BGL0000	SSBG003	0.00	Cadmium	0.50				
BGL0000	SSBG004	0.00	Cadmium	0.50				
BGL0000	SSBG004	0.00	Cadmium	0.50				
BGL0000	SSBG000	4.00	Cadmium	0.50				
BGL0000	SSBG001	4.00	Cadmium	0.50				
BGL0000	SSBG002	4.00	Cadmium	0.50				
BGL0000	SSBG003	4.00	Cadmium	0.50				
BGL0000	SSBG003	4.00	Cadmium	0.50				
BGL0000	SSBG004	4.00	Cadmium	0.50				
BGL0000	SSBG000	19.00	Cadmium	0.50				
BGL0000	SSBG001	19.00	Cadmium	0.50				
BGL0000	SSBG002	19.00	Cadmium	0.50				
BGL0000	SSBG003	19.00	Cadmium	0.50				
BGL0000	SSBG004	19.00	Cadmium	0.50				
BGL0000	SSBG005	19.00	Cadmium	0.50				
BGL0000	SSBG000	39.00	Cadmium	0.50				
BGL0000	SSBG001	39.00	Cadmium	0.50				
BGL0000	SSBG002	39.00	Cadmium	0.50				
BGL0000	SSBG003	39.00	Cadmium	0.50				
BGL0000	SSBG004	39.00	Cadmium	0.50				
BGL0000	SSBG005	39.00	Cadmium	0.50				
Note: all shaded numbers are non detects treated here as one half the detection limit of 1.								

Chromium

SITE_ID	SAMP_ID	SAMP_D	LAB_CH	CONC	logconc	Ln CONC	BIN
BGL0000	SSBG002	19.00	Chromium	59.6	1.78	4.09	1.6
BGL0000	SSBG005	19.00	Chromium	60.0	1.78	4.09	1.8
BGL0000	SSBG000	39.00	Chromium	69.4	1.84	4.24	2
BGL0000	SSBG004	19.00	Chromium	74.4	1.87	4.31	2.2
BGL0000	SSBG002	39.00	Chromium	83.9	1.92	4.43	2.4
BGL0000	SSBG003	39.00	Chromium	86.4	1.94	4.46	2.5
BGL0000	SSBG004	39.00	Chromium	86.8	1.94	4.46	
BGL0000	SSBG001	39.00	Chromium	87.2	1.94	4.47	
BGL0000	SSBG003	19.00	Chromium	87.7	1.94	4.47	
BGL0000	SSBG005	39.00	Chromium	108.0	2.03	4.68	
BGL0000	SSBG000	19.00	Chromium	110.0	2.04	4.70	
BGL0000	SSBG001	19.00	Chromium	110.0	2.04	4.70	
BGL0000	SSBG004	4.00	Chromium	119.0	2.08	4.78	
BGL0000	SSBG003	0.00	Chromium	123.0	2.09	4.81	
BGL0000	SSBG001	4.00	Chromium	127.0	2.10	4.84	
BGL0000	SSBG001	0.00	Chromium	135.0	2.13	4.91	
BGL0000	SSBG002	0.00	Chromium	145.0	2.16	4.98	
BGL0000	SSBG002	4.00	Chromium	147.0	2.17	4.99	
BGL0000	SSBG004	0.00	Chromium	148.0	2.17	5.00	
BGL0000	SSBG004	0.00	Chromium	151.0	2.18	5.02	
BGL0000	SSBG001	0.00	Chromium	160.0	2.20	5.08	
BGL0000	SSBG000	0.00	Chromium	165.0	2.22	5.11	
BGL0000	SSBG002	0.00	Chromium	184.0	2.26	5.21	
BGL0000	SSBG003	4.00	Chromium	199.0	2.30	5.29	
BGL0000	SSBG000	4.00	Chromium	214.0	2.33	5.37	
BGL0000	SSBG003	4.00	Chromium	251.0	2.40	5.53	

Bin	*Frequency*
1.6	0
1.8	2
2	7
2.2	11
2.4	6
2.5	0
More	0



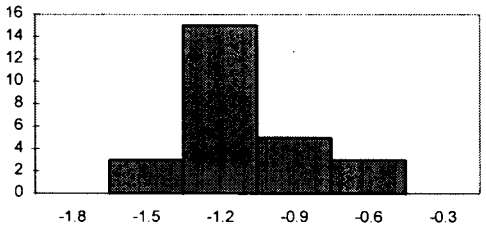
Mean [Ln(conc)]	4.76969223	
Std Dev [Ln(conc)]	0.38736459	
Z	1.645	
95 th Quantile (mg/Kg)	**223**	
Bias %	0.29	(OK, <5%)
95 % Confidence Limits on 95 th Quantile		
a = 5%		
p = 95%		
K (estimating factor) =	2.3556	
95% LL (mg/kg) =	**152**	
95% UL (mg/kg)=	**294**	

Chromium

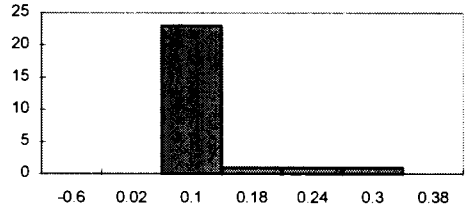
CONC	lnconc	lnconc^2	rank number	lnconc rank	a stats	W stats	
59.6	4.088	16.709	1.000	4.088	0.4407	0.633637299	
60.0	4.094	16.764	2.000	4.094	0.3043	0.386957451	
69.4	4.240	17.977	3.000	4.240	0.2533	0.266830769	
74.4	4.309	18.571	4.000	4.309	0.2151	0.194768708	
83.9	4.430	19.622	5.000	4.430	0.1836	0.124172326	
86.4	4.459	19.883	6.000	4.459	0.1563	0.096309894	
86.8	4.464	19.924	7.000	4.464	0.1316	0.072863395	
87.2	4.468	19.965	8.000	4.468	0.1089	0.057608965	
87.7	4.474	20.016	9.000	4.474	0.0876	0.045246336	
108.0	4.682	21.922	10.000	4.682	0.0672	0.019797289	
110.0	4.700	22.095	11.000	4.700	0.0476	0.009748214	
110.0	4.700	22.095	12.000	4.700	0.0284	0.004081271	
119.0	4.779	22.840	13.000	4.779	0.0094	0.000310772	
123.0	4.812	23.157	14.000	4.812		**1.912**	this is sum for W
127.0	4.844	23.466	15.000	4.844		**3.657**	this is sq of sum for W
135.0	4.905	24.062	16.000	4.905			
145.0	4.977	24.768	17.000	4.977			
147.0	4.990	24.904	18.000	4.990		**0.975**	**this is W**
148.0	4.997	24.972	19.000	4.997			**W is > 0.92; assume log normal distribution**
151.0	5.017	25.173	20.000	5.017			
160.0	5.075	25.757	21.000	5.075			
165.0	5.106	26.071	22.000	5.106			
184.0	5.215	27.196	23.000	5.215			
199.0	5.293	28.019	24.000	5.293			
214.0	5.366	28.794	25.000	5.366			
251.0	5.525	30.531	26.000	5.525			
	4.770	**595.250**					
	124.012						
	15378.97565	**3.751**	this is the d value				

SITE_ID	SAMP_ID	SAMP_DEPTH	LAB_CHEM	CONC	logconc	LN CONC	BIN
BGL00004	SSBG0029	0.00	Chromium, Hexavalent (+6)	0.023	-1.63827	-3.772261	
BGL00003	SSBG0020	4.00	Chromium, Hexavalent (+6)	0.025	-1.60206	-3.688879	-0.3
BGL00004	SSBG0037	39.00	Chromium, Hexavalent (+6)	0.028	-1.55284	-3.575551	-0.6
BGL00001	SSBG0009	39.00	Chromium, Hexavalent (+6)	0.036	-1.4437	-3.324236	-0.9
BGL00004	SSBG0028	0.00	Chromium, Hexavalent (+6)	0.037	-1.4318	-3.296837	-1.2
BGL00001	SSBG0002	4.00	Chromium, Hexavalent (+6)	0.037	-1.4318	-3.296837	-1.5
BGL00002	SSBG0010	0.00	Chromium, Hexavalent (+6)	0.038	-1.42022	-3.270169	-1.8
BGL00003	SSBG0019	0.00	Chromium, Hexavalent (+6)	0.038	-1.42022	-3.270169	
BGL00002	SSBG0018	39.00	Chromium, Hexavalent (+6)	0.040	-1.39794	-3.218876	
BGL00002	SSBG0011	4.00	Chromium, Hexavalent (+6)	0.041	-1.38722	-3.194183	
BGL00001	SSBG0005	19.00	Chromium, Hexavalent (+6)	0.041	-1.38722	-3.194183	
BGL00003	SSBG0027	39.00	Chromium, Hexavalent (+6)	0.042	-1.37675	-3.170086	
BGL00004	SSBG0033	19.00	Chromium, Hexavalent (+6)	0.053	-1.27572	-2.937463	
BGL00002	SSBG0014	19.00	Chromium, Hexavalent (+6)	0.055	-1.25964	-2.900422	
BGL00003	SSBG0023	19.00	Chromium, Hexavalent (+6)	0.055	-1.25964	-2.900422	
BGL00005	SSBG0042	19.00	Chromium, Hexavalent (+6)	0.055	-1.25964	-2.900422	-0.6
BGL00004	SSBG0030	4.00	Chromium, Hexavalent (+6)	0.061	-1.21467	-2.796881	0.02
BGL00005	SSBG0039	4.00	Chromium, Hexavalent (+6)	0.062	-1.20761	-2.780621	0.1
BGL00006	SSBG0056	39.00	Chromium, Hexavalent (+6)	0.071	-1.14874	-2.645075	0.18
BGL00001	SSBG0001	0.00	Chromium, Hexavalent (+6)	0.077	-1.11351	-2.56395	0.24
BGL00005	SSBG0038	0.00	Chromium, Hexavalent (+6)	0.080	-1.09691	-2.525729	0.3
BGL00005	SSBG0046	39.00	Chromium, Hexavalent (+6)	0.083	-1.08092	-2.488915	0.38
BGL00006	SSBG0052	19.00	Chromium, Hexavalent (+6)	0.096	-1.01773	-2.343407	
BGL00006	SSBG0049	4.00	Chromium, Hexavalent (+6)	0.150	-0.82391	-1.89712	
BGL00006	SSBG0048	0.00	Chromium, Hexavalent (+6)	0.190	-0.72125	-1.660731	
BGL00006	SSBG0047	0.00	Chromium, Hexavalent (+6)	0.250	-0.60206	-1.386294	

Bin	*requency*
-1.8	0
-1.5	3
-1.2	15
-0.9	5
-0.6	3
-0.3	0
More	0



Bin	*requency*
-0.6	0
0.02	0
0.1	23
0.18	1
0.24	1
0.3	1
0.38	0
More	0



Mean [Ln(conc)]	-2.884605
Std Dev [Ln(conc)]	0.58672
Z	1.645
95 th Quantile (mg/Kg)	**0.147**
Bias %	0.66 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%

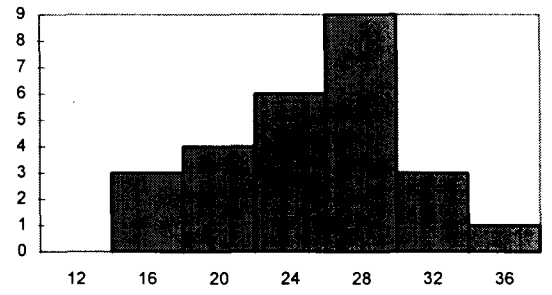
p = 95%

K (estimating factor) =	2.3556
95% LL (mg/kg) =	**0.071**
95% UL (mg/kg)=	**0.223**

CONC	lnconc	lnconc^2	rank num	lnconc rank	a stats	W stats	
0.023	-3.7722611	14.230	1	-3.772261	0.4407	1.0515	
0.025	-3.6888795	13.608	2	-3.688879	0.3043	0.61717	
0.028	-3.5755508	12.785	3	-3.575551	0.2533	0.42515	
0.036	-3.3242363	11.051	4	-3.324236	0.2151	0.21098	
0.037	-3.2968374	10.869	5	-3.296837	0.1836	0.14833	
0.037	-3.2968374	10.869	6	-3.296837	0.1563	0.12052	
0.038	-3.2701691	10.694	7	-3.270169	0.1316	0.09294	
0.038	-3.2701691	10.694	8	-3.270169	0.1089	0.06807	
0.040	-3.2188758	10.361	9	-3.218876	0.0876	0.03839	
0.041	-3.1941832	10.203	10	-3.194183	0.0672	0.0267	
0.041	-3.1941832	10.203	11	-3.194183	0.0476	0.01398	
0.042	-3.1700857	10.049	12	-3.170086	0.0284	0.00766	
0.053	-2.9374634	8.629	13	-2.937463	0.0094	0.00035	
0.055	-2.9004221	8.412	14	-2.900422		**2.822**	this is sum for W
0.055	-2.9004221	8.412	15	-2.900422		**7.962**	this is sq of sum for W
0.055	-2.9004221	8.412	16	-2.900422			
0.061	-2.7968814	7.823	17	-2.796881			
0.062	-2.7806209	7.732	18	-2.780621		**0.925**	**this is W**
0.071	-2.6450754	6.996	19	-2.645075			**W is > 0.92; assume log normal distribution**
0.077	-2.5639499	6.574	20	-2.56395			
0.080	-2.5257286	6.379	21	-2.525729			
0.083	-2.4889147	6.195	22	-2.488915			
0.096	-2.3434071	5.492	23	-2.343407			
0.150	-1.89712	3.599	24	-1.89712			
0.190	-1.6607312	2.758	25	-1.660731			
0.250	-1.3862944	1.922	26	-1.386294			
	-2.885	**224.951**					
	-75.000						
	5624.9583	**8.606**	this is the d value				

Site ID	Samp ID	Samp De	LabChem	CONC	Ln CONC	Bin
BGL0000	SSBG000	0.00	Cobalt	26.7	3.2846636	12
BGL0000	SSBG001	0.00	Cobalt	25.5	3.2386785	16
BGL0000	SSBG001	0.00	Cobalt	24.6	3.2027464	20
BGL0000	SSBG002	0.00	Cobalt	19.8	2.9856819	24
BGL0000	SSBG002	0.00	Cobalt	20.9	3.0397492	28
BGL0000	SSBG003	0.00	Cobalt	21.6	3.0726933	32
BGL0000	SSBG004	0.00	Cobalt	20.8	3.034953	36
BGL0000	SSBG004	0.00	Cobalt	24.4	3.1945831	
BGL0000	SSBG000	4.00	Cobalt	27.4	3.310543	
BGL0000	SSBG001	4.00	Cobalt	30.3	3.4111477	
BGL0000	SSBG002	4.00	Cobalt	29.7	3.391147	
BGL0000	SSBG003	4.00	Cobalt	20.4	3.0155349	
BGL0000	SSBG003	4.00	Cobalt	25.6	3.2425924	
BGL0000	SSBG004	4.00	Cobalt	21.1	3.049273	
BGL0000	SSBG000	19.00	Cobalt	25.7	3.246491	
BGL0000	SSBG001	19.00	Cobalt	26.2	3.2657594	
BGL0000	SSBG002	19.00	Cobalt	18.2	2.9014216	
BGL0000	SSBG003	19.00	Cobalt	17.7	2.8735646	
BGL0000	SSBG004	19.00	Cobalt	15.8	2.7600099	
BGL0000	SSBG005	19.00	Cobalt	15.8	2.7600099	
BGL0000	SSBG000	39.00	Cobalt	12.6	2.5336968	
BGL0000	SSBG001	39.00	Cobalt	23.2	3.1441523	
BGL0000	SSBG002	39.00	Cobalt	25	3.2188758	
BGL0000	SSBG003	39.00	Cobalt	29.1	3.3707382	
BGL0000	SSBG004	39.00	Cobalt	17.7	2.8735646	
BGL0000	SSBG005	39.00	Cobalt	32.9	3.4934727	

Bin	*Frequency*
12	0
16	3
20	4
24	6
28	9
32	3
36	1
More	0



Mean [Ln(conc)]	3.112144
Std Dev [Ln(conc)]	0.2309655
Z	1.645
95 th Quantile (mg/Kg)	**33**
Bias %	0.10 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**27**
95% UL (mg/kg)=	**39**

LEHR Facility, Davis, California

Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

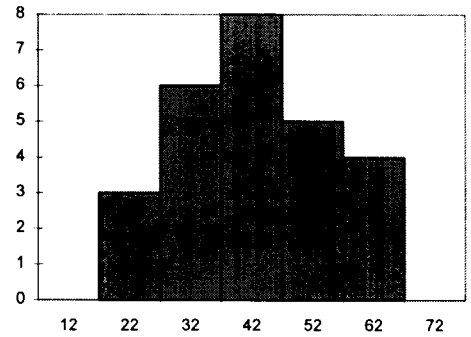
i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=26)
1	26.7	3.285	10.789	2.5337	0.4407	0.422973214
2	25.5	3.239	10.489	2.76001	0.3043	0.198141224
3	24.6	3.203	10.258	2.76001	0.2533	0.159867029
4	19.8	2.986	8.914	2.87356	0.2151	0.106942027
5	20.9	3.040	9.240	2.87356	0.1836	0.080229229
6	21.6	3.073	9.441	2.90142	0.1563	0.05990072
7	20.8	3.035	9.211	2.98568	0.1316	0.036858195
8	24.4	3.195	10.205	3.01553	0.1089	0.025151118
9	27.4	3.311	10.960	3.03495	0.0876	0.018189208
10	30.3	3.411	11.636	3.03975	0.0672	0.013368049
11	29.7	3.391	11.500	3.04927	0.0476	0.008073093
12	20.4	3.016	9.093	3.07269	0.0284	0.003693509
13	25.6	3.243	10.514	3.14415	0.0094	0.00047405
14	21.1	3.049	9.298	3.19458		
15	25.7	3.246	10.540	3.20275		
16	26.2	3.266	10.665	3.21888		
17	18.2	2.901	8.418	3.23868		
18	17.7	2.874	8.257	3.24259		
19	15.8	2.760	7.618	3.24649		
20	15.8	2.760	7.618	3.26576		
21	12.6	2.534	6.420	3.28466		
22	23.2	3.144	9.886	3.31054		
23	25	3.219	10.361	3.37074		
24	29.1	3.371	11.362	3.39115		
25	17.7	2.874	8.257	3.41115		
26	32.9	3.493	12.204	3.49347		
		$[SUM (x_i)]^2$	$SUM (x_i^2)$			
		6547.358	253.155			

W	
0.96402	W is greater than 0.92. Cannot rule out lognormal distribution.

d
1.33363

SITE_ID	SAMP_ID	SAMP_D	LAB_CH	CONC	Ln CONC	BIN
BGL00005	SSBG0039	4.00	Copper	20.1	3.00	
BGL00004	SSBG0030	4.00	Copper	21.0	3.04	12
BGL00001	SSBG0009	39.00	Copper	21.2	3.05	22
BGL00004	SSBG0028	0.00	Copper	25.1	3.22	32
BGL00004	SSBG0029	0.00	Copper	25.8	3.25	42
BGL00001	SSBG0002	4.00	Copper	25.9	3.25	52
BGL00006	SSBG0047	0.00	Copper	28.8	3.36	62
BGL00006	SSBG0049	4.00	Copper	31.9	3.46	72
BGL00006	SSBG0052	19.00	Copper	31.9	3.46	
BGL00001	SSBG0001	0.00	Copper	32.7	3.49	
BGL00005	SSBG0038	0.00	Copper	33.5	3.51	
BGL00003	SSBG0019	0.00	Copper	35.5	3.57	
BGL00006	SSBG0048	0.00	Copper	35.8	3.58	
BGL00005	SSBG0042	19.00	Copper	36.5	3.60	
BGL00002	SSBG0010	0.00	Copper	37.3	3.62	
BGL00004	SSBG0033	19.00	Copper	39.2	3.67	
BGL00003	SSBG0023	19.00	Copper	39.8	3.68	
BGL00003	SSBG0020	4.00	Copper	42.5	3.75	
BGL00001	SSBG0005	19.00	Copper	42.7	3.75	
BGL00005	SSBG0046	39.00	Copper	43.3	3.77	
BGL00002	SSBG0018	39.00	Copper	44.5	3.80	
BGL00004	SSBG0037	39.00	Copper	45.0	3.81	
BGL00002	SSBG0011	4.00	Copper	56.6	4.04	
BGL00002	SSBG0014	19.00	Copper	57.0	4.04	
BGL00003	SSBG0027	39.00	Copper	57.1	4.04	
BGL00006	SSBG0056	39.00	Copper	59.5	4.09	

Bin	*Frequency*
12	0
22	3
32	6
42	8
52	5
62	4
72	0
More	0



Mean [Ln(conc)]	3.57351594
Std Dev [Ln(conc)]	0.31218915
Z	1.645
95 th Quantile (mg/Kg)	**60**
Bias %	0.19 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**45**
95% UL (mg/kg)=	**74**

LEHR Facility, Davis, California

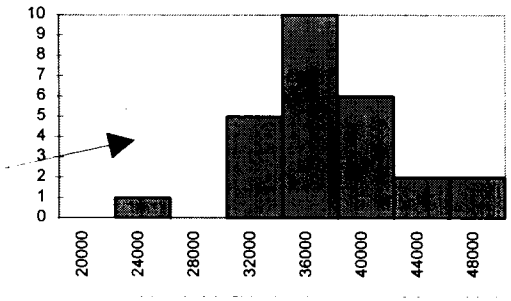
Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=26)	W
1	20.1	3.001	9.004	3.001	0.4407	0.478272538	**0.95779**
2	21.0	3.045	9.269	3.045	0.3043	0.304385715	
3	21.2	3.054	9.327	3.054	0.2533	0.250526387	**d**
4	25.1	3.223	10.387	3.223	0.2151	0.174906659	**2.43655**
5	25.8	3.250	10.565	3.250	0.1836	0.102134476	
6	25.9	3.254	10.590	3.254	0.1563	0.084596784	
7	28.8	3.360	11.292	3.360	0.1316	0.053663486	
8	31.9	3.463	11.990	3.463	0.1089	0.031754468	
9	31.9	3.463	11.990	3.463	0.0876	0.025132271	
10	32.7	3.487	12.162	3.487	0.0672	0.013204251	
11	33.5	3.512	12.331	3.512	0.0476	0.00747945	
12	35.5	3.570	12.742	3.570	0.0284	0.001404682	
13	35.8	3.578	12.802	3.578	0.0094	0.000182025	
14	36.5	3.597	12.941	3.597			
15	37.3	3.619	13.097	3.619			
16	39.2	3.669	13.459	3.669			
17	39.8	3.684	13.571	3.684			
18	42.5	3.750	14.059	3.750			
19	42.7	3.754	14.094	3.754			
20	43.3	3.768	14.199	3.768			
21	44.5	3.795	14.406	3.795			
22	45.0	3.807	14.491	3.807			
23	56.6	4.036	16.289	4.036			
24	57.0	4.043	16.346	4.043			
25	57.1	4.045	16.360	4.045			
26	59.5	4.086	16.695	4.086			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		8632.531	334.457				

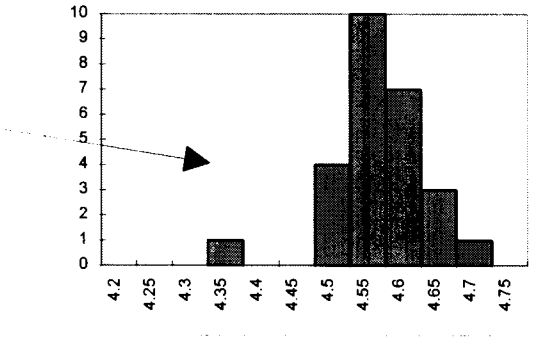
W is greater than 0.92.
Cannot rule out lognormal distribution.

Site ID	Samp ID	Samp De	LabChem	CONC	log conc	Ln CONC	Bin
BGL0000	SSBG00	0.00	Iron	34500	4.538	10.449	20000
BGL0000	SSBG00	0.00	Iron	35700	4.553	10.483	24000
BGL0000	SSBG00	0.00	Iron	34800	4.542	10.457	28000
BGL0000	SSBG00	0.00	Iron	30900	4.490	10.339	32000
BGL0000	SSBG00	0.00	Iron	31300	4.496	10.351	36000
BGL0000	SSBG00	0.00	Iron	33600	4.526	10.422	40000
BGL0000	SSBG00	0.00	Iron	33000	4.519	10.404	44000
BGL0000	SSBG00	0.00	Iron	36600	4.563	10.508	48000
BGL0000	SSBG00	4.00	Iron	33500	4.525	10.419	
BGL0000	SSBG00	4.00	Iron	46300	4.666	10.743	
BGL0000	SSBG00	4.00	Iron	38400	4.584	10.556	
BGL0000	SSBG00	4.00	Iron	32000	4.505	10.373	
BGL0000	SSBG00	4.00	Iron	30500	4.484	10.325	
BGL0000	SSBG00	4.00	Iron	33100	4.520	10.407	4.2
BGL0000	SSBG00	19.00	Iron	37100	4.569	10.521	4.25
BGL0000	SSBG00	19.00	Iron	44500	4.648	10.703	4.3
BGL0000	SSBG00	19.00	Iron	32200	4.508	10.380	4.35
BGL0000	SSBG00	19.00	Iron	33400	4.524	10.416	4.4
BGL0000	SSBG00	19.00	Iron	32100	4.507	10.377	4.45
BGL0000	SSBG00	19.00	Iron	30400	4.483	10.322	4.5
BGL0000	SSBG00	39.00	Iron	20600	4.314	9.933	4.55
BGL0000	SSBG00	39.00	Iron	36700	4.565	10.511	4.6
BGL0000	SSBG00	39.00	Iron	42600	4.629	10.660	4.65
BGL0000	SSBG00	39.00	Iron	38400	4.584	10.556	4.7
BGL0000	SSBG00	39.00	Iron	39000	4.591	10.571	4.75
BGL0000	SSBG00	39.00	Iron	44000	4.64345	10.692	

Bin	*Frequency*
20000	0
24000	1
28000	0
32000	5
36000	10
40000	6
44000	2
48000	2
More	0



Bin	*Frequency*
4.2	0
4.25	0
4.3	0
4.35	1
4.4	0
4.45	0
4.5	4
4.55	10
4.6	7
4.65	3
4.7	1
4.75	0
More	0



Mean [Ln(conc)]	10.4568931
Std Dev [Ln(conc)]	0.16070903
Z	1.645
95 th Quantile (mg/Kg)	**45,309**
Bias %	0.05 (OK, <5%)
95 % Confidence Limits on 95 th Quantile	
a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**39,828**
95% UL (mg/kg)=	**50,790**

LEHR Facility, Davis, California

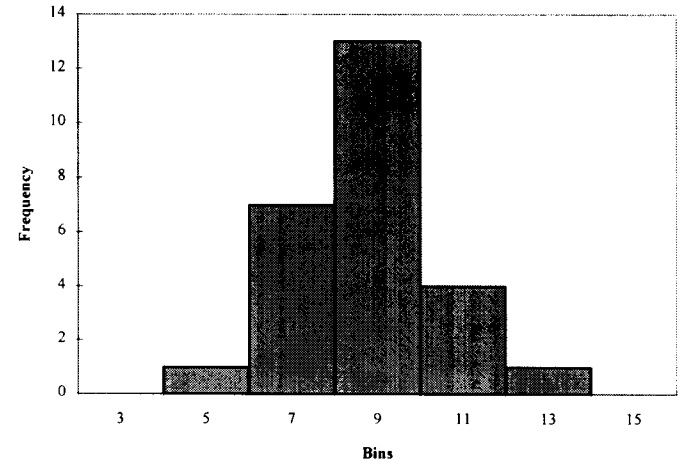
Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i		x_i	$(x_i)^2$	x_i		$a^*(x_{n-i+1} - x_i)$	
(# Samples)	CONC	LN (Conc)	$[LN(Conc)]^2$	Ranked	a stats	(n=26)	**W**
1	34500	10.449	109.176	9.933	0.4407	0.356901285	**0.9021**
2	35700	10.483	109.891	10.322	0.3043	0.115952475	
3	34800	10.457	109.357	10.325	0.2533	0.092825065	**d**
4	30900	10.339	106.885	10.339	0.2151	0.069068195	**0.64568**
5	31300	10.351	107.151	10.351	0.1836	0.040381636	
6	33600	10.422	108.624	10.373	0.1563	0.028496859	
7	33000	10.404	108.249	10.377	0.1316	0.023582908	
8	36600	10.508	110.414	10.380	0.1089	0.015425741	
9	33500	10.419	108.562	10.404	0.0876	0.009309181	
10	46300	10.743	115.410	10.407	0.0672	0.006754605	
11	38400	10.556	111.425	10.416	0.0476	0.003169912	
12	32000	10.373	107.609	10.419	0.0284	0.001081243	
13	30500	10.325	106.616	10.422	0.0094	0.000248473	
14	33100	10.407	108.312	10.449			
15	37100	10.521	110.699	10.457			
16	44500	10.703	114.559	10.483			
17	32200	10.380	107.739	10.508			
18	33400	10.416	108.500	10.511			
19	32100	10.377	107.674	10.521			
20	30400	10.322	106.548	10.556			
21	20600	9.933	98.665	10.556			
22	36700	10.511	110.471	10.571			
23	42600	10.660	113.627	10.660			
24	38400	10.556	111.425	10.692			
25	39000	10.571	111.753	10.703			
26	44000	10.692	114.318	10.743			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		73918.310	2843.658				

W is less than 0.92.
Cannot assume lognormal distribution.

SITE_ID	SAMP_ID	SAMP_D	LAB_CH	CONC	Ln CONC	BIN
BGL0000	SSBG000	39.00	Lead	3.4	1.22377543	
BGL0000	SSBG003	4.00	Lead	5.4	1.68639895	3
BGL0000	SSBG000	4.00	Lead	6.1	1.80828877	5
BGL0000	SSBG003	4.00	Lead	6.2	1.82454929	7
BGL0000	SSBG002	0.00	Lead	6.6	1.88706965	9
BGL0000	SSBG002	0.00	Lead	6.7	1.90210753	11
BGL0000	SSBG001	39.00	Lead	6.8	1.91692261	13
BGL0000	SSBG004	4.00	Lead	7.0	1.94591015	15
BGL0000	SSBG002	4.00	Lead	7.5	2.01490302	
BGL0000	SSBG001	0.00	Lead	7.6	2.02814825	
BGL0000	SSBG004	0.00	Lead	7.7	2.04122033	
BGL0000	SSBG000	0.00	Lead	7.9	2.06686276	
BGL0000	SSBG000	19.00	Lead	8.0	2.07944154	
BGL0000	SSBG004	0.00	Lead	8.1	2.09186406	
BGL0000	SSBG004	19.00	Lead	8.2	2.10413415	
BGL0000	SSBG003	19.00	Lead	8.4	2.12823171	
BGL0000	SSBG003	0.00	Lead	8.5	2.14006616	
BGL0000	SSBG004	39.00	Lead	8.7	2.16332303	
BGL0000	SSBG002	19.00	Lead	8.8	2.17475172	
BGL0000	SSBG003	39.00	Lead	8.9	2.18605128	
BGL0000	SSBG005	19.00	Lead	9.0	2.19722458	
BGL0000	SSBG001	19.00	Lead	9.1	2.20827441	
BGL0000	SSBG001	4.00	Lead	9.3	2.2300144	
BGL0000	SSBG001	0.00	Lead	10.1	2.31253542	
BGL0000	SSBG002	39.00	Lead	10.4	2.34180581	
BGL0000	SSBG005	39.00	Lead	11.9	2.4765384	

Bin	*Frequency*
3	0
5	1
7	7
9	13
11	4
13	1
15	0
More	0



Mean [Ln(conc)]	2.04540052
Std Dev [Ln(conc)]	0.24367414
Z	1.645
95 th Quantile (mg/Kg)	**11.5**
Bias %	0.11 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**9.4**
95% UL (mg/kg)=	**13.7**

LEHR Facility, Davis, California

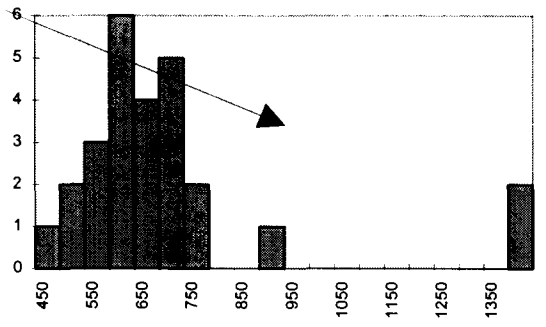
Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

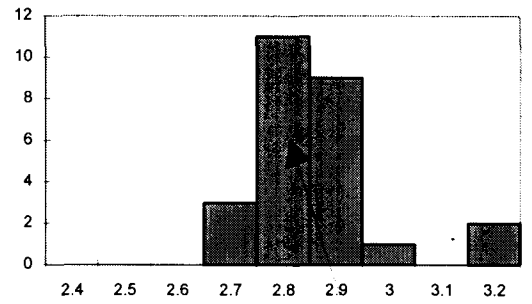
i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a*(x_{n-i+1} - x_i)$ (n=26)	W
1	3.4	1.224	1.498	1.224	0.4407	0.55209264	**0.902967**
2	5.4	1.686	2.844	1.686	0.3043	0.19944031	
3	6.1	1.808	3.270	1.808	0.2533	0.12772568	d
4	6.2	1.825	3.329	1.825	0.2151	0.08721554	**1.484427**
5	6.6	1.887	3.561	1.887	0.1836	0.05897319	
6	6.7	1.902	3.618	1.902	0.1563	0.0461268	
7	6.8	1.917	3.675	1.917	0.1316	0.03541733	
8	7.0	1.946	3.787	1.946	0.1089	0.02492085	
9	7.5	2.015	4.060	2.015	0.0876	0.01300159	
10	7.6	2.028	4.113	2.028	0.0672	0.00752088	
11	7.7	2.041	4.167	2.041	0.0476	0.00414174	
12	7.9	2.067	4.272	2.067	0.0284	0.00105851	
13	8.0	2.079	4.324	2.079	0.0094	0.00011677	
14	8.1	2.092	4.376	2.092			
15	8.2	2.104	4.427	2.104			
16	8.4	2.128	4.529	2.128			
17	8.5	2.140	4.580	2.140			
18	8.7	2.163	4.680	2.163			
19	8.8	2.175	4.730	2.175			
20	8.9	2.186	4.779	2.186			
21	9.0	2.197	4.828	2.197			
22	9.1	2.208	4.876	2.208			
23	9.3	2.230	4.973	2.230			
24	10.1	2.313	5.348	2.313			
25	10.4	2.342	5.484	2.342			
26	11.9	2.477	6.133	2.477			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		2828.156	110.260				

W is less than 0.92.
Cannot assume lognormal distribution.

Site ID	Samp ID	Samp De	LabChem	CONC	log conc	Ln CONC	Bin
BGL00001	SSBG0001	0.00	Manganese	592	2.772	6.384	450
BGL00002	SSBG0010	0.00	Manganese	638	2.805	6.458	500
BGL00003	SSBG0019	0.00	Manganese	579	2.763	6.361	550
BGL00004	SSBG0028	0.00	Manganese	468	2.670	6.148	600
BGL00004	SSBG0029	0.00	Manganese	479	2.680	6.172	650
BGL00005	SSBG0038	0.00	Manganese	567	2.754	6.340	700
BGL00006	SSBG0047	0.00	Manganese	514	2.711	6.242	750
BGL00006	SSBG0048	0.00	Manganese	606	2.782	6.407	800
BGL00001	SSBG0002	4.00	Manganese	592	2.772	6.384	850
BGL00002	SSBG0011	4.00	Manganese	744	2.872	6.612	900
BGL00003	SSBG0020	4.00	Manganese	699	2.844	6.550	950
BGL00004	SSBG0030	4.00	Manganese	527	2.722	6.267	1000
BGL00005	SSBG0039	4.00	Manganese	654	2.816	6.483	1050
BGL00006	SSBG0049	4.00	Manganese	562	2.750	6.332	1100
BGL00001	SSBG0005	19.00	Manganese	661	2.820	6.494	1150
BGL00002	SSBG0014	19.00	Manganese	731	2.864	6.594	1200
BGL00003	SSBG0023	19.00	Manganese	634	2.802	6.452	1250
BGL00004	SSBG0033	19.00	Manganese	683	2.834	6.526	1300
BGL00005	SSBG0042	19.00	Manganese	587	2.769	6.375	1350
BGL00006	SSBG0052	19.00	Manganese	527	2.722	6.267	1400
BGL00001	SSBG0009	39.00	Manganese	437	2.640	6.080	
BGL00002	SSBG0018	39.00	Manganese	870	2.940	6.768	
BGL00003	SSBG0027	39.00	Manganese	687	2.837	6.532	
BGL00004	SSBG0037	39.00	Manganese	1390	3.143	N/A	
BGL00005	SSBG0046	39.00	Manganese	628	2.798	6.443	
BGL00006	SSBG0056	39.00	Manganese	1390	3.143	N/A	

Bin	*Frequency*
450	1
500	2
550	3
600	6
650	4
700	5
750	2
800	0
850	0
900	1
950	0
1000	0
1050	0
1100	0
1150	0
1200	0
1250	0
1300	0
1350	0
1400	2
More	0





Mean [Ln(conc)]	6.403
Std Dev [Ln(conc)]	0.15973
Z	1.645
95 th Quantile (mg/Kg)	**785**
Bias %	0.05 (OK, <5%)
95 % Confidence Limits on 95 th Quantile	
a = 5%	
p = 95%	
K (estimating factor) =	2.391
95% LL (mg/kg) =	**686**
95% UL (mg/kg)=	**884**

2.4	*Bin*	*Frequency*
2.5	2.4	0
2.6	2.5	0
2.7	2.6	0
2.8	2.7	3
2.9	2.8	11
3	2.9	9
3.1	3	1
3.2	3.1	0
	3.2	2
	More	0

Note: Dotted cells are numbers that were excluded from the 95th quantile calculation.
Data were flagged by lab as inaccurate.
Concentrations were above instrument calibration.

LEHR Facility, Davis, California

Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=26)
1	592	6.384	40.749	6.080	0.4493	0.309370015
2	638	6.458	41.710	6.148	0.3098	0.143614835
3	579	6.361	40.466	6.172	0.2554	0.107960865
4	468	6.148	37.804	6.242	0.2145	0.065943194
5	479	6.172	38.090	6.267	0.1807	0.047909667
6	567	6.340	40.200	6.267	0.1512	0.0392053
7	514	6.242	38.965	6.332	0.1245	0.020200373
8	606	6.407	41.048	6.340	0.0997	0.01423198
9	592	6.384	40.749	6.361	0.0764	0.007413536
10	744	6.612	43.719	6.375	0.0539	0.004151601
11	699	6.550	42.898	6.384	0.0321	0.001894976
12	527	6.267	39.278	6.384	0.0107	0.000250095
13	654	6.483	42.031	6.407		
14	562	6.332	40.088	6.443		
15	661	6.494	42.169	6.452		
16	731	6.594	43.486	6.458		
17	634	6.452	41.629	6.483		
18	683	6.526	42.595	6.494		
19	587	6.375	40.641	6.526		
20	527	6.267	39.278	6.532		
21	437	6.080	36.966	6.550		
22	870	6.768	45.813	6.594		
23	687	6.532	42.671	6.612		
24	628	6.443	41.506	6.768		

$[SUM (x_i)]^2$	$SUM (x_i^2)$
23615.091	984.549

W
0.9898649

W is greater than 0.916.
Cannot rule out lognormal distribution.

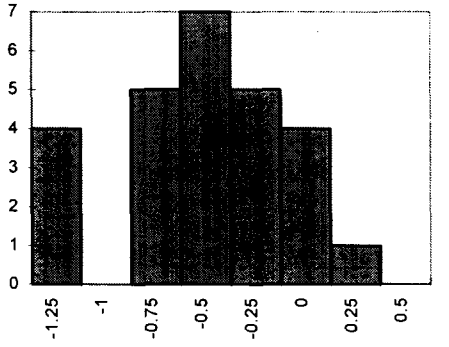
d
0.5868146

Samp ID	CONC
SSBG0037	1390
SSBG0056	1390

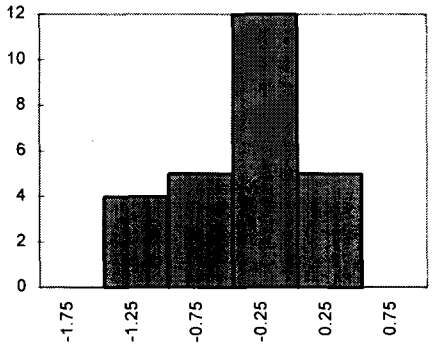
Outliers removed from calculation.
Data were flagged by lab as inaccurate.
Concentrations were above instrument calibration.

Site ID	Samp ID	Samp De	LabChem	CONC	log conc	Ln CONC	Bin
BGL00001	SSBG0001	0.00	Mercury	0.49	-0.3098	-0.7133499	-1.25
BGL00002	SSBG0010	0.00	Mercury	0.43	-0.36653	-0.8439701	-1
BGL00003	SSBG0019	0.00	Mercury	0.48	-0.31876	-0.7339692	-0.75
BGL00004	SSBG0028	0.00	Mercury	0.41	-0.38722	-0.8915981	-0.5
BGL00004	SSBG0029	0.00	Mercury	0.66	-0.18046	-0.4155154	-0.25
BGL00005	SSBG0038	0.00	Mercury	0.67	-0.17393	-0.4004776	0
BGL00006	SSBG0047	0.00	Mercury	0.82	-0.08619	-0.1984509	0.25
BGL00006	SSBG0048	0.00	Mercury	1.6	0.20412	0.4700036	0.5
BGL00001	SSBG0002	4.00	Mercury	0.16	-0.79588	-1.8325815	
BGL00002	SSBG0011	4.00	Mercury	0.05	-1.30103	-2.9957323	
BGL00003	SSBG0020	4.00	Mercury	0.75	-0.12494	-0.2876821	
BGL00004	SSBG0030	4.00	Mercury	0.16	-0.79588	-1.8325815	
BGL00005	SSBG0039	4.00	Mercury	0.2	-0.69897	-1.6094379	
BGL00006	SSBG0049	4.00	Mercury	0.33	-0.48149	-1.1086626	
BGL00001	SSBG0005	19.00	Mercury	0.22	-0.65758	-1.5141277	-1.75
BGL00002	SSBG0014	19.00	Mercury	0.24	-0.61979	-1.4271164	-1.25
BGL00003	SSBG0023	19.00	Mercury	0.05	-1.30103	-2.9957323	-0.75
BGL00004	SSBG0033	19.00	Mercury	0.12	-0.92082	-2.1202635	-0.25
BGL00005	SSBG0042	19.00	Mercury	0.13	-0.88606	-2.0402208	0.25
BGL00006	SSBG0052	19.00	Mercury	0.05	-1.30103	-2.9957323	0.75
BGL00001	SSBG0009	39.00	Mercury	0.23	-0.63827	-1.469676	
BGL00002	SSBG0018	39.00	Mercury	0.27	-0.56864	-1.3093333	
BGL00003	SSBG0027	39.00	Mercury	0.05	-1.30103	-2.9957323	
BGL00004	SSBG0037	39.00	Mercury	0.17	-0.76955	-1.7719568	
BGL00005	SSBG0046	39.00	Mercury	0.18	-0.74473	-1.7147984	
BGL00006	SSBG0056	39.00	Mercury	0.21	-0.67778	-1.5606477	

Bin	*Frequency*
-1.25	4
-1	0
-0.75	5
-0.5	7
-0.25	5
0	4
0.25	1
0.5	0
More	0



Bin	*Frequency*
-1.75	0
-1.25	4
-0.75	5
-0.25	12
0.25	5
0.75	0
More	0



Mean [Ln(conc)]	-1.4349747
Std Dev [Ln(conc)]	0.9274537
Z	1.645
95 th Quantile (mg/Kg)	**1.09**
Bias %	1.67 (OK, <5%)
95 % Confidence Limits on 95 th Quantile	
a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**0.07**
95% UL (mg/kg)=	**2.12**

Note: Shaded samples are non-detects, treated here as one-half the detection limit value of 0.1

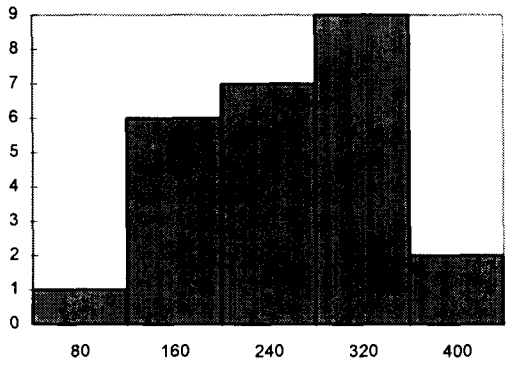
conc	ln(conc)	ln(conc)^2	rank numb	ln(conc)ra	a stats	W stat	
0.49	-0.71335	0.5088681	1	-2.99573	0.4407	1.5273498	
0.43	-0.84397	0.7122855	2	-2.99573	0.3043	0.8512127	
0.48	-0.73397	0.5387107	3	-2.99573	0.2533	0.6859491	
0.41	-0.8916	0.7949472	4	-2.99573	0.2151	0.5582393	
0.66	-0.41552	0.1726531	5	-2.12026	0.1836	0.3129917	
0.67	-0.40048	0.1603823	6	-2.04022	0.1563	0.2073899	
0.82	-0.19845	0.0393828	7	-1.83258	0.1316	0.1445774	
1.6	0.47	0.2209034	8	-1.83258	0.1089	0.1076598	
0.16	-1.83258	3.3583548	9	-1.77196	0.0876	0.0771194	
0.05	-2.99573	8.9744119	10	-1.7148	0.0672	0.0407323	
0.75	-0.28768	0.082761	11	-1.60944	0.0476	0.014285	
0.16	-1.83258	3.3583548	12	-1.56065	0.0284	0.0037923	
0.2	-1.60944	2.5902904	13	-1.51413	0.0094	0.0004178	
0.33	-1.10866	1.2291328	14	-1.46968		**4.532**	this is sum for W
0.22	-1.51413	2.2925828	15	-1.42712		**20.536**	this is sq of sum for W
0.24	-1.42712	2.0366611	16	-1.30933			
0.05	-2.99573	8.9744119	17	-1.10866			
0.12	-2.12026	4.4955175	18	-0.8916		**0.955**	**this is W**
0.13	-2.04022	4.162501	19	-0.84397			**W is > 0.92; assume log normal distribution**
0.05	-2.99573	8.9744119	20	-0.73397			
0.23	-1.46968	2.1599475	21	-0.71335			
0.27	-1.30933	1.7143537	22	-0.41552			
0.05	-2.99573	8.9744119	23	-0.40048			
0.17	-1.77196	3.139831	24	-0.28768			
0.18	-1.7148	2.9405336	25	-0.19845			
0.21	-1.56065	2.4356214	26	0.47			
	-1.435	**75.042**					
	-37.309						
	1391.987	**21.5042596**	this is the d value				

Site ID	Samp ID	Samp De	LabChem	CONC		Bin		
BGL0000	SSBG000	0.00	Molybden	1				
BGL0000	SSBG001	0.00	Molybden	1				
BGL0000	SSBG001	0.00	Molybden	1				
BGL0000	SSBG002	0.00	Molybden	1				
BGL0000	SSBG002	0.00	Molybden	1				
BGL0000	SSBG003	0.00	Molybden	1				
BGL0000	SSBG004	0.00	Molybden	1				
BGL0000	SSBG004	0.00	Molybden	1				
BGL0000	SSBG000	4.00	Molybden	1				
BGL0000	SSBG001	4.00	Molybden	1				
BGL0000	SSBG002	4.00	Molybden	1				
BGL0000	SSBG003	4.00	Molybden	1				
BGL0000	SSBG003	4.00	Molybden	1				
BGL0000	SSBG004	4.00	Molybden	1				
BGL0000	SSBG000	19.00	Molybden	1				
BGL0000	SSBG001	19.00	Molybden	1				
BGL0000	SSBG002	19.00	Molybden	1				
BGL0000	SSBG003	19.00	Molybden	1				
BGL0000	SSBG004	19.00	Molybden	1				
BGL0000	SSBG005	19.00	Molybden	1				
BGL0000	SSBG000	39.00	Molybden	1				
BGL0000	SSBG001	39.00	Molybden	1				
BGL0000	SSBG002	39.00	Molybden	1				
BGL0000	SSBG003	39.00	Molybden	1				
BGL0000	SSBG004	39.00	Molybden	1				
BGL0000	SSBG005	39.00	Molybden	1				

Note: All shaded numbers are non detects treated as one half the detection limit of 2.

Site ID	Samp ID	Samp De	LabChem	CONC	Ln CONC	Bin
BGL00001	SSBG0001	0.00	Nickel	313	5.74620319	80
BGL00002	SSBG0010	0.00	Nickel	266	5.58349631	160
BGL00003	SSBG0019	0.00	Nickel	289	5.66642669	240
BGL00004	SSBG0028	0.00	Nickel	224	5.41164605	320
BGL00004	SSBG0029	0.00	Nickel	271	5.60211882	400
BGL00005	SSBG0038	0.00	Nickel	231	5.44241771	480
BGL00006	SSBG0047	0.00	Nickel	264	5.5759491	
BGL00006	SSBG0048	0.00	Nickel	286	5.65599181	
BGL00001	SSBG0002	4.00	Nickel	404	6.00141488	
BGL00002	SSBG0011	4.00	Nickel	271	5.60211882	
BGL00003	SSBG0020	4.00	Nickel	337	5.82008293	
BGL00004	SSBG0030	4.00	Nickel	315	5.75257264	
BGL00005	SSBG0039	4.00	Nickel	333	5.80814249	
BGL00006	SSBG0049	4.00	Nickel	227	5.42495002	80
BGL00001	SSBG0005	19.00	Nickel	251	5.52545294	150
BGL00002	SSBG0014	19.00	Nickel	189	5.24174702	220
BGL00003	SSBG0023	19.00	Nickel	104	4.6443909	270
BGL00004	SSBG0033	19.00	Nickel	122	4.80402104	320
BGL00005	SSBG0042	19.00	Nickel	106	4.66343909	370
BGL00006	SSBG0052	19.00	Nickel	78.6	4.3643717	420
BGL00001	SSBG0009	39.00	Nickel	114	4.73619845	
BGL00002	SSBG0018	39.00	Nickel	153	5.03043792	
BGL00003	SSBG0027	39.00	Nickel	162	5.08759634	
BGL00004	SSBG0037	39.00	Nickel	183	5.20948615	
BGL00005	SSBG0046	39.00	Nickel	141	4.94875989	
BGL00006	SSBG0056	39.00	Nickel	231	5.44241771	

Bin	*Frequency*
80	1
160	6
240	7
320	9
400	2
480	1
More	0



Bin	*Frequency*
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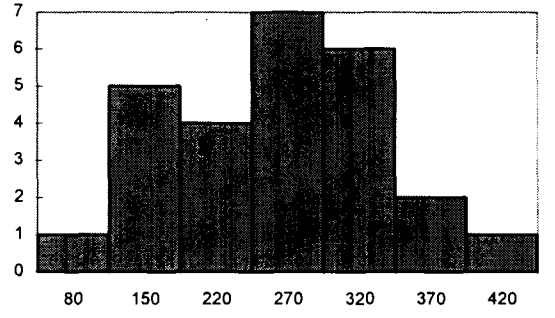
150	5
220	4
270	7
320	6
370	2
420	1
More	0



Mean [Ln(conc)]	5.3381481
Std Dev [Ln(conc)]	0.43050369
Z	1.645
95 th Quantile (mg/Kg)	**423**
Bias %	0.36 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**271**
95% UL (mg/kg)=	**574**

LEHR Facility, Davis, California

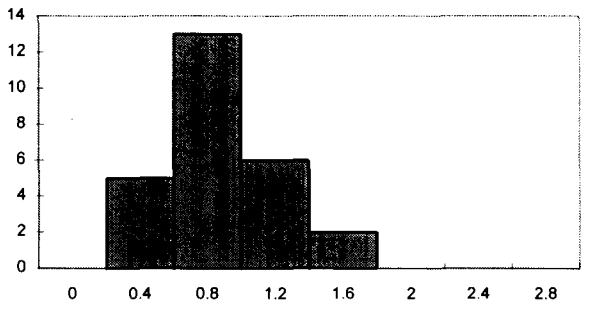
Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=26)	**W**
1	313	5.746	33.019	4.36437	0.4407	0.721444929	**0.93315**
2	266	5.583	31.175	4.64439	0.3043	0.357763085	
3	289	5.666	32.108	4.66344	0.2533	0.28995337	**d**
4	224	5.412	29.286	4.7362	0.2151	0.218622088	**4.63334**
5	271	5.602	31.384	4.80402	0.1836	0.172984642	
6	231	5.442	29.620	4.94876	0.1563	0.11217132	
7	264	5.576	31.091	5.03044	0.1316	0.082322892	
8	286	5.656	31.990	5.0876	0.1089	0.056031499	
9	404	6.001	36.017	5.20949	0.0876	0.034394622	
10	271	5.602	31.384	5.24175	0.0672	0.022965553	
11	337	5.820	33.873	5.41165	0.0476	0.007820825	
12	315	5.753	33.092	5.42495	0.0284	0.002854283	
13	333	5.808	33.735	5.44242	0.0094	0	
14	227	5.425	29.430	5.44242			
15	251	5.525	30.531	5.52545			
16	189	5.242	27.476	5.57595			
17	104	4.644	21.570	5.5835			
18	122	4.804	23.079	5.60212			
19	106	4.663	21.748	5.60212			
20	78.6	4.364	19.048	5.65599			
21	114	4.736	22.432	5.66643			
22	153	5.030	25.305	5.7462			
23	162	5.088	25.884	5.75257			
24	183	5.209	27.139	5.80814			
25	141	4.949	24.490	5.82008			
26	231	5.442	29.620	6.00141			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		19263.178	745.525				

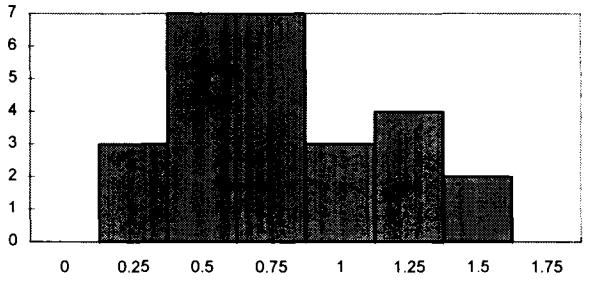
W is greater than 0.92.
Cannot rule out lognormal distribution.

Site ID	Samp ID	Samp De	LabChem	CONC	Ln CONC	Bin
BGL00001	SSBG0001	0.00	Selenium	0.6	-0.5108256	0
BGL00002	SSBG0010	0.00	Selenium	0.23	-1.469676	0.4
BGL00003	SSBG0019	0.00	Selenium	0.5	-0.6931472	0.8
BGL00004	SSBG0028	0.00	Selenium	1	0	1.2
BGL00004	SSBG0029	0.00	Selenium	1.1	0.0953102	1.6
BGL00005	SSBG0038	0.00	Selenium	0.45	-0.7985077	2
BGL00006	SSBG0047	0.00	Selenium	1.4	0.3364722	2.4
BGL00006	SSBG0048	0.00	Selenium	1.1	0.0953102	2.8
BGL00001	SSBG0002	4.00	Selenium	0.75	-0.2876821	
BGL00002	SSBG0011	4.00	Selenium	0.52	-0.6539265	
BGL00003	SSBG0020	4.00	Selenium	0.31	-1.171183	
BGL00004	SSBG0030	4.00	Selenium	0.65	-0.4307829	
BGL00005	SSBG0039	4.00	Selenium	0.9	-0.1053605	
BGL00006	SSBG0049	4.00	Selenium	1.3	0.2623643	
BGL00001	SSBG0005	19.00	Selenium	0.48	-0.7339692	0
BGL00002	SSBG0014	19.00	Selenium	0.24	-1.4271164	0.25
BGL00003	SSBG0023	19.00	Selenium	0.64	-0.4462871	0.5
BGL00004	SSBG0033	19.00	Selenium	1.1	0.0953102	0.75
BGL00005	SSBG0042	19.00	Selenium	1.2	0.1823216	1
BGL00006	SSBG0052	19.00	Selenium	0.5	-0.6931472	1.25
BGL00001	SSBG0009	39.00	Selenium	0.21	-1.5606477	1.5
BGL00002	SSBG0018	39.00	Selenium	0.38	-0.967584	1.75
BGL00003	SSBG0027	39.00	Selenium	0.5	-0.6931472	
BGL00004	SSBG0037	39.00	Selenium	0.58	-0.5447272	
BGL00005	SSBG0046	39.00	Selenium	0.65	-0.4307829	
BGL00006	SSBG0056	39.00	Selenium	0.78	-0.2484614	

Bin	*Frequency*
0	0
0.4	5
0.8	13
1.2	6
1.6	2
2	0
2.4	0
2.8	0
More	0



Bin	*Frequency*
0	0
0.25	3
0.5	7
0.75	7
1	3
1.25	4
1.5	2
1.75	0
More	0



Mean [Ln(conc)]	-0.4923028
Std Dev [Ln(conc)]	0.5370339
Z	1.645
95 th Quantile (mg/Kg)	**1.48**
Bias %	0.56 (OK, <5%)
95 % Confidence Limits on 95 th Quantile	
a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**0.79**
95% UL (mg/kg)=	**2.17**

Note: No sa Note: Shaded samples are non detects treated here as one half the detection limit of 1.

LEHR Facility, Davis, California

Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=26)	W
1	0.6	-0.511	0.261	-1.560648	0.4407	0.83606078	**0.95156**
2	0.23	-1.470	2.160	-1.469676	0.3043	0.52705984	
3	0.5	-0.693	0.480	-1.427116	0.2533	0.40767062	d
4	1	0.000	0.000	-1.171183	0.2151	0.27242268	**7.21014**
5	1.1	0.095	0.009	-0.967584	0.1836	0.19514738	
6	0.45	-0.799	0.638	-0.798508	0.1563	0.13970373	
7	1.4	0.336	0.113	-0.733969	0.1316	0.09659034	
8	1.1	0.095	0.009	-0.693147	0.1089	0.06400997	
9	0.75	-0.288	0.083	-0.693147	0.0876	0.03895448	
10	0.52	-0.654	0.428	-0.693147	0.0672	0.02724726	
11	0.31	-1.171	1.372	-0.653926	0.0476	0.01062163	
12	0.65	-0.431	0.186	-0.544727	0.0284	0.00323602	
13	0.9	-0.105	0.011	-0.510826	0.0094	0.00060666	
14	1.3	0.262	0.069	-0.446287			
15	0.48	-0.734	0.539	-0.430783			
16	0.24	-1.427	2.037	-0.430783			
17	0.64	-0.446	0.199	-0.287682			
18	1.1	0.095	0.009	-0.248461			
19	1.2	0.182	0.033	-0.105361			
20	0.5	-0.693	0.480	0			
21	0.21	-1.561	2.436	0.0953102			
22	0.38	-0.968	0.936	0.0953102			
23	0.5	-0.693	0.480	0.0953102			
24	0.58	-0.545	0.297	0.1823216			
25	0.65	-0.431	0.186	0.2623643			
26	0.78	-0.248	0.062	0.3364722			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		163.837	13.512				

W is greater than 0.92.
Cannot rule out lognormal distribution.

Site ID	Samp ID	Samp De	LabChem	CONC		Bin	
BGL0000	SSBG000	0.00	Silver	0.26			
BGL0000	SSBG001	0.00	Silver	1			
BGL0000	SSBG001	0.00	Silver	1			
BGL0000	SSBG002	0.00	Silver	1			
BGL0000	SSBG002	0.00	Silver	1			
BGL0000	SSBG003	0.00	Silver	1			
BGL0000	SSBG004	0.00	Silver	1			
BGL0000	SSBG004	0.00	Silver	1			
BGL0000	SSBG000	4.00	Silver	1			
BGL0000	SSBG001	4.00	Silver	1			
BGL0000	SSBG002	4.00	Silver	1			
BGL0000	SSBG003	4.00	Silver	1			
BGL0000	SSBG003	4.00	Silver	1			
BGL0000	SSBG004	4.00	Silver	1			
BGL0000	SSBG000	19.00	Silver	1			
BGL0000	SSBG001	19.00	Silver	1			
BGL0000	SSBG002	19.00	Silver	1			
BGL0000	SSBG003	19.00	Silver	1			
BGL0000	SSBG004	19.00	Silver	1			
BGL0000	SSBG005	19.00	Silver	1			
BGL0000	SSBG000	39.00	Silver	1			
BGL0000	SSBG001	39.00	Silver	1			
BGL0000	SSBG002	39.00	Silver	1			
BGL0000	SSBG003	39.00	Silver	1			
BGL0000	SSBG004	39.00	Silver	1			
BGL0000	SSBG005	39.00	Silver	1			
Note: all shaded samples are non detects treated as one half the detection limit of 2							

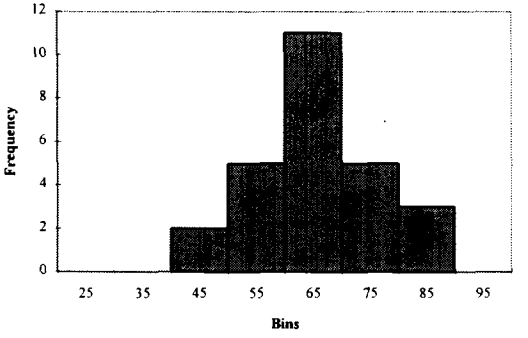
Site ID	Samp ID	Samp De	LabChem	CONC		Bin		
BGL0000	SSBG000	0.00	Thallium	0.68				
BGL0000	SSBG001	0.00	Thallium	1				
BGL0000	SSBG001	0.00	Thallium	1				
BGL0000	SSBG002	0.00	Thallium	1				
BGL0000	SSBG002	0.00	Thallium	1				
BGL0000	SSBG003	0.00	Thallium	1				
BGL0000	SSBG004	0.00	Thallium	1				
BGL0000	SSBG004	0.00	Thallium	1				
BGL0000	SSBG000	4.00	Thallium	1				
BGL0000	SSBG001	4.00	Thallium	1				
BGL0000	SSBG002	4.00	Thallium	1				
BGL0000	SSBG003	4.00	Thallium	1				
BGL0000	SSBG003	4.00	Thallium	1				
BGL0000	SSBG004	4.00	Thallium	1				
BGL0000	SSBG000	19.00	Thallium	1				
BGL0000	SSBG001	19.00	Thallium	1				
BGL0000	SSBG002	19.00	Thallium	1				
BGL0000	SSBG003	19.00	Thallium	1				
BGL0000	SSBG004	19.00	Thallium	1				
BGL0000	SSBG005	19.00	Thallium	1				
BGL0000	SSBG000	39.00	Thallium	1				
BGL0000	SSBG001	39.00	Thallium	1				
BGL0000	SSBG002	39.00	Thallium	1				
BGL0000	SSBG003	39.00	Thallium	1				
BGL0000	SSBG004	39.00	Thallium	1				
BGL0000	SSBG005	39.00	Thallium	1				

Note: all shaded values are non detects treated here as one half the detection limit of 2.

SITE_ID	SAMP_ID	SAMP_DEPTH	LAB_CHEM	CONC	Ln CONC
BGL00001	SSBG0009	39.00	Vanadium	37.1	3.61361697
BGL00005	SSBG0039	4.00	Vanadium	38.9	3.66099425
BGL00004	SSBG0030	4.00	Vanadium	45.7	3.8220983
BGL00001	SSBG0002	4.00	Vanadium	45.9	3.82646512
BGL00004	SSBG0029	0.00	Vanadium	46.6	3.84160054
BGL00004	SSBG0028	0.00	Vanadium	49.3	3.89792408
BGL00001	SSBG0001	0.00	Vanadium	54.5	3.9982007
BGL00006	SSBG0047	0.00	Vanadium	55.3	4.01277291
BGL00006	SSBG0049	4.00	Vanadium	56.0	4.02535169
BGL00003	SSBG0019	0.00	Vanadium	58.0	4.06044301
BGL00006	SSBG0052	19.00	Vanadium	58.1	4.06216566
BGL00003	SSBG0023	19.00	Vanadium	58.5	4.06902675
BGL00005	SSBG0038	0.00	Vanadium	58.7	4.07243973
BGL00001	SSBG0005	19.00	Vanadium	59.9	4.09267651
BGL00002	SSBG0010	0.00	Vanadium	60.1	4.09600984
BGL00005	SSBG0042	19.00	Vanadium	61.6	4.12066187
BGL00006	SSBG0048	0.00	Vanadium	62.2	4.130355
BGL00003	SSBG0020	4.00	Vanadium	62.9	4.14154616
BGL00004	SSBG0033	19.00	Vanadium	66.2	4.19268046
BGL00002	SSBG0018	39.00	Vanadium	67.7	4.21508618
BGL00005	SSBG0046	39.00	Vanadium	70.7	4.25844557
BGL00003	SSBG0027	39.00	Vanadium	71.8	4.27388448
BGL00004	SSBG0037	39.00	Vanadium	72.0	4.27666612
BGL00002	SSBG0014	19.00	Vanadium	76.1	4.33204826
BGL00002	SSBG0011	4.00	Vanadium	76.9	4.34250588
BGL00006	SSBG0056	39.00	Vanadium	78.7	4.36564316

Mean [Ln(conc)]	4.0692811
Std Dev [Ln(conc)]	0.1987387
Z	1.645
95 th Quantile (mg/Kg)	**81**
Bias %	0.08 (OK, <5%)
95 % Confidence Limits on 95 th Quantile	
a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**69**
95% UL (mg/kg)=	**93**

	Bin	*Frequency*
25		
35	25	0
45	35	0
55	45	2
65	55	5
75	65	11
85	75	5
95	85	3
	95	0
More		0



LEHR Facility, Davis, California

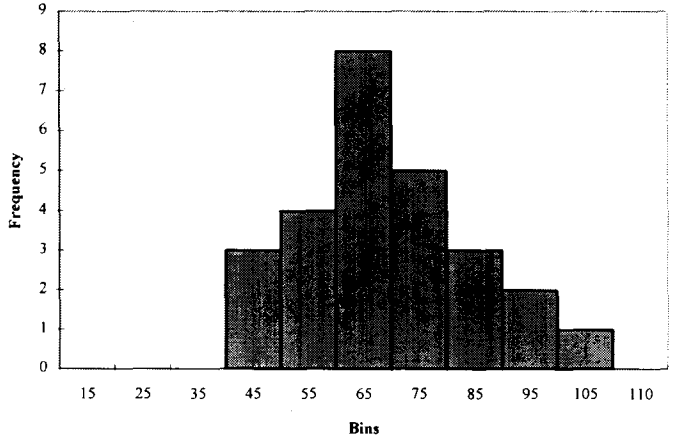
Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i		x_i	$(x_i)^2$	x_i		$a^*(x_{n-i+1} - x_i)$	
(# Samples)	CONC	LN (Conc)	$[LN(Conc)]^2$	Ranked	a stats	(n=26)	W
1	37.1	3.614	13.058	3.613617	0.4407	0.3314179	**0.94754**
2	38.9	3.661	13.403	3.660994	0.3043	0.207384	
3	45.7	3.822	14.608	3.822098	0.2533	0.1291703	d
4	45.9	3.826	14.642	3.826465	0.2151	0.0968382	**0.98743**
5	46.6	3.842	14.758	3.841601	0.1836	0.0793673	
6	49.3	3.898	15.194	3.897924	0.1563	0.0563495	
7	54.5	3.998	15.986	3.998201	0.1316	0.0285421	
8	55.3	4.013	16.102	4.012773	0.1089	0.0195919	
9	56.0	4.025	16.203	4.025352	0.0876	0.0101786	
10	58.0	4.060	16.487	4.060443	0.0672	0.0046981	
11	58.1	4.062	16.501	4.062166	0.0476	0.0027844	
12	58.5	4.069	16.557	4.069027	0.0284	0.0007663	
13	58.7	4.072	16.585	4.07244	0.0094	0.0001902	
14	59.9	4.093	16.750	4.092677			
15	60.1	4.096	16.777	4.09601			
16	61.6	4.121	16.980	4.120662			
17	62.2	4.130	17.060	4.130355			
18	62.9	4.142	17.152	4.141546			
19	66.2	4.193	17.579	4.19268			
20	67.7	4.215	17.767	4.215086			
21	70.7	4.258	18.134	4.258446			
22	71.8	4.274	18.266	4.273884			
23	72.0	4.277	18.290	4.276666			
24	76.1	4.332	18.767	4.332048			
25	76.9	4.343	18.857	4.342506			
26	78.7	4.366	19.059	4.365643			
		$[SUM (x_i)]^2$	$SUM (x_i^2)$				
		11193.917	431.523				

W is greater than 0.92.
Cannot rule out lognormal distribution.

SITE_ID	SAMP_ID	SAMP_D	LAB_CH	CONC	Ln CONC	BIN
BGL0000	SSBG003	4.00	Zinc	37.6	3.6270041	15
BGL0000	SSBG000	39.00	Zinc	39.6	3.6788291	25
BGL0000	SSBG003	4.00	Zinc	43.0	3.7612001	35
BGL0000	SSBG002	0.00	Zinc	47.9	3.8691155	45
BGL0000	SSBG002	0.00	Zinc	49.3	3.8979241	55
BGL0000	SSBG000	4.00	Zinc	49.8	3.908015	65
BGL0000	SSBG005	19.00	Zinc	53.2	3.9740584	75
BGL0000	SSBG004	4.00	Zinc	56.4	4.0324692	85
BGL0000	SSBG004	0.00	Zinc	56.6	4.036009	95
BGL0000	SSBG003	0.00	Zinc	57.0	4.0430513	105
BGL0000	SSBG004	19.00	Zinc	58.3	4.0656021	110
BGL0000	SSBG004	0.00	Zinc	59.4	4.0842942	
BGL0000	SSBG000	0.00	Zinc	60.6	4.1042949	
BGL0000	SSBG001	0.00	Zinc	60.6	4.1042949	
BGL0000	SSBG004	39.00	Zinc	64.0	4.1588831	
BGL0000	SSBG003	19.00	Zinc	66.1	4.1911687	
BGL0000	SSBG002	4.00	Zinc	67.8	4.2165622	
BGL0000	SSBG001	0.00	Zinc	69.5	4.2413268	
BGL0000	SSBG003	39.00	Zinc	69.6	4.2427646	
BGL0000	SSBG000	19.00	Zinc	73.0	4.2904594	
BGL0000	SSBG001	39.00	Zinc	78.8	4.366913	
BGL0000	SSBG002	19.00	Zinc	79.0	4.3694479	
BGL0000	SSBG001	19.00	Zinc	84.2	4.4331949	
BGL0000	SSBG001	4.00	Zinc	87.2	4.4682043	
BGL0000	SSBG002	39.00	Zinc	90.4	4.5042443	
BGL0000	SSBG005	39.00	Zinc	101.0	4.6151205	

Bin	*Frequency*
15	0
25	0
35	0
45	3
55	4
65	8
75	5
85	3
95	2
105	1
110	0
More	0



Mean [Ln(conc)]	4.126325
Std Dev [Ln(conc)]	0.25134
Z	1.645
95 th Quantile (mg/Kg)	**94**
Bias %	0.12 (OK, <5%)

95 % Confidence Limits on 95 th Quantile

a = 5%	
p = 95%	
K (estimating factor) =	2.3556
95% LL (mg/kg) =	**75**
95% UL (mg/kg)=	**112**

LEHR Facility, Davis, California

Shapiro Wilk Test to Determine Whether Log Transformed Data Fits Normal Distribution

i (# Samples)	CONC	x_i LN (Conc)	$(x_i)^2$ $[LN(Conc)]^2$	x_i Ranked	a stats	$a^*(x_{n-i+1} - x_i)$ (n=26)
1	37.6	3.627	13.155	3.627004	0.4407	0.4354629
2	39.6	3.679	13.534	3.678829	0.3043	0.2511738
3	43.0	3.761	14.147	3.7612	0.2533	0.1790842
4	47.9	3.869	14.970	3.869116	0.2151	0.1213335
5	49.3	3.898	15.194	3.897924	0.1836	0.0865718
6	49.8	3.908	15.273	3.908015	0.1563	0.0717258
7	53.2	3.974	15.793	3.974058	0.1316	0.0416384
8	56.4	4.032	16.261	4.032469	0.1089	0.0229012
9	56.6	4.036	16.289	4.036009	0.0876	0.0179858
10	57.0	4.043	16.346	4.043051	0.0672	0.0116599
11	58.3	4.066	16.529	4.065602	0.0476	0.005977
12	59.4	4.084	16.681	4.084294	0.0284	0.0021183
13	60.6	4.104	16.845	4.104295	0.0094	0
14	60.6	4.104	16.845	4.104295		
15	64.0	4.159	17.296	4.158883		
16	66.1	4.191	17.566	4.191169		
17	67.8	4.217	17.779	4.216562		
18	69.5	4.241	17.989	4.241327		
19	69.6	4.243	18.001	4.242765		
20	73.0	4.290	18.408	4.290459		
21	78.8	4.367	19.070	4.366913		
22	79.0	4.369	19.092	4.369448		
23	84.2	4.433	19.653	4.433195		
24	87.2	4.468	19.965	4.468204		
25	90.4	4.504	20.288	4.504244		
26	101.0	4.615	21.299	4.615121		
		$[SUM (x_i)]^2$	$SUM (x_i^2)$			
		11509.954	444.270			

W
0.98562

W is greater than 0.92.
Cannot rule out lognormal distribution.

d
1.5793