



U.S. Department of Energy

Oakland Operations Office, Oakland, California

FINAL RADIONUCLIDE AIR EMISSION ANNUAL REPORT (SUBPART H OF 40 CFR 61) CALENDAR YEAR 1998

for the:

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

prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 95612-5208

prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, California 94608-1827

June 11, 1999

Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

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ACRONYMNS

°F	Degrees Fahrenheit
AEC	Atomic Energy Commission
bgs	Below ground surface
C-14	Carbon-14
Co-60	Cobalt-60
COC	Constituents of Concern
Cs-137	Cesium-137
cu. yd(s).	Cubic yards
D&D	Decontamination and decommissioning
DCG	Derived concentration guide
EDE	Effective dose equivalent
ER/WM	Environmental Restoration/Waste Management
ITEH	UC Davis Institute of Toxicology and Environmental Health
LEHR	Laboratory for Energy-Related Health Research
LFI	Limited Field Investigation
LLW	Low-level radioactive waste
MEI	Maximally exposed individual
mrem	Millirem
mSv/yr	Milli-Sievert per year
NESHAP	National Emissions Standards for Hazardous Air Pollutants

pCi/g	Pico-Curies per gram
PM ₁₀	Particulate matter with ≤ 10 μ -meters aerodynamic diameter
RA	Removal Actions
Ra-226	Radium-226
rem	Roentgen equivalent man
Site	LEHR Site
SWT	Southwest Trenches Area
Sr-90	Strontium-90
TPHRL	Toxic Pollutant Health Research Laboratory
UC Davis	University of California, Davis
UCL	Upper Confidence Limit
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency

US Department of Energy
Radionuclide Air Emission Annual Report
(Subpart H of 40 CFR 61)
Calendar Year 1998

Site Name: Laboratory for Energy-Related Health Research (LEHR)

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1. FACILITY INFORMATION

The Laboratory for Energy-Related Health Research (LEHR) facility is in compliance with the requirements of 40 CFR Part 61 Subpart H - National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Emissions of Radionuclides from USDOE Facilities. The NESHAP regulations require that radionuclide emissions not exceed levels that would result in an effective dose equivalent (EDE) of 10 millirem per year (mrem/yr). There are currently no remaining point sources of radionuclide emission at the LEHR facility. Potential fugitive/area sources of radionuclide emissions were modeled using the USEPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC Version 1.0. The total estimated contribution to the EDE from non-point source emissions for reporting year 1998 was estimated to be 4.2×10^{-3} mrem/yr (approximately 0.04% of the 10 mrem/yr standard).

1.1 Site Description

The LEHR Facility (Site) is located in Solano County, California, in the southeast one-quarter of Section 21, Township 8 North, Range 2 East, Mount Diablo Base and Meridian. It is approximately 1.5 miles south of the town of Davis (Figure 1), and occupies the southeast portion of the University of California, Davis (UC Davis) campus. The Site is bounded by UC Davis research facilities, private farmland, and the South Fork of Putah Creek. The southern boundary of the LEHR Site is the northern levee of the South Fork of Putah Creek.

The local climate is Mediterranean, with mild winters and long summers. Based on data collected from the on-site meteorological station in 1998, the average winter temperature was 46°F, and the average summer temperature was 76 °F. Precipitation data was also collected from the UC Davis climatological data center, located approximately one mile northwest of the Site. Based on the UC Davis data, the total precipitation for 1998 was 24.1 inches (with 17.9 inches and 25.4 inches recorded in 1997 and 1996, respectively). The sun shines approximately 95% of the time in the summer and about 45% in the winter.

The prevailing wind direction is from the south, reflecting frequent incursions of marine air through the Carquinez Strait into the Sacramento Valley. Changes in wind direction are common, with winds from the northwest occurring diurnally. Several times a year, strong winds blow from the north, generally following the passage of Pacific storm systems (USDOE, 1994). Based on data collected from the on-site meteorological station in 1998, during the winter months (October – April) the wind directions vary, with the primary wind direction frequency being from the north and a significant wind direction frequency from the south. During the summer months (May – September) the predominant wind direction is from the south. The average windspeed recorded at the LEHR Site meteorological station in 1998 was approximately 1.6 meters per second (m/s) or 3.7

miles per hour (mph), the maximum windspeed was 8.8 m/s (19.6 mph) and the median windspeed was 1.4 m/s (3.1 mph).

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 some crop land. Approximately 75% 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% of the agricultural land in the LEHR vicinity is irrigated, and some of the nearby lands are used for cattle grazing (USDOE, 1988).

The Site encompasses approximately 15 acres and contains laboratory buildings and former animal-handling facilities (Figure 2). Of the 15 acres, approximately 45% is paved or covered by structures. Approximately 30% is unpaved and relatively free of vegetation. Five percent is covered by large, deep-rooted vegetation. Outdoor dog pens occupy approximately 20%, or 3 acres, of the LEHR Site. The land is owned by the Regents of the University of California and was leased to the United States Department of Energy (USDOE) through 1989. USDOE still owns the buildings on-site.

In the early 1950s, the Atomic Energy Commission (AEC, now USDOE) began conducting radiological studies at the Site on laboratory animals, particularly beagles. Initial studies were carried out on the main campus and involved the irradiation of beagles. The LEHR Site began operating in its present location in 1958 when full-scale experimental use of radioactive materials began. Research at LEHR through the mid-1980s focused on the health effects from chronic exposure to radionuclides, primarily strontium-90 (Sr-90) and radium-226 (Ra-226). In the early 1970s, a cobalt-60 (Co-60) irradiator facility was constructed at the LEHR Site to study the effects of chronic exposure to gamma rays on bone marrow cells of beagles. In 1975, USDOE initiated a program at the Site to study the potential health effects of combustion products from fossil fuel power plants. In 1983, the Toxic Pollutant Health Research Laboratory (TPHRL) was established at the LEHR Site. USDOE-funded research at LEHR ended in 1989. The Site is presently occupied by the UC Davis Institute of Toxicology and Environmental Health (ITEH) and LEHR Environmental Restoration/Waste Management (ER/WM) project.

1.2 Source Description

The NESHAP requirements primarily target point source/stack emissions. However, a Memorandum of Understanding between USDOE and USEPA (USDOE, 1995) applies the same point source criteria to potential non-point diffuse area sources.

1.2.1 Point Sources

The point sources were removed from the Site prior to 1998. There were no point sources of radionuclide emissions at the LEHR facility in 1998, and therefore, none are noted in this report.

1.2.2 Non-Point Sources

Non-point sources were limited to windblown fugitive dust from the following areas (see Table 1):

- the Southwest Trenches Area;
- the Ra/Sr Treatment Systems Area, and;
- the Eastern and Western Dog Pens Area.

For this report, radionuclide concentrations from 1996 and 1997 soil sampling and 1998 waste profile soil sampling from the Southwest Trenches (see below) were used to calculate fugitive dust emission rates. No other changes to the LEHR site occurred during 1998, thus, the emissions calculated for the other three areas were identical for 1997 and 1998.

1.2.3 Southwest Trenches Area

The Southwest Trenches (SWT) Area is located in the southwest corner of the LEHR facility (Figure 2). The SWT Area underwent extensive environmental restoration during the summer of 1998. Several COCs were either consistently detected at the SWT Area or were associated with past operations and releases to the environment. These COCs were considered “driver COCs” and their concentrations were used during the removal action (RA) to guide the excavation activities. The driver COCs at the SWT Area include radium-226 (Ra-226), strontium-90 (Sr-90), chlordane, hexavalent chromium, nitrate, and mercury.

Prior to the RA, the Southwest Trenches were divided into three sub-areas: the northern, southern, and western trenches (Figure 3). Separation into these three sub-trenches enabled a detailed classification of contaminants buried in the subsurface. In general, chlordane-impacted soil was found at the surface of the western trench to an approximate depth of 3.5 ft bgs. In the northern trench, buried syringes, needles, and glass were found. The materials in the southern trench consisted of metals, pottery, ceramics, and labeled tritium bottles with unidentified liquids. In addition, syringes, needles, and glass were also identified in the southern trench. Waste material in the western area was comprised mostly of rubber gloves and boots, empty vials, and huge remains of animal bones as well as wastes similar to those found in the northern trench.

In August 1998, contaminated soil and buried wastes were removed from the trenches for proper storage and disposal. The RA was implemented by utilizing a backhoe to explore the area. Initially, exploration began by excavating digging in a vertical grid pattern to an approximate depth

of three feet to determine the waste locations. Once the wastes were encountered and identified, removal by excavation proceeded.

Approximately 350 cubic yards (cu. yds.) of surface soil impacted by chlordane was excavated from the western trenches. Next, waste from all three trenches was removed. Approximately 208 cu. yds. of soil were removed from the northern trench to an average depth of 7 ft bgs. In the southern trench, 190 cu. yds. of soil were removed to an average depth of 5.3 ft bgs. In the western trench, 466 cu. yds. of soil were excavated to an average depth of 8 ft bgs. The approximate amount of soil removed from the Southwest Trenches was 1,214 cu. yds., about 918 cu. yds. of which was low-level radioactive waste (LLW). The LLW was loaded into sealed containers for off-site disposal. The remaining soil was identified as potentially hazardous due to chlordane and stockpiled on-site.

Both composite waste samples and confirmation soil samples were sent for detailed analyses to a commercial laboratory approved by the United States Environmental Protection Agency (USEPA). Carbon-14 (C-14) and cesium-137 (Cs-137) at 177 pCi/g and 176 pCi/g, respectively, were the highest radionuclide activities detected during the RA at the Southwest Trenches. In addition, during the 1996 Limited Field Investigation (LFI), Sr-90 was detected at 16,700 pCi/g in a sludge sample from the chemical dispensing area. The sludge encountered during the 1996 LFI was excavated during the 1998 RA.

Table 2 summarizes all radionuclides found in the Southwest Trenches waste above their soil background values. Confirmation soil samples were taken after excavation of the southern trench; C-14 was below its detection limit of 0.1 pCi/g, and the Cs-137 activities were detected at or below 1.18 pCi/g.

Ambient air samples were monitored during the entire removal action at the Southwest Trenches from four stations around the perimeter of the site and one distant station serving as a background station. Details of the air monitoring results will be presented in the Final RA Report. All detected radionuclides were either below their specific background values or below the Derived Concentration Guide (DCG). Fugitive dust or particulate matter-10 (PM₁₀) emissions from the excavation activities were closely monitored. USEPA established a PM₁₀ standard not to exceed 150 µg/m³ for a 24-hour period to particles with aerodynamic diameters less than or equal to 10 micrometers (µm) (Federal Register, 1987). PM₁₀ concentrations did not exceed the 150 µg/m³ air quality standard during the entire RA. The maximum PM₁₀ concentration during the RA was 93 µg/m³ collected at the air monitoring station located within the Southwest Trenches.

The Southwest Trenches emissions were based on the 1998 waste data and are summarized in Section 2.

1.2.4 Ra/Sr Treatment Systems Area

The Radium and Strontium Treatment Systems are located between Animal Hospital Nos. 1 and 2 (H-219 and H-218) in the western portion of the LEHR facility (Figure 2) and together comprise the Ra/Sr Treatment System Area. These systems were used to treat radiological liquid wastes generated from the animal experiments.

The Ra-226 Treatment System reportedly received low-level radioactive waste, including fecal material and washdown water from Animal Hospital No. 2. The system consisted of two septic tanks each containing multiple compartments separated by weirs, a distribution box, three dry wells, and one leach trench and associated distribution pipelines. Solids settled out in the septic tanks and fluids were pumped from the tanks and fed through the distribution box to one of the three vertical dry wells or the leach trench. Currently, both of the tanks associated with this system are empty.

The Sr-90 (Imhoff) Treatment System reportedly received low-level radioactive waste from Sr-90 experiments. Effluent was processed through the Imhoff Treatment System and then was discharged to two leach fields. The Imhoff Treatment System, consisting of a series of nine tanks, primarily used sedimentation, aeration, chemical clarification, and filtration to treat the wastes prior to passing the remaining waste water through a cation exchange resin and discharging the remaining fluid to the Sr-90 leach fields.

The Ra/Sr Treatment System Area was investigated and characterized as part of the 1996 LFI. Analysis of the distribution of radionuclides in the soil of the Ra/Sr Treatment System Area indicates that the Strontium (Imhoff) Treatment System operations did not significantly impact surrounding soil. Significant Ra/Sr contamination associated with the Ra Treatment System is generally confined to, or is immediately adjacent to, the leach lines and dry wells. No additional surface soil data were collected in 1998 for the Ra/Sr Treatment System Area.

The Ra/Sr Treatment System Area emissions were based on the most recent data for the area collected in 1996 and are summarized in Section 2.

1.2.5 Eastern & Western Dog Pens Area

The Eastern and Western Dog Pens Area, located near the center of the LEHR facility (Figure 2), are a potential diffuse source of radiological emissions. The dog pens were used to house dogs involved in the Ra-226 and Sr-90 research activities at the LEHR Site. The western area originally contained 320 pens. In 1975, 64 pens were removed to allow for construction of the Cellular Biology Lab (Building H-294; Figure 2). The eastern area contained 96 pens and overlies UC Davis Landfill No. 2. Excreta from dogs housed in outdoor pens contained low levels of radiological constituents. Solids were removed from the pens on a daily basis. Urine evaporated and/or infiltrated the gravel fill in the pens. An estimated 2 mCi of Sr-90 and 0.5 mCi of Ra-226 were potentially excreted in dog urine in these areas over the life of the project (Weiss Associates, 1997b).

Between June and August 1996, the following were removed from the dog pen areas: fencing and concrete curbing for 256 Western and 96 Eastern Dog Pens, concrete dog pen pedestals, and some soil. After removal of the dog pens, 24 surface soil samples were collected from randomly selected locations and were submitted for radionuclide analysis. Only Sr-90, Ra-226 and Cs-137 were detected above background in these 24 samples.

In 1997, additional investigation was performed in the Western Dog Pens as detailed in the *Draft Technical Report: Results of Western Dog Pen, Background and Off-Site Investigations* (Weiss Associates, 1998). Phase A of the investigation consisted of reviewing historical information and conducting a general gamma scan of the dog pens gravel. During Phase B, 46 gravel and 75 soil samples, including 4 gravel and 6 soil duplicates, were submitted to an off-site analytical laboratory for selected radionuclide analyses. Results of the analyses concluded that only Ra-226 (maximum activity of 1.94 pCi/g), Sr-90 (maximum activity in gravel of 3.59 pCi/g), Cs-137 (maximum activity of 0.115 pCi/g), thorium-234 (maximum activity less than 2 pCi/g), and uranium-238 (maximum activity of 1.62 pCi/g) were present in soil in activities above background.

In 1998, Phase C of the Dog Pens Investigation was completed in the Western Dog Pens area. This investigation included collecting a surface soil sample from 20 different dog pens. In addition, a soil boring with multiple samples was completed at each of the 20 dog pens. All of the soil samples were submitted to an off-site analytical laboratory for selected radionuclide analyses. Results concluded that only the following radionuclides were present at activities greater than background: Sr-90 (maximum activity of 0.71 pCi/g); Cs-137 (maximum activity of 0.072 pCi/g); C-14 (maximum activity of 2.02 pCi/g); Th-234 (maximum activity of 2.4 pCi/g); U-235 (maximum activity of 0.317 pCi/g); U-238 (maximum activity of 2.4 pCi/g); and Pb-210 (maximum activity of 4.53 pCi/g).

The Eastern and Western Dog Pens Area emissions were based on the 1997 and 1998 investigation data and are summarized in Section 2.

2. AIR EMISSION DATA

2.1 Point Sources

All point sources have been removed from the Site, and there are currently no point sources of radionuclide emissions at the LEHR facility.

2.2 Non-Point Sources

As discussed in Section 1, radionuclide emission sources at the LEHR facility in 1998 were limited to four areas of potential windblown, fugitive dust emission sources of radionuclides: the Southwest Trenches Area; the Ra/Sr Treatment Systems Area; and the Western and Eastern Dog Pen Areas. Based on the surface soil sampling results from the Ra/Sr Treatment Systems and Western and Eastern Dog Pens, surface contamination is conservatively assumed to exist across the entire area of each potential radionuclide emissions source. No changes to site conditions at these three locations occurred during 1998 that would result in emissions different from those estimated for the 1997 calendar year NESHAP report. However, source conditions at the Southwest Trenches changed as a result of extensive excavation of contaminated soil and buried wastes. Thus, modeling assumptions were modified for the Southwest Trenches Area. Specifically, WA conservatively used the maximum radionuclide activities from the excavated wastes and assumed the wastes were exposed to the atmosphere during the RA. Otherwise, the modeling assumptions are identical to those assumed in the 1997 calendar year *Radionuclide Air Emission Annual Report*.

To calculate air emissions for the calendar year 1998 *Radionuclide Air Emission Annual Report*, the surface area of each non-point source area was determined, using a scaled map of the Site, as follows:

- Southwest Trenches Area surface area = 1,915 square meters (m²)
- Ra/Sr Treatment System Area surface area = 1,980 m²;
- Western Dog Pens surface area = 9,500 m², and
- Eastern Dog Pens surface area = 3,900 m².

The particulate resuspension rate model used to calculate the fugitive dust emission rate is based on the USEPA's guidance document entitled *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites* (Cowherd, 1985). Cowherd provides a methodology

for the rapid, worst-case assessment of inhalation exposure to respirable particulate emissions, defined as airborne particles equal to or smaller than 10 μ -meters aerodynamic diameter (PM_{10}). PM_{10} particulate emission rates from LEHR site fugitive sources were estimated using the equation developed by Cowherd for estimating respirable particle emissions from wind erosion of surfaces with an "unlimited reservoir" of erodible particles, adjusted for site specific data using the following formula:

$$E_{10} = 0.036 \times (1 - V) \times \left(\frac{[u]}{u_t} \right)^3 \times F(x) \quad (\text{Eq. 1})$$

where

- E_{10} = annual average PM_{10} emission rate per unit contaminated surface, g/(m²-hr),
- V = fraction of contaminated surface vegetative cover (assumed zero for bare soil),
- $[u]$ = mean annual windspeed at 7 m height = $[u]_{\text{site}} \times \ln(700/z_0)/\ln(300/z_0) = 2.71$ m/s,
- $[u]_{\text{site}}$ = 95% UCL of LEHR site meteorological tower mean annual windspeed at 3 m height (= 2.32 m/s),
- z_0 = emission source area roughness height (2 cm),
- x = $0.866 u_t / [u]$ = dimensionless ratio,
- $F(x)$ = function plotted in Figure 4-3 of the guidance document, (= 5.6×10^{-2});
- u_t = threshold value of windspeed at 7 m height = $u_{\text{friction}} / 0.4 \times \ln(700/z_0) = 7.3$ m/sec; and,
- u_{friction} = threshold friction velocity (50 cm/sec).

The fraction of contaminated surface vegetative cover was conservatively assumed to be zero (i.e. bare soil). The roughness height of 2 cm represents a value between the ranges for a plowed field and grasslands (Cowherd, 1985). Cowherd recommends a procedure for determining the threshold friction velocity based upon surface soil sieve analysis data. Because no surface soil sieve analysis data were available for the LEHR Site, a conservative threshold friction velocity of 50 cm/s was selected, following Cowherd's example application #1, for a rural emergency response application (Cowherd, 1985).

Cowherd (1985) recommends using the mean annual windspeed data tabulated in Table 4-1 of the particulate emission rate guidance document. However, since the tabulated values are based on 1977 meteorological data from Sacramento, and because site-specific data are available from the LEHR on-site meteorological tower, the on-site data were selected as more representative of local site conditions. The 95% UCL of the LEHR Site meteorological tower mean annual windspeed data was calculated using meteorological data collected between January 1998 and December 1998.

The 95% UCL was calculated using equations for characterizing confidence limits of the mean for lognormal populations (Gilbert, 1987), as recommended by USEPA Guidance (USEPA, 1992a). The resulting 95% UCL of the LEHR site meteorological tower mean annual windspeed for 1998 was 2.32 m/s). Because the on-site meteorological tower is 3 meters, the windspeed must be

converted to the equivalent windspeed at a height of 7 meters using a variation of Cowherd's equation 4-3, which assumes a logarithmic velocity profile near the earth's surface.

The annual average PM₁₀ emission rate per unit contaminated surface estimated using equation 1 and the data discussed above is 2.87×10^{-8} g/(m²-sec). This emission rate is combined with the maximum radionuclide activity measured above background in surface soil activities for each potential emission source to calculate a particulate emission rate based on the following equation:

$$E_{\text{area}} = E_{10} \times A_{\text{area}} \times (60 \times 60 \times 24 \times 365 \text{ sec/yr}) \times C_{\text{Rad}} \times (10^{-12} \text{ Ci/pCi}) \text{ (Eq. 2)}$$

where

E_{area} = annual average PM₁₀ emission rate for the potential radionuclide emission source, Ci/yr;

E_{10} = annual average PM₁₀ emission rate per unit contaminated surface, g/(m²-sec);

A_{area} = surface area of potential radionuclide emission source, m²; and,

C_{Rad} = maximum of the measured surface soil radionuclide activities, pCi/g.

Equations 1 and 2 and the methodology discussed above were used to estimate the non-point source fugitive dust radionuclide emission rate for each of the four potential radionuclide emission sources, as presented in Tables 2 through 5.

2.3 Particulate Matter-10 (PM₁₀)

PM₁₀ data were calculated based on a volumetric flow rate. Glass fiber filters, prepared by an USEPA-approved commercial laboratory, were used to collect particulates greater than 10 μm at an average flow rate of 1.15 cubic meter per minute (m³/min) for 24 hours; the total air volume was estimated to be 1,700 m³. Concentration of PM₁₀ was calculated by the equation below:

$$C_{\text{PM-10}} = \frac{M_{\text{ff}} - M_{\text{fi}}}{V} \quad \text{(Eq. 3)}$$

where

$C_{\text{PM-10}}$ = concentration of PM₁₀, μg/m³;

M_{ff} = weight of the glass fiber filter after 24-hr reported by the laboratory, μg;

M_{fi} = weight of the glass fiber filter before sampling reported by the laboratory, μg; and,

V = total air volume, m³.

Equation 3 was also used to calculate all the PM₁₀ values for samples collected during the RA at the Southwest Trenches.

3. DOSE ASSESSMENTS

3.1 Description of Dose Model

Compliance with the NESHAP requirements for diffuse, non-point source emissions was assessed using the USEPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC Version 1.0. This code was used to calculate the EDE to individual receptors at various distances from the four potential LEHR facility radionuclide emission sources. A total of four CAP88-PC runs were executed to model the fugitive dust emission sources described in Section 2. For each of the four potential radionuclide emission sources, a human receptor was identified in the north, south, east and west quadrants from the source.

The area source algorithm employed by CAP88-PC, Version 1, assumes the distance from an area source to a receptor is measured as the distance from the centroid of the area source to the receptor (USEPA, 1992b). For the LEHR facility CAP88-PC modeling, the distance from an area source to a receptor is measured as the approximate distance from the centroid of the area source to the building assumed to house the receptor. Each CAP88-PC run included receptor distances to the respective source's maximally exposed individual (MEI), as well as the distances to MEIs identified for the other three potential radionuclide emission sources ("location" column for each source in Table 6). The CAP88-PC model output is included in Appendix A.

The reported EDE to an MEI at the LEHR facility includes contributions from all four potential LEHR facility radionuclide emission sources based on the CAP88-PC model output. Based on the combined source exposures, the human receptor at the LEHR facility is located in the Medical Clinic Building (H-215) (Table 6).

The collective population dose is calculated as the average radiation dose to an individual in a specified area, multiplied by the number of individuals in that area. A total of four "population" CAP88-PC runs were executed to model the four fugitive dust emission sources. For each of four potential radionuclide emission sources, the CAP88-PC model was run with an updated population data file used in the calendar year 1997 *Radionuclide Air Emission Annual Report*. The 1997 population data value was increased by 4% for the calendar year 1998 report. This increase assumed a conservative population growth of 4%/yr at a distance greater than 1 kilometer from the Site accounting for the increase in residential population in Davis and the student population at the UC Davis campus.

This population file includes receptors within a distance of 10 km from the Site, rather than 80 km as specified in USDOE guidance. This modification was necessary to avoid including the large number of receptors in the Sacramento area whose exposure to radionuclides resulting from the

LEHR facility would be negligible, but whose population numbers would have a large effect on the collective population dose results. This approach is appropriate for calculating the collective population dose for the primarily rural LEHR facility surroundings. The results of the CAP88-PC population dose runs based upon the combined source exposures are presented in Table 7 and Appendix A.

3.2 Summary of Input Parameters

The input parameters for the CAP88-PC Version 1.0 runs are summarized for the Southwest Trenches Area, the Ra/Sr Treatment Systems Area, and the Eastern and Western Dog Pen Areas in Tables 8, 9, 10, and 11, respectively. As noted above, the areal extent of each source was conservatively calculated assuming that the maximum activity of the observed radiological surface soil contamination was present across the entire potential radionuclide emission source area. Conservative radionuclide emissions were calculated using the maximum of the soil radionuclide activities measured for each potential area source and applying the USEPA-recommended particulate resuspension rate model to calculate the fugitive dust emission rates.

The Sacramento area wind file included with the CAP88-PC Version 1.0 computer code was used for the modeling. LEHR on-site meteorological data were not utilized for the modeling due to incompatible formats between on-site data (MET144) and the CAP88-PC requirement (CD144). Use of the Sacramento wind file is appropriate because of the Sites' close proximity (approximately 15 miles) to Sacramento, the similar geography of the two areas, and the lack of intervening geographical anomalies.

4. COMPLIANCE ASSESSMENT

Point Source Effective Dose Equivalent: None

Non-Point Source Effective Dose Equivalent: 4.2×10^{-3} mrem/yr (4.2×10^{-5} mSv/yr)

Location of Maximally Exposed Individual: Reproductive Biology Laboratory (H-215),
30 m north of the former Southwest Trenches
Area (Figure 2)

4.1 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See, 18 U. S. C. 1001).

Signature: _____ Date: _____
Robert Devany
LEHR Site ER/WM Project Manager

Signature: _____ Date: _____
Susan Fields
USDOE-LEHR Project Manager

5. ADDITIONAL INFORMATION

For facilities that have completed construction or modification projects during the 1998 calendar year for which no application for approval to construct or modify was required for submission to USEPA, provide a brief description of the construction or modification project and an estimate of potential doses to the public.

There were construction or modification projects completed within the 1998 calendar year at the LEHR facility for which approval to construct or modify was required or waived under Section 61.96 of Subpart H of 40 CFR 61. In the summer of 1998 (June through September), contaminated soil and buried wastes from the Southwest Trenches were excavated and removed for proper storage and disposal. The approximate amount of soil removed from the Southwest Trenches was 1,214 cu. yds. and approximately 918 cu. yds. of this soil was classified as low level waste (LLW).

The collective population equivalent dose to the Davis residents was 1.79×10^{-4} person-rem/yr, and the EDE for the maximally exposed individual was 6.32×10^{-5} mrem/yr as estimated by CAP88-PC. The predicted EDE for the MEI is orders of magnitude below the 10 mrem/yr standard as required by 40 CFR Part 61 Subpart H.

- **Identify any unplanned releases of radionuclides to the atmosphere.**

There were no unplanned releases of radionuclides to the atmosphere during 1998.

- **Results of the dose assessment associated with the diffuse source emissions from the facility.**

As noted in Sections 1 and 2, there are currently no point sources of radionuclide emissions at the LEHR facility. The only potential sources of radionuclide emissions remaining at the LEHR Site are diffuse sources of fugitive dust, and the results of the dose assessment associated with the diffuse source emissions from the LEHR facility are presented in Section 3 and Table 6. The total contribution to the EDE to the MEI resulting from non-point source emissions was estimated to be 4.2×10^{-3} mrem/yr (4.2×10^{-5} mSv/yr), far below the 10 mrem/yr standard.

6. REFERENCES

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7. ACKNOWLEDGEMENTS

The following personnel worked on the LEHR Facility 1998 NESHAP Report:

Name and Position	Responsibility
Michael Dresen LEHR Program Manager, WA	Senior guidance and review, and quality assurance.
Robert Devany LEHR Project Manager, WA	Project management, guidance and review.
Michael Zimmerman Air Program Task Leader, WA	Technical guidance and review, and quality assurance.
Jason Tseng Staff Engineer, WA	Project coordination, modeling, and report writing.
Craig Adams Graphics, WA	Graphics.
Nerissa de Jesus Administrative Assistant, WA	Word processing and report compilation.
Ted Trammel Production Personnel, WA	Report production.

TABLES

Table 1. Summary of LEHR Site Potential Diffuse Radionuclide Sources

Potential Fugitive Source	Description
Southwest Trenches	Disposal trenches and chemical dispensing area in the southwest corner of the LEHR Site.
Radium/Strontium Treatment System	Ra-226 treatment tank and the associated leach field and dry wells, and the Sr-90 treatment tanks and associated leach system.
Dog Pens Areas	The western and eastern dog pens areas.

Table 2. Summary of Maximum Surface Soil Activities for Radionuclides Exceeding Background and Their Associated PM₁₀ Emission Rates, LEHR Southwest Trenches Area

Radionuclide	Maximum Activity (pCi/g)	Maximum PM ₁₀ Emission Rate (Ci/yr)
Actinium-228	0.66	1.0E-09
Americium-241	0.09	1.4E-10
Bismuth-212	0.49	7.5E-10
Bismuth-214	2.44	3.7E-09
Carbon-14	177.00	2.7E-07
Cesium-137	176.00	2.7E-07
Cobalt-60	0.02	3.2E-11
Lead-210	9.77	1.5E-08
Lead-212	0.63	9.6E-10
Lead-214	2.66	4.1E-09
Plutonium-241	0.56	8.5E-10
Potassium-40	13.60	2.1E-08
Radium-223	0.97	1.5E-09
Radium-226	2.34	3.6E-09
Radium-228	0.66	1.0E-09
Strontium-90	8.71	1.5E-08
Thallium-208	0.21	3.1E-10
Thorium-228	0.72	1.1E-09
Thorium-230	0.61	9.3E-10
Thorium-232	0.54	8.2E-10
Thorium-234	1.17	1.8E-09
Tritium	2.90	4.4E-09
Uranium-233/234	0.27	4.1E-10
Uranium-235	0.08	1.2E-10
Uranium-238	0.51	7.7E-10

Table 3. Summary of Maximum Surface Soil Activities for Radionuclides Exceeding Background and Their Associated PM₁₀ Emission Rates, LEHR Ra/Sr Treatment System

Radionuclide	Maximum Activity (pCi/g)	Maximum PM ₁₀ Emission Rate (Ci/yr)
Americium-241	0.024	3.8E-11
Bismuth-212	0.38	6.0E-10
Cesium-137	0.054	8.6E-11
Lead-210	1.4	2.2E-09
Plutonium-241	1.5	2.4E-09
Radium-223	0.04	6.3E-11
Radium-226	1.73	2.7E-09
Thorium-234	0.55	8.7E-10
Uranium-235	0.12	1.9E-10

Table 4. Summary of Maximum Surface Soil Activities for Radionuclides Exceeding Background and Their Associated PM₁₀ Emission Rates, LEHR Western Dog Pens Area

Radionuclide	Maximum Activity (pCi/g)	Maximum PM ₁₀ Emission Rate (Ci/yr)
Bismuth-212	0.62	4.7E-09
Bismuth-214	0.84	6.4E-09
Carbon-14	11.3	8.6E-08
Cesium-137	0.159	1.2E-09
Cobalt-60	0.028	2.1E-10
Lead-210	3.3	2.5E-08
Lead-212	0.99	7.5E-09
Radium-223	0.32	2.4E-09
Radium-226	1.9	1.4E-08
Strontium-90	5.66	4.3E-08
Thallium-208	0.272	2.1E-09
Thorium-234	0.93	7.1E-09
Uranium-235	0.14	1.1E-09

Table 5. Summary of Maximum Surface Soil Activities for Radionuclides Exceeding Background and Their Associated PM₁₀ Emission Rates, LEHR Eastern Dog Pens Area

Radionuclide	Maximum Activity (pCi/g)	Maximum PM ₁₀ Emission Rate (Ci/yr)
Bismuth-212	0.49	1.5E-09
Carbon-14	11.3	3.5E-08
Cobalt-60	0.028	8.7E-11
Radium-223	0.32	1.0E-09
Radium-226	1.04	3.2E-09
Strontium-90	3.25	1.0E-08
Thorium-234	0.88	2.7E-09
Uranium-235	0.14	4.4E-10

Table 6. Summary of On-Site Effective Dose Equivalent (EDE) to Maximally Exposed Individuals (MEIs) Resulting from Radionuclide Emissions from Each Potential Fugitive Dust Emission Source

MEI Receptor Description	Southwest Trenches Area		Ra/Sr Leach Systems Area		Western Dog Pens Area		Eastern Dog Pens Area		Maximum Total Dose (mrem/yr) ³
	(mrem/yr) ¹	Location ²	(mrem/yr) ¹	Location ²	(mrem/yr) ¹	Location ²	(mrem/yr) ¹	Location ²	
Reproductive Biology Laboratory (H-215)	2.8E-03	30 m North	7.1E-05	50 m South	1.3E-03	40 m West	9.4E-06	130 m West	4.2E-03
UCD Building East of LEHR Site	6.3E-05	350 m East	2.8E-05	350 m East	7.6E-05	300 m East	1.9E-06	180 m East	1.7E-04
Off-site Receptor South of Putah Creek	6.0E-05	1,000 m South	2.7E-05	1,400 m South	7.1E-05	1,200 m South	7.4E-07	1,000 m South	1.6E-04
Off-site Receptor West of LEHR Site	9.3E-05	250 m West	3.0E-05	250 m West	8.1E-05	400 m West	1.2E-06	500 m West	2.1E-04
Animal Hospital Building No. 1 (H-219)	3.7E-04	100 m North	7.6E-04	15 m North	4.6E-04	65 m West	6.1E-06	165 m West	1.6E-03
Animal Hospital Building East of OU-2	4.3E-04	90 m North	1.9E-04	25 m East	1.3E-03	40 m West	8.2E-06	140 m West	1.9E-03
Animal Hospital Building No. 2 (H-218)	5.6E-04	75m North	5.4E-04	15 m South	4.6E-04	65 m West	6.1E-06	165 m West	1.6E-03
Cellular Biology Laboratory (H-294)	1.6E-04	140 m NNE	5.1E-05	90 m NNE	5.8E-04	65 m North	6.9E-06	150 m NNE	8.0E-04

¹ The EDE to the MEI is taken as the maximum modeled dose within a 22.5° sector in the direction and at the distance indicated in the "location" column. The dose 30 m North of the Southwest Trenches Area, for example, would be the maximum modeled dose at 30 m North, 30 m NNE and 30 m NNW.

² The distance from an area source to a receptor is defined by CAP88-PC as distance from the centroid of the area source to the receptor (USEPA, 1992b). For the LEHR facility CAP88-PC modeling, the distance from an area source to a receptor is measured as the approximate distance from the centroid of area source to the building assumed to house the receptor.

³ The Maximum Total Dose is the sum of EDEs modeled for each MEI receptor from the four potential radionuclide fugitive dust sources. Value in boldface is the Maximum Total Dose for the Site-wide MEI.

Table 8. LEHR Facility NESHAP - CAP88-PC Inputs: Southwest Trenches Area

Run type (Dataset ID: OUIRECEP.SCR)	Individual	Receptor distances (m): 30, 75, 90, 100, 140, 250, 350, 1000	
Run type (Dataset ID: OUIPOP.SCR)	Population	Population file to use: 99LEHR.POP	
Modeling Options	Generate genetic effects?	Yes	
	Create Dose and Risk Factor file?	Yes	
	Create Concentration Table file?	Yes	
	Create Chi/Q Table file?	Yes	
Meteorological Data			
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)		
Annual precipitation (cm/yr):	70.7 (1998 Sacramento average)		
Annual ambient temperature (deg. C):	15.6 (1998 Sacramento average)		
Height of lid (m):	1,000 (CAP88-PC default)		
Source Data			
Source type:	AREA		
Number of source:	1		
Height (m):	0		
Area (m ²):	1,915		
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)		
Agricultural Data			
	Source: Rural (CAP88-PC defaults)		
	Vegetable	Milk	Beef
Fraction home produced:	0.7	0.399	0.442
Fraction from assessment area:	0.3	0.601	0.558
Fraction imported:	0	0	0
Beef cattle density (#/km ²):	8.81E-02 (CAP88-PC default)		
Milk cattle density (#/km ²):	2.85E-02 (CAP88-PC default)		
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)		

Table 7. Summary of Estimated Collective Population Dose Resulting from Radionuclide Emissions from Each Fugitive Dust Emission Source

Potential Emission Source	Maximally Exposed Individual		Collective Population Dose (person-rem/yr)
	(mrem/yr)	Location	
Southwest Trenches Area	3.74E-05	250 m North	1.06E-04
Ra/Sr Leach Systems Area	3.18E-06	250 m North	8.98E-06
Western Dog Pens Area	2.00E-05	250 m North	5.68E-05
Eastern Dog Pens Area	2.61E-06	250 m North	7.36E-06
Total LEHR Site	6.32E-05		1.79E-04

Source of data: CAP88-PC Version 1.0 modeling output files.

Table 8. LEHR Facility NESHAP - CAP88-PC Inputs: Southwest Trenches Area (continued)

Radionuclide Release Data		2.86E-08 (Using Cowherd, 1985, unlimited erosion potential.)				
PM ₁₀ Emission Rate (g/m ² -sec):		Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size ¹ (μm)	Class ¹
		Ac-228	0.66	1.1E-09	1	Y
		Am-241	0.089	1.5E-10	1	W
		Bi-212	0.49	8.5E-10	1	W
		Bi-214	2.44	4.2E-09	1	W
		C-14	177	3.1E-07	0	
		Cs-137	176	3.0E-07	1	D
		Co-60	0.021	3.6E-11	1	Y
		Pb-210	9.77	1.7E-08	1	D
		Pb-212	0.63	1.1E-09	1	D
		Pb-214	2.66	4.6E-09	1	D
		Pu-241	0.56	9.6E-10	1	Y
		K-40	13.6	2.4E-08	1	D
		Ra-223	0.97	1.7E-09	1	W
		Ra-226	2.34	4.0E-09	1	W
		Ra-228	0.66	1.1E-09	1	W
		Sr-90	8.71	1.5E-08	1	D
		Tl-208	0.21	3.6E-10	1	D
		Th-228	0.72	1.3E-09	1	Y
		Th-230	0.61	1.1E-09	1	Y
		Th-232	0.54	9.2E-10	1	Y
		Th-234	1.17	2.0E-09	1	Y
		H-3	2.9	5.0E-09	0	
		U-233/234	0.27	4.6E-10	1	Y
		U-235	0.08	1.3E-10	1	Y
		U-238	0.51	8.7E-10	1	Y

¹ CAP88-PC default particle size and lung retention class.

Table 9. LEHR Facility NESHAP - CAP88-PC Inputs: Ra/Sr Treatment System

Run type (Dataset ID:OU2RECEP.SCR)	Individual	Receptor distances (m): 15, 25, 50, 90, 250, 350, 1400		
Run type (Dataset ID: OU2POP.SCR)	Population	Population file to use: 99LEHR.POP		
Modeling Options	Generate genetic effects?	Yes		
	Create Dose and Risk Factor file?	Yes		
	Create Concentration Table file?	Yes		
	Create Chi/Q Table file?	Yes		
Meteorological Data				
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)			
Annual precipitation (cm/yr):	70.7 (1998 Sacramento average)			
Annual ambient temperature (deg. C):	15.6 (1998 Sacramento average)			
Height of lid (m):	1,000 (CAP88-PC default)			
Source Data				
Source type:	AREA			
Number of source:	1			
Height (m):	0			
Area (m ²):	1,980			
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)			
Agricultural Data				
	Source: Rural (CAP88-PC defaults)			
	Vegetable	Milk	Beef	
Fraction home produced:	0.7	0.399	0.442	
Fraction from assessment area:	0.3	0.601	0.558	
Fraction imported:	0	0	0	
Beef cattle density (#/km ²):	8.81E-02 (CAP88-PC default)			
Milk cattle density (#/km ²):	2.85E-02 (CAP88-PC default)			
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)			
Radionuclide Release Data				
PM ₁₀ Emission rate (g/m ² -sec):	2.86E-08 (Using Cowherd, 1985, unlimited erosion potential.)			
	Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size ¹ (µm)
	Am-241	0.024	4.3E-11	1
	Bi-212	0.38	6.8E-10	1
	Cs-137	0.054	9.7E-11	1
	Pb-210	1.4	2.5E-09	1
	Pu-241	1.5	2.7E-09	1
	Ra-223	0.04	7.2E-11	1
	Ra-226	1.73	3.1E-09	1
	Th-234	0.55	9.8E-10	1
	U-235	0.12	2.1E-10	1

¹ CAP88-PC default particle size and lung retention class.

Table 10. LEHR Facility NESHAP - CAP88-PC Inputs: Western Dog Pens

Run type (Dataset ID: OU3aRECP.SCR)	Individual	Receptor distances (m): 40, 65, 300, 400, 1200			
Run type (Dataset ID: OU3aPOP.SCR)	Population	Population file to use: 99LEHR.POP			
Modeling Options	Generate genetic effects?	Yes			
	Create Dose and Risk Factor file?	Yes			
	Create Concentration Table file?	Yes			
	Create Chi/Q Table file?	Yes			
Meteorological Data					
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)				
Annual precipitation (cm/yr):	70.7 (1998 Sacramento average)				
Annual ambient temperature (deg. C):	15.6 (1998 Sacramento average)				
Height of lid (m):	1,000 (CAP88-PC default)				
Source Data					
Source type:	AREA				
Number of source:	1				
Height (m):	0				
Area (m ²):	9,500				
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)				
Agricultural Data					
	Source: Rural (CAP88-PC defaults)				
	Vegetable	Milk	Beef		
Fraction home produced:	0.7	0.399	0.442		
Fraction from assessment area:	0.3	0.601	0.558		
Fraction imported:	0	0	0		
Beef cattle density (#/km ²):	8.81E-02 (CAP88-PC default)				
Milk cattle density (#/km ²):	2.85E-02 (CAP88-PC default)				
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)				
Radionuclide Release Data					
PM ₁₀ Emission rate (g/m ² -sec):	2.86E-08(Using Cowherd, 1985, unlimited erosion potential.)				
	Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size ¹ (µm)	Class ¹
	Bi-212	0.62	5.3E-09	1	W
	Bi-214	0.84	7.2E-09	1	W
	C-14	11.3	9.7E-08	0	*
	Cs-137	0.159	1.4E-09	1	D
	Co-60	0.028	2.4E-10	1	Y
	Pb-210	3.3	2.8E-08	1	D
	Pb-212	0.99	8.5E-09	1	D
	Ra-223	0.32	2.7E-09	1	W
	Ra-226	1.9	1.6E-08	1	W
	Sr-90	5.66	4.9E-08	1	D
	Tl-208	0.272	2.3E-09	1	D
	Th-234	0.93	8.0E-09	1	Y
	U-235	0.14	1.2E-09	1	Y

¹ CAP88-PC default particle size and lung retention class.

Table 11. LEHR Facility NESHAP - CAP88-PC Inputs: Eastern Dog Pens

Run type (Dataset ID: OU3bRECP.SCR)	Individual	Receptor distances (m): 130, 140, 150, 165, 180, 500, 1000			
Run type (Dataset ID: OU3bPOP.SCR)	Population	Population file to use: 99LEHR.POP			
Modeling Options	Generate genetic effects?	Yes			
	Create Dose and Risk Factor file?	Yes			
	Create Concentration Table file?	Yes			
	Create Chi/Q Table file?	Yes			
Meteorological Data					
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)				
Annual precipitation (cm/yr):	70.7 (1998 Sacramento average)				
Annual ambient temperature (deg. C):	15.6 (1998 Sacramento average)				
Height of lid (m):	1,000 (CAP88-PC default)				
Source Data					
Source type:	AREA				
Number of source:	1				
Height (m):	0				
Area (m ²):	3,900				
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)				
Agricultural Data					
	Source: Rural (CAP88-PC defaults)				
	Vegetable	Milk	Beef		
Fraction home produced:	0.7	0.399	0.442		
Fraction from assessment area:	0.3	0.601	0.558		
Fraction imported:	0	0	0		
Beef cattle density (#/km ²):	8.81E-02 (CAP88-PC default)				
Milk cattle density (#/km ²):	2.85E-02 (CAP88-PC default)				
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)				
Radionuclide Release Data					
PM ₁₀ Emission Rate (g/m ² -sec):	2.86E-08 (Using Cowherd, 1985, unlimited erosion potential.)				
	Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size ¹ (µm)	Class ¹
	Bi-212	0.49	1.7E-09	1	W
	C-14	11.3	4.0E-08	0	*
	Co-60	0.028	9.9E-11	1	Y
	Ra-223	0.32	1.1E-09	1	W
	Ra-226	1.04	3.7E-09	1	W
	Sr-90	3.25	1.1E-08	1	D
	Th-234	0.88	3.1E-09	1	Y
	U-235	0.14	4.9E-10	1	Y

¹ CAP88-PC default particle size and lung retention class.

ATTACHMENT 1

USDOE SUPPLEMENTAL INFORMATION

ATTACHMENT 1

USDOE SUPPLEMENTAL INFORMATION

- **Provide an estimate of collective dose equivalent for 1998 releases.**
 - The collective population dose for calendar year 1998 emissions to the population within an 80-km distance of the facility is estimated to be 6.32×10^{-5} person-rem/yr.
- **Provide information on the status of compliance with Subparts Q and T of 40 CFR Part 61.**
 - LEHR is in compliance with Subparts Q and T of 40 CFR part 61, based on a radon study conducted at the LEHR facility by USDOE (USDOE, 1990).
- **Provide information on radon-220 emissions from sources containing uranium-232 and thorium-232 where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the nonradon dose to the public.**
 - There are no unencapsulated uranium-232 or thorium-232 sources stored at the facility. The emissions from radon-220 from encapsulated sources would not result in a dose to a member of the public in excess of 0.1 mrem/yr or exceed 10% of the nonradon dose to the public from the Site.
- **Provide information on radon-222 emissions from nondisposal/nonstorage sources where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the nonradon dose to the public.**
 - There are no nondisposal or nonstorage sources of radon-222 located at the facility.
- **Give the number of emission points subject to the continuous monitoring requirements of Section 61.93(b) of 40 CFR, the number of these emission points that do not comply with Section 61.93(b) requirements, and the cost of upgrades. Describe site periodic confirmatory measurement plans. Indicate the status of the QA program described by Appendix B, Method 114.**
 - There are no point source emissions that require continuous monitoring according to Subpart H of 40 CFR.

FIGURES

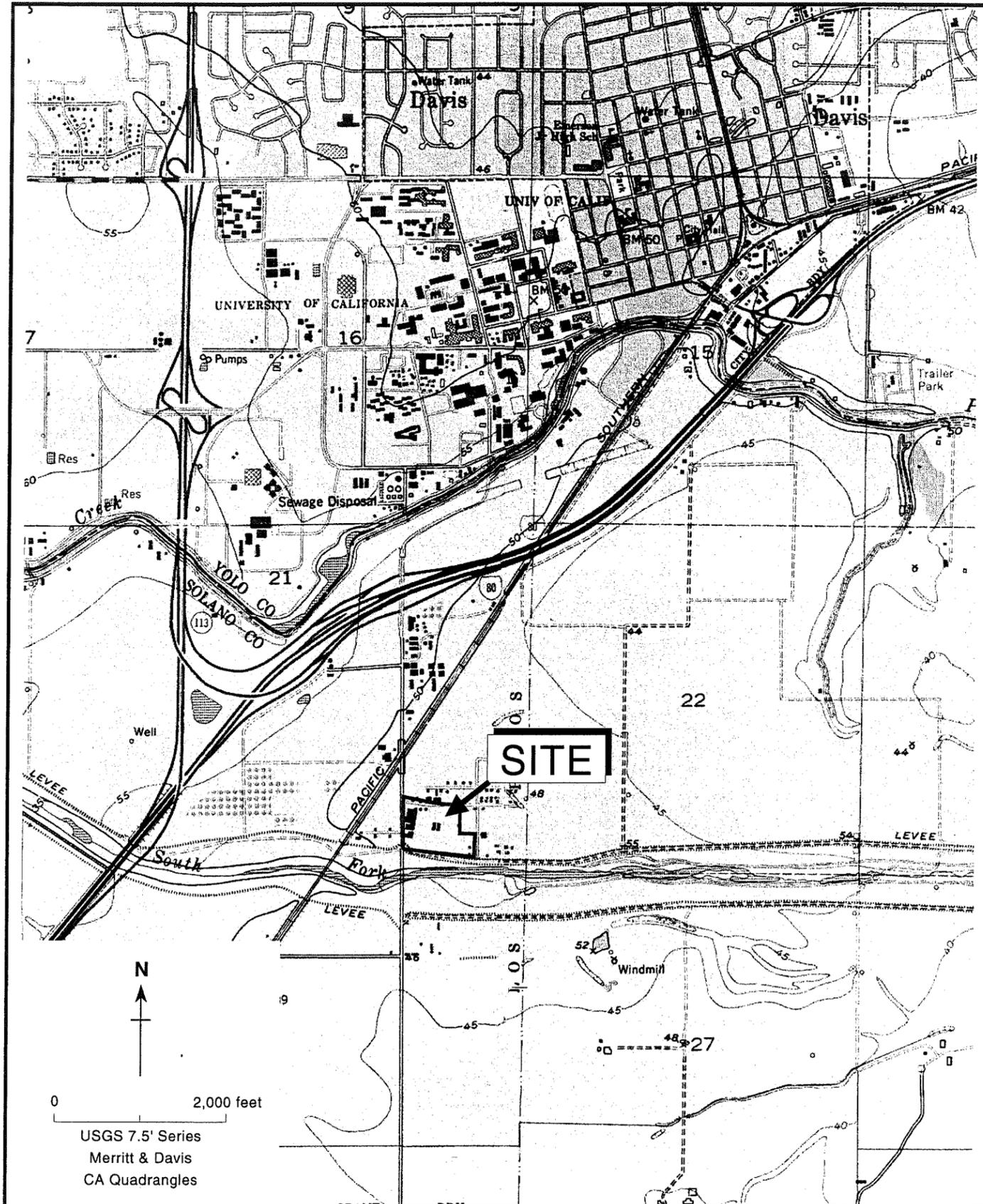


Figure 1. LEHR Facility Location Map, UC Davis, California

Weiss Associates

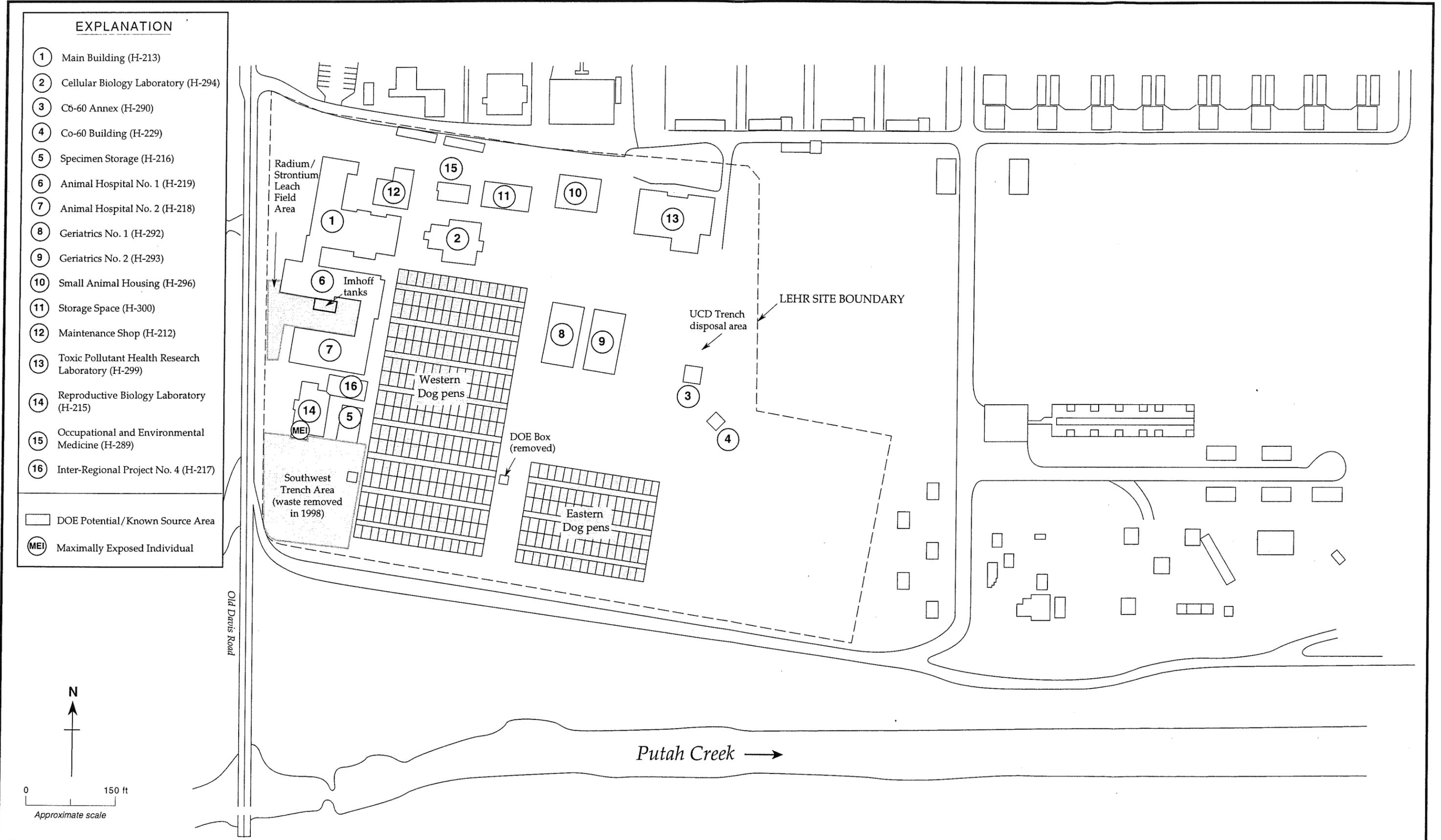


Figure 2. Potential and Known DOE Source Areas, LEHR Facility, UC Davis, California

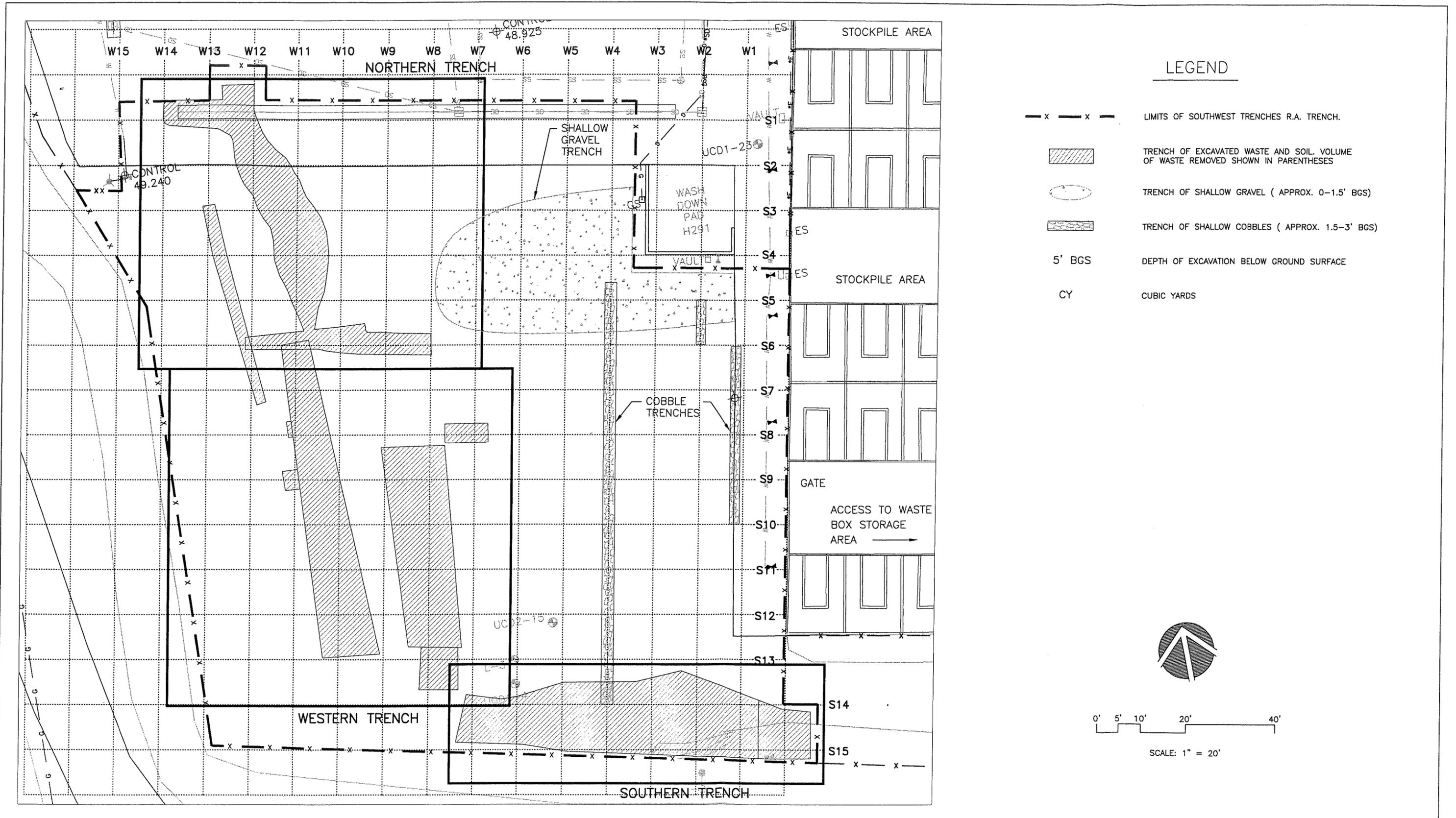


FIGURE 3. THE SOUTHWEST TRENCHES AREA EXCAVATION CELL, LEHR SITE, UC DAVIS, CALIFORNIA

APPENDIX A

CAP88-PC OUTPUT RESULTS

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E

Non-Radon Individual Assessment
Jun 9, 1999 9:38 am

Facility: Laboratory for Energy-Related Health Research
Address: UC Davis, ITEH
Old Davis Road, 1 Shields Avenue
City: Davis
State: CA Zip: 95616

Source Category: DOE Facilities
Source Type: Area
Emission Year: 1998

Comments: Radionuclides -- Individual

Dataset Name: n98RaSri
Dataset Date: Jun 9, 1999 9:31 am
Wind File: WNDFILES\SAC0320.WND

Jun 9, 1999 9:38 am
SUMMARY

age 1

P

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	9.31E-05
BREAST	6.87E-05

R MAR	7.49E-04
LUNGS	1.47E-03
THYROID	6.77E-05
ENDOST	9.80E-03
RMNDR	6.29E-04
EFFEC	7.85E-04

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	3.67E-04
INHALATION	4.15E-04
AIR IMMERSION	4.15E-10
GROUND SURFACE	3.16E-06
INTERNAL	7.82E-04
EXTERNAL	3.16E-06
TOTAL	7.85E-04

Jun 9, 1999 9:38 am
SUMMARY

age 2

P

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
AM-241	8.00E-05
BI-212	7.71E-08
CS-137	2.77E-07
PB-210	3.88E-04
PU-241	5.00E-05
RA-223	2.18E-06
RA-226	1.72E-04
TH-234	2.35E-07
U-235	9.22E-05
TOTAL	7.85E-04

Jun 9, 1999 9:38 am
SUMMARY

age 3

P

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	7.68E-10
BONE	4.97E-10
THYROID	1.15E-11
BREAST	9.66E-11
LUNG	3.30E-09
STOMACH	7.30E-11
BOWEL	4.74E-11
LIVER	1.90E-09
PANCREAS	5.42E-11
URINARY	2.90E-10
OTHER	6.63E-11
TOTAL	7.10E-09

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	2.42E-09
INHALATION	4.60E-09
AIR IMMERSION	9.82E-15
GROUND SURFACE	7.31E-11
INTERNAL	7.03E-09
EXTERNAL	7.31E-11
TOTAL	7.10E-09

Jun 9, 1999 9:38 am
SUMMARY

age 4

P

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
AM-241	4.09E-10
BI-212	9.91E-13
CS-137	7.25E-12
PB-210	2.77E-09
PU-241	1.91E-10
RA-223	5.02E-11
RA-226	2.45E-09

TH-234	8.09E-12
U-235	1.22E-09
TOTAL	7.10E-09

Jun 9, 1999 9:38 am
SUMMARY

P

age 5

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

Direction	Distance (m)					
	15	25	50	90	250	350
1400						
N	7.6E-04	3.9E-04	1.2E-04	6.2E-05	3.2E-05	3.0E-05
2.7E-05 NNW	7.6E-04	4.1E-04	1.3E-04	5.6E-05	3.1E-05	2.9E-05
2.7E-05 NW	7.5E-04	3.9E-04	1.2E-04	5.8E-05	3.2E-05	2.9E-05
2.7E-05 WNW	7.8E-04	3.1E-04	1.1E-04	5.2E-05	3.0E-05	2.9E-05
2.7E-05 W	7.7E-04	2.5E-04	7.9E-05	4.4E-05	2.9E-05	2.8E-05
2.7E-05 WSW	7.2E-04	1.7E-04	5.6E-05	3.5E-05	2.8E-05	2.8E-05
2.7E-05 SW	6.2E-04	1.4E-04	4.4E-05	3.2E-05	2.8E-05	2.7E-05
2.7E-05 SSW	5.4E-04	1.4E-04	4.9E-05	3.3E-05	2.8E-05	2.7E-05
2.7E-05 S	4.6E-04	1.6E-04	6.4E-05	4.0E-05	2.9E-05	2.8E-05
2.7E-05 SSE	4.4E-04	1.7E-04	7.1E-05	4.3E-05	3.0E-05	2.8E-05
2.7E-05 SE	4.7E-04	1.7E-04	6.1E-05	3.7E-05	2.8E-05	2.8E-05
2.7E-05 ESE	5.7E-04	1.5E-04	5.0E-05	3.3E-05	2.8E-05	2.8E-05
2.7E-05 E	6.5E-04	1.5E-04	4.7E-05	3.4E-05	2.8E-05	2.8E-05
2.7E-05 ENE	7.5E-04	1.9E-04	6.0E-05	3.5E-05	2.8E-05	2.8E-05
2.7E-05 NE	7.9E-04	2.7E-04	8.0E-05	4.6E-05	3.0E-05	2.9E-05
2.7E-05 NNE	7.8E-04	3.3E-04	1.1E-04	5.1E-05	3.0E-05	2.9E-05

Jun 9, 1999 9:38 am
SUMMARY

P

age 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)					
Direction	15	25	50	90	250	350
1400						
N	6.9E-09	3.5E-09	1.1E-09	5.0E-10	2.3E-10	2.0E-10
1.8E-10 NNW	6.9E-09	3.7E-09	1.1E-09	4.4E-10	2.1E-10	2.0E-10
1.8E-10 NW	6.8E-09	3.5E-09	1.0E-09	4.6E-10	2.2E-10	2.0E-10
1.8E-10 WNW	7.0E-09	2.8E-09	8.9E-10	4.0E-10	2.1E-10	1.9E-10
1.8E-10 W	7.0E-09	2.2E-09	6.5E-10	3.3E-10	2.0E-10	1.9E-10
1.8E-10 WSW	6.5E-09	1.5E-09	4.5E-10	2.5E-10	1.9E-10	1.8E-10
1.8E-10 SW	5.6E-09	1.2E-09	3.4E-10	2.2E-10	1.8E-10	1.8E-10
1.8E-10 SSW	4.9E-09	1.2E-09	3.8E-10	2.3E-10	1.8E-10	1.8E-10
1.8E-10 S	4.1E-09	1.4E-09	5.2E-10	2.9E-10	2.0E-10	1.9E-10
1.8E-10 SSE	3.9E-09	1.4E-09	5.8E-10	3.3E-10	2.0E-10	1.9E-10
1.8E-10 SE	4.2E-09	1.4E-09	4.9E-10	2.7E-10	1.9E-10	1.9E-10
1.8E-10 ESE	5.1E-09	1.3E-09	3.8E-10	2.4E-10	1.9E-10	1.8E-10
1.8E-10 E	5.9E-09	1.3E-09	3.6E-10	2.4E-10	1.9E-10	1.8E-10
1.8E-10 ENE	6.7E-09	1.6E-09	4.8E-10	2.5E-10	1.9E-10	1.8E-10
1.8E-10 NE	7.1E-09	2.4E-09	6.6E-10	3.5E-10	2.0E-10	1.9E-10
1.8E-10 NNE	7.1E-09	3.0E-09	9.2E-10	4.0E-10	2.1E-10	1.9E-10
1.8E-10						

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Population Assessment
Jun 9, 1999 9:38 am

Facility: Laboratory for Energy-Related Health Research
Address: UC Davis, ITEH
Old Davis Road, 1 Shields Avenue
City: Davis
State: CA Zip: 95616

Effective Dose Equivalent
(mrem/year)

3.18E-06

At This Location: 250 Meters North

Source Category: DOE Facilities
Source Type: Area
Emission Year: 1998

Comments: Radionuclides -- Population

Dataset Name: n98RaSrp
Dataset Date: Jun 9, 1999 9:32 am
Wind File: WNDFILES\SAC0320.WND
Population File: POPFILES\99LEHR.POP

Jun 9, 1999 9:38 am
SYNOPSIS

age 1

P

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 250 Meters North
 Lifetime Fatal Cancer Risk: 3.41E-11

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	3.58E-07	1.01E-06
BREAST	2.01E-07	5.74E-07
R MAR	2.53E-06	7.15E-06
LUNGS	9.83E-06	2.75E-05
THYROID	1.94E-07	5.55E-07
ENDOST	3.25E-05	9.21E-05
RMNDR	2.00E-06	5.68E-06
EFFEC	3.18E-06	8.98E-06

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Deaths/Year Risk Risk Range Higher	Number of People	Number of People		Deaths/Year	
		In This Risk Range Or Higher	In This Risk Range	In This Range Or Higher	In This Range Or Higher
1.0E+00 TO 1.0E-01 0.00E+00	0	0	0.00E+00	0	0.00E+00
1.0E-01 TO 1.0E-02 0.00E+00	0	0	0.00E+00	0	0.00E+00
1.0E-02 TO 1.0E-03 0.00E+00	0	0	0.00E+00	0	0.00E+00
1.0E-03 TO 1.0E-04 0.00E+00	0	0	0.00E+00	0	0.00E+00
1.0E-04 TO 1.0E-05 0.00E+00	0	0	0.00E+00	0	0.00E+00
1.0E-05 TO 1.0E-06 0.00E+00	0	0	0.00E+00	0	0.00E+00
LESS THAN 1.0E-06 1.36E-09	103655	103655	1.36E-09	103655	1.36E-09

Jun 9, 1999 9:38 am
 SYNOPSIS

RADIONUCLIDE EMISSIONS DURING THE YEAR 1998

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
AM-241	W	1.00	4.3E-11	4.3E-11
BI-212	W	1.00	6.8E-10	6.8E-10
CS-137	D	1.00	9.7E-11	9.7E-11
PB-210	D	1.00	2.5E-09	2.5E-09
PU-241	Y	1.00	2.7E-09	2.7E-09
RA-223	W	1.00	7.2E-11	7.2E-11
RA-226	W	1.00	3.1E-09	3.1E-09
TH-234	Y	1.00	9.8E-10	9.8E-10
U-235	Y	1.00	2.1E-10	2.1E-10

SITE INFORMATION

Temperature: 16 degrees C
 Precipitation: 71 cm/y
 Mixing Height: 1000 m

Jun 9, 1999 9:38 am
 SYNOPSIS

P

age 3

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
 Area (sq m): 1.98E+03

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000

Beef Cattle Density: 8.81E-02
 Milk Cattle Density: 2.85E-02

Land Fraction Cultivated
for Vegetable Crops: 1.18E-02

Jun 9, 1999 9:38 am
SYNOPSIS

P

age 4

POPULATION DATA

		Distance (m)					
		250	750	1500	2500	3500	4500
6523	Direction						
4100	N	400	400	2080	2080	3656	1084
268	NNW	400	400	2080	4160	2407	2140
2195	NW	400	400	2080	2080	2080	5840
312	WNW	400	400	2080	2080	2080	4160
10	W	400	100	10	10	10	10
1	WSW	0	0	5	5	5	5
2	SW	0	0	2	2	2	2
2	SSW	0	0	2	2	2	2
1	S	0	0	2	2	2	2
0	SSE	0	0	2	2	2	2
1	SE	0	0	2	2	2	2
2	ESE	0	0	2	2	2	2
1900	E	0	0	0	208	208	1588
13980	ENE	105	105	520	1248	1352	4264
300	NE	400	300	104	1201	7496	3970
12	NNE	400	400	2900	2912	2900	10

Distance (m)

Direction	9023
-----------	------

N	1082
NNW	104
NW	78
WNW	104
W	52
WSW	0
SW	0
SSW	0
S	0
SSE	2
SE	2
ESE	2
E	1
ENE	418
NE	156
NNE	2

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E

Non-Radon Individual Assessment
Jun 9, 1999 9:38 am

Facility: Laboratory for Energy-Related Health Research
Address: UC Davis, ITEH
Old Davis Road, 1 Shields Avenue
City: Davis
State: CA Zip: 95616

Source Category: DOE Facilities
Source Type: Area
Emission Year: 1998

Comments: Radionuclides -- Individual

Dataset Name: n98SWTi
Dataset Date: Jun 9, 1999 9:26 am
Wind File: WNDFILES\SAC0320.WND

Jun 9, 1999 9:38 am
SUMMARY

age 1

P

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	5.15E-04
BREAST	5.12E-04

R MAR	2.43E-03
LUNGS	8.98E-03
THYROID	5.31E-04
ENDOST	2.49E-02
RMNDR	1.69E-03
EFFEC	2.85E-03

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	1.07E-03
INHALATION	1.72E-03
AIR IMMERSION	1.06E-08
GROUND SURFACE	5.84E-05
INTERNAL	2.79E-03
EXTERNAL	5.84E-05
TOTAL	2.85E-03

Jun 9, 1999 9:38 am
SUMMARY

age 2

P

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
AC-228	1.16E-07
AM-241	1.00E-04
BI-212	3.39E-08
BI-214	6.96E-09
C-14	1.08E-06
CS-137	2.89E-04
CO-60	2.42E-07
PB-210	9.04E-04
PB-212	2.13E-07
PB-214	5.91E-09
PU-241	6.31E-06
RA-223	1.80E-05
RA-226	7.78E-05
RA-228	8.44E-06
K-40	1.01E-04
SR-90	4.86E-05
TL-208	9.56E-10
TH-228	3.70E-04
TH-230	3.12E-04
TH-232	3.90E-04

TH-234	1.68E-07
H-3	3.67E-09
U-233	3.73E-05
U-234	3.68E-05
U-235	2.03E-05
U-238	1.24E-04
TOTAL	2.85E-03

Jun 9, 1999 9:38 am
SUMMARY

P

age 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	3.67E-09
BONE	1.34E-09
THYROID	2.09E-10
BREAST	1.72E-09
LUNG	1.74E-08
STOMACH	1.08E-09
BOWEL	5.06E-10
LIVER	5.33E-09
PANCREAS	9.69E-10
URINARY	1.16E-09
OTHER	1.19E-09
TOTAL	3.46E-08

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	1.40E-08
INHALATION	1.91E-08
AIR IMMERSION	2.57E-13
GROUND SURFACE	1.41E-09
INTERNAL	3.32E-08
EXTERNAL	1.41E-09
TOTAL	3.46E-08

Jun 9, 1999 9:38 am
SUMMARY

P

age 4

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
AC-228	2.33E-12
AM-241	5.12E-10
BI-212	4.36E-13
BI-214	8.07E-13
C-14	2.63E-11
CS-137	7.55E-09
CO-60	6.07E-12
PB-210	6.44E-09
PB-212	3.65E-12
PB-214	1.01E-12
PU-241	2.41E-11
RA-223	4.14E-10
RA-226	1.12E-09
RA-228	9.11E-11
K-40	2.53E-09
SR-90	8.19E-10
TL-208	2.34E-14
TH-228	7.41E-09
TH-230	2.56E-09
TH-232	2.20E-09
TH-234	5.82E-12
H-3	9.94E-14
U-233	4.83E-10
U-234	4.77E-10
U-235	2.68E-10
U-238	1.63E-09
TOTAL	3.46E-08

Jun 9, 1999 9:38 am
SUMMARY

age 5

P

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

		Distance (m)					
Direction		30	75	90	100	140	250
350	N	2.6E-03	5.6E-04	4.3E-04	3.7E-04	2.2E-04	1.1E-04
		8.6E-05					

7.8E-05	NNW	2.8E-03	5.0E-04	3.6E-04	3.0E-04	1.8E-04	9.7E-05
8.2E-05	NW	2.6E-03	5.1E-04	3.8E-04	3.3E-04	2.0E-04	1.0E-04
7.6E-05	WNW	2.2E-03	4.3E-04	3.2E-04	2.7E-04	1.7E-04	9.3E-05
7.0E-05	W	1.6E-03	3.1E-04	2.3E-04	2.0E-04	1.3E-04	8.2E-05
6.3E-05	WSW	1.0E-03	1.8E-04	1.4E-04	1.2E-04	8.9E-05	6.8E-05
6.1E-05	SW	7.2E-04	1.3E-04	1.1E-04	9.8E-05	7.8E-05	6.4E-05
6.1E-05	SSW	8.2E-04	1.5E-04	1.2E-04	1.0E-04	7.9E-05	6.5E-05
6.7E-05	S	1.0E-03	2.4E-04	1.9E-04	1.7E-04	1.1E-04	7.6E-05
7.1E-05	SSE	1.1E-03	2.9E-04	2.3E-04	2.0E-04	1.3E-04	8.3E-05
6.5E-05	SE	1.0E-03	2.1E-04	1.7E-04	1.4E-04	1.0E-04	7.2E-05
6.2E-05	ESE	8.2E-04	1.6E-04	1.2E-04	1.1E-04	8.3E-05	6.6E-05
6.3E-05	E	7.9E-04	1.5E-04	1.3E-04	1.1E-04	8.6E-05	6.7E-05
6.3E-05	ENE	1.1E-03	1.9E-04	1.4E-04	1.2E-04	8.9E-05	6.8E-05
7.3E-05	NE	1.6E-03	3.2E-04	2.5E-04	2.2E-04	1.4E-04	8.6E-05
7.5E-05	NNE	2.3E-03	4.2E-04	3.1E-04	2.6E-04	1.6E-04	9.1E-05

Distance (m)

Direction	1000
-----------	------

N	6.2E-05
NNW	6.0E-05
NW	6.1E-05
WNW	6.0E-05
W	5.9E-05
WSW	5.8E-05
SW	5.8E-05
SSW	5.8E-05
S	5.9E-05
SSE	6.0E-05
SE	5.9E-05
ESE	5.8E-05
E	5.8E-05
ENE	5.8E-05
NE	6.0E-05
NNE	6.0E-05

Jun 9, 1999 9:38 am
SUMMARY

P

age 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Direction	Distance (m)					
	30	75	90	100	140	250
350						
N	3.2E-08	7.0E-09	5.4E-09	4.7E-09	2.9E-09	1.6E-09
1.3E-09 NNW	3.5E-08	6.3E-09	4.5E-09	3.8E-09	2.4E-09	1.4E-09
1.2E-09 NW	3.2E-08	6.4E-09	4.9E-09	4.2E-09	2.7E-09	1.5E-09
1.2E-09 WNW	2.6E-08	5.4E-09	4.0E-09	3.5E-09	2.2E-09	1.4E-09
1.1E-09 W	1.9E-08	3.9E-09	3.1E-09	2.7E-09	1.8E-09	1.2E-09
1.1E-09 WSW	1.3E-08	2.4E-09	1.9E-09	1.7E-09	1.3E-09	1.0E-09
9.9E-10 SW	9.0E-09	1.8E-09	1.5E-09	1.4E-09	1.2E-09	1.0E-09
9.7E-10 SSW	1.0E-08	2.0E-09	1.6E-09	1.5E-09	1.2E-09	1.0E-09
9.7E-10 S	1.3E-08	3.1E-09	2.5E-09	2.2E-09	1.6E-09	1.2E-09
1.0E-09 SSE	1.4E-08	3.7E-09	3.0E-09	2.6E-09	1.9E-09	1.2E-09
1.1E-09 SE	1.3E-08	2.8E-09	2.2E-09	2.0E-09	1.5E-09	1.1E-09
1.0E-09 ESE	1.0E-08	2.1E-09	1.7E-09	1.5E-09	1.2E-09	1.0E-09
9.8E-10 E	9.8E-09	2.1E-09	1.7E-09	1.6E-09	1.3E-09	1.0E-09
9.9E-10 ENE	1.4E-08	2.5E-09	2.0E-09	1.7E-09	1.3E-09	1.1E-09
9.9E-10 NE	2.0E-08	4.1E-09	3.3E-09	2.9E-09	2.0E-09	1.3E-09
1.1E-09 NNE	2.8E-08	5.4E-09	3.9E-09	3.3E-09	2.2E-09	1.3E-09
1.1E-09						

Direction	Distance (m)
	1000

N	9.7E-10
NNW	9.6E-10
NW	9.7E-10
WNW	9.6E-10
W	9.5E-10
WSW	9.4E-10
SW	9.3E-10
SSW	9.3E-10
S	9.4E-10
SSE	9.5E-10
SE	9.4E-10
ESE	9.3E-10
E	9.4E-10
ENE	9.4E-10
NE	9.5E-10
NNE	9.6E-10

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Population Assessment

Jun 9, 1999 9:39 am

Facility: Laboratory for Energy-Related Health Research
Address: UC Davis, ITEH
Old Davis Road, 1 Shields Avenue
City: Davis
State: CA Zip: 95616

Effective Dose Equivalent
(mrem/year)

3.74E-05

At This Location: 250 Meters North

Source Category: DOE Facilities
Source Type: Area
Emission Year: 1998

Comments: Radionuclides -- Population

Dataset Name: n98SWTp
Dataset Date: Jun 9, 1999 9:28 am
Wind File: WNDFILES\SAC0320.WND
Population File: POPFILES\99LEHR.POP

Jun 9, 1999 9:39 am

SYNOPSIS

age 1

P

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 250 Meters North
 Lifetime Fatal Cancer Risk: 4.38E-10

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	3.62E-06	1.06E-05
BREAST	3.19E-06	9.42E-06
R MAR	2.56E-05	7.25E-05
LUNGS	1.68E-04	4.71E-04
THYROID	3.28E-06	9.68E-06
ENDOST	2.95E-04	8.30E-04
RMNDR	1.28E-05	3.68E-05
EFFEC	3.74E-05	1.06E-04

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Deaths/Year Risk	Risk Range	Number of People	Number of People In This Risk Range Or Higher	Deaths/Year In This Risk Range	Deaths/Year In This Risk Range Or Higher
0.00E+00	1.0E+00 TO 1.0E-01	0	0	0.00E+00	0.00E+00
0.00E+00	1.0E-01 TO 1.0E-02	0	0	0.00E+00	0.00E+00
0.00E+00	1.0E-02 TO 1.0E-03	0	0	0.00E+00	0.00E+00
0.00E+00	1.0E-03 TO 1.0E-04	0	0	0.00E+00	0.00E+00
0.00E+00	1.0E-04 TO 1.0E-05	0	0	0.00E+00	0.00E+00
0.00E+00	1.0E-05 TO 1.0E-06	0	0	0.00E+00	0.00E+00
1.75E-08	LESS THAN 1.0E-06	103655	103655	1.75E-08	1.75E-08

Jun 9, 1999 9:39 am
 SYNOPSIS

RADIONUCLIDE EMISSIONS DURING THE YEAR 1998

Nuclide	Class	Size	Source	TOTAL
			#1 Ci/y	Ci/y
AC-228	Y	1.00	1.1E-09	1.1E-09
AM-241	W	1.00	1.5E-10	1.5E-10
BI-212	W	1.00	8.5E-10	8.5E-10
BI-214	W	1.00	4.2E-09	4.2E-09
C-14	*	0.00	3.1E-08	3.1E-08
CS-137	D	1.00	3.0E-07	3.0E-07
CO-60	Y	1.00	3.6E-11	3.6E-11
PB-210	D	1.00	1.7E-08	1.7E-08
PB-212	D	1.00	1.1E-09	1.1E-09
PB-214	D	1.00	4.6E-09	4.6E-09
PU-241	Y	1.00	9.6E-10	9.6E-10
RA-223	W	1.00	1.7E-09	1.7E-09
RA-226	W	1.00	4.0E-09	4.0E-09
RA-228	W	1.00	1.1E-09	1.1E-09
K-40	D	1.00	2.4E-08	2.4E-08
SR-90	D	1.00	1.5E-08	1.5E-08
TL-208	D	1.00	3.6E-10	3.6E-10
TH-228	Y	1.00	1.2E-09	1.2E-09
TH-230	Y	1.00	1.1E-09	1.1E-09
TH-232	Y	1.00	9.2E-10	9.2E-10
TH-234	Y	1.00	2.0E-09	2.0E-09
H-3	*	0.00	5.0E-09	5.0E-09
U-233	Y	1.00	2.3E-10	2.3E-10
U-234	Y	1.00	2.3E-10	2.3E-10
U-235	Y	1.00	1.3E-10	1.3E-10
U-238	Y	1.00	8.7E-10	8.7E-10

SITE INFORMATION

Temperature: 16 degrees C
 Precipitation: 71 cm/y
 Mixing Height: 1000 m

Jun 9, 1999 9:39 am
 SYNOPSIS

P

age 3

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
 Area (sq m): 1.91E+03

Plume Rise
 Pasquill Cat: A B C D E F G

Zero: 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000
Beef Cattle Density:	8.81E-02		
Milk Cattle Density:	2.85E-02		
Land Fraction Cultivated for Vegetable Crops:	1.18E-02		

Jun 9, 1999 9:39 am
SYNOPSIS

P

age 4

POPULATION DATA

		Distance (m)					
		250	750	1500	2500	3500	4500
6523	Direction						
4100	N	400	400	2080	2080	3656	1084
268	NNW	400	400	2080	4160	2407	2140
2195	NW	400	400	2080	2080	2080	5840
312	WNW	400	400	2080	2080	2080	4160
10	W	400	100	10	10	10	10
1	WSW	0	0	5	5	5	5
2	SW	0	0	2	2	2	2
2	SSW	0	0	2	2	2	2
1	S	0	0	2	2	2	2
0	SSE	0	0	2	2	2	2
	SE	0	0	2	2	2	2

1	ESE	0	0	2	2	2	2
2	E	0	0	0	208	208	1588
1900	ENE	105	105	520	1248	1352	4264
13980	NE	400	300	104	1201	7496	3970
300	NNE	400	400	2900	2912	2900	10
12							

Distance (m)

Direction 9023

N	1082
NNW	104
NW	78
WNW	104
W	52
WSW	0
SW	0
SSW	0
S	0
SSE	2
SE	2
ESE	2
E	1
ENE	418
NE	156
NNE	2

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E

Non-Radon Individual Assessment
Jun 9, 1999 9:39 am

Facility: Laboratory for Energy-Related Health Research
Address: UC Davis, ITEH
Old Davis Road, 1 Shields Avenue
City: Davis
State: CA Zip: 95616

Source Category: DOE Facilities
Source Type: Area
Emission Year: 1998

Comments: Radionuclides -- Individual

Dataset Name: n98WDPi
Dataset Date: Jun 9, 1999 9:35 am
Wind File: WNDFILES\SAC0320.WND

Jun 9, 1999 9:39 am
SUMMARY

age 1

P

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	1.35E-04
BREAST	1.38E-04

R MAR	1.81E-03
LUNGS	1.94E-03
THYROID	1.35E-04
ENDOST	1.85E-02
RMNDR	1.36E-03
EFFEC	1.47E-03

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	9.23E-04
INHALATION	5.43E-04
AIR IMMERSION	1.10E-08
GROUND SURFACE	5.10E-06
INTERNAL	1.47E-03
EXTERNAL	5.11E-06
TOTAL	1.47E-03

Jun 9, 1999 9:39 am
SUMMARY

age 2

P

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
BI-212	1.38E-07
BI-214	7.74E-09
C-14	2.34E-06
CS-137	9.00E-07
CO-60	1.06E-06
PB-210	1.01E-03
PB-212	1.09E-06
RA-223	1.92E-05
RA-226	2.08E-04
SR-90	1.07E-04
TL-208	3.98E-09
TH-234	4.39E-07
U-235	1.19E-04
TOTAL	1.47E-03

Jun 9, 1999 9:39 am
SUMMARY

age 3

P

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	2.91E-09
BONE	1.09E-09
THYROID	2.39E-11
BREAST	2.04E-10
LUNG	4.50E-09
STOMACH	1.50E-10
BOWEL	1.32E-10
LIVER	4.15E-09
PANCREAS	1.15E-10
URINARY	7.23E-10
OTHER	1.41E-10
TOTAL	1.41E-08

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	7.37E-09
INHALATION	6.64E-09
AIR IMMERSION	2.67E-13
GROUND SURFACE	1.19E-10
INTERNAL	1.40E-08
EXTERNAL	1.19E-10
TOTAL	1.41E-08

Jun 9, 1999 9:39 am
SUMMARY

age 4

P

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
BI-212	1.78E-12
BI-214	8.97E-13
C-14	5.71E-11

CS-137	2.35E-11
CO-60	2.66E-11
PB-210	7.22E-09
PB-212	1.87E-11
RA-223	4.41E-10
RA-226	2.97E-09
SR-90	1.80E-09
TL-208	9.75E-14
TH-234	1.51E-11
U-235	1.57E-09
TOTAL	1.41E-08

Jun 9, 1999 9:39 am
SUMMARY

P

age 5

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

Direction	Distance (m)				
	40	65	300	400	1200
N	1.4E-03	5.5E-04	1.0E-04	8.7E-05	7.2E-05
NNW	1.5E-03	5.8E-04	9.1E-05	8.2E-05	7.2E-05
NW	1.4E-03	5.4E-04	9.5E-05	8.5E-05	7.2E-05
WNW	1.3E-03	4.6E-04	8.9E-05	8.1E-05	7.1E-05
W	1.1E-03	3.5E-04	8.3E-05	7.8E-05	7.1E-05
WSW	9.5E-04	2.5E-04	7.5E-05	7.3E-05	7.0E-05
SW	8.3E-04	2.0E-04	7.4E-05	7.2E-05	7.0E-05
SSW	7.0E-04	2.1E-04	7.4E-05	7.2E-05	7.0E-05
S	5.9E-04	2.5E-04	8.0E-05	7.6E-05	7.1E-05
SSE	5.7E-04	2.6E-04	8.4E-05	7.8E-05	7.1E-05
SE	6.1E-04	2.5E-04	7.8E-05	7.5E-05	7.1E-05
ESE	7.3E-04	2.1E-04	7.5E-05	7.3E-05	7.0E-05
E	8.5E-04	2.1E-04	7.5E-05	7.3E-05	7.0E-05
ENE	9.9E-04	2.6E-04	7.6E-05	7.3E-05	7.0E-05
NE	1.1E-03	3.6E-04	8.5E-05	7.9E-05	7.1E-05
NNE	1.3E-03	4.8E-04	8.8E-05	8.1E-05	7.1E-05

Jun 9, 1999 9:39 am
SUMMARY

P

age 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Direction	Distance (m)				
	40	65	300	400	1200
N	1.4E-08	5.2E-09	8.7E-10	7.4E-10	6.0E-10
NNW	1.4E-08	5.5E-09	7.9E-10	7.0E-10	5.9E-10
NW	1.3E-08	5.1E-09	8.2E-10	7.2E-10	6.0E-10
WNW	1.2E-08	4.3E-09	7.6E-10	6.8E-10	5.9E-10
W	1.0E-08	3.3E-09	7.1E-10	6.5E-10	5.9E-10
WSW	9.1E-09	2.3E-09	6.3E-10	6.1E-10	5.8E-10
SW	7.9E-09	1.8E-09	6.1E-10	6.0E-10	5.8E-10
SSW	6.6E-09	1.9E-09	6.1E-10	6.0E-10	5.8E-10
S	5.7E-09	2.3E-09	6.8E-10	6.4E-10	5.9E-10
SSE	5.4E-09	2.5E-09	7.1E-10	6.6E-10	5.9E-10
SE	5.8E-09	2.3E-09	6.6E-10	6.2E-10	5.8E-10
ESE	6.9E-09	1.9E-09	6.2E-10	6.0E-10	5.8E-10
E	8.1E-09	1.9E-09	6.3E-10	6.1E-10	5.8E-10
ENE	9.5E-09	2.5E-09	6.3E-10	6.1E-10	5.8E-10
NE	1.1E-08	3.4E-09	7.3E-10	6.6E-10	5.9E-10
NNE	1.2E-08	4.5E-09	7.6E-10	6.8E-10	5.9E-10

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Population Assessment

Jun 9, 1999 9:39 am

Facility: Laboratory for Energy-Related Health Research
Address: UC Davis, ITEH
Old Davis Road, 1 Shields Avenue
City: Davis
State: CA Zip: 95616

Effective Dose Equivalent
(mrem/year)

2.00E-05

At This Location: 250 Meters North

Source Category: DOE Facilities
Source Type: Area
Emission Year: 1998

Comments: Radionuclides -- Population

Dataset Name: n98WDPp
Dataset Date: Jun 9, 1999 9:35 am
Wind File: WNDFILES\SAC0320.WND
Population File: POPFILES\99LEHR.POP

Jun 9, 1999 9:39 am
SYNOPSIS

age 1

P

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 250 Meters North
 Lifetime Fatal Cancer Risk: 2.32E-10

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	1.58E-06	4.52E-06
BREAST	1.63E-06	4.65E-06
R MAR	1.74E-05	5.01E-05
LUNGS	5.56E-05	1.55E-04
THYROID	1.57E-06	4.50E-06
ENDOST	1.99E-04	5.67E-04
RMNDR	1.54E-05	4.39E-05
EFFEC	2.00E-05	5.68E-05

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Deaths/Year Risk Risk Range Higher	Number of People		Deaths/Year	
	Number of People	In This Risk Range Or Higher	In This Risk Range	In This Range Or Higher
1.0E+00 TO 1.0E-01 0.00E+00	0	0	0.00E+00	
1.0E-01 TO 1.0E-02 0.00E+00	0	0	0.00E+00	
1.0E-02 TO 1.0E-03 0.00E+00	0	0	0.00E+00	
1.0E-03 TO 1.0E-04 0.00E+00	0	0	0.00E+00	
1.0E-04 TO 1.0E-05 0.00E+00	0	0	0.00E+00	
1.0E-05 TO 1.0E-06 0.00E+00	0	0	0.00E+00	
LESS THAN 1.0E-06 9.25E-09	103655	103655	9.25E-09	

Jun 9, 1999 9:39 am
 SYNOPSIS

RADIONUCLIDE EMISSIONS DURING THE YEAR 1998

Nuclide	Class	Size	Source	TOTAL
			#1 Ci/y	Ci/y
BI-212	W	1.00	5.3E-09	5.3E-09
BI-214	W	1.00	7.2E-09	7.2E-09
C-14	*	0.00	9.7E-08	9.7E-08
CS-137	D	1.00	1.4E-09	1.4E-09
CO-60	Y	1.00	2.4E-10	2.4E-10
PB-210	D	1.00	2.8E-08	2.8E-08
PB-212	D	1.00	8.5E-09	8.5E-09
RA-223	W	1.00	2.7E-09	2.7E-09
RA-226	W	1.00	1.6E-08	1.6E-08
SR-90	D	1.00	4.8E-08	4.8E-08
TL-208	D	1.00	2.3E-09	2.3E-09
TH-234	Y	1.00	8.0E-09	8.0E-09
U-235	Y	1.00	1.2E-09	1.2E-09

SITE INFORMATION

Temperature: 16 degrees C
 Precipitation: 71 cm/y
 Mixing Height: 1000 m

Jun 9, 1999 9:39 am
 SYNOPSIS

P

age 3

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
 Area (sq m): 9.50E+03

Plume Rise
 Pasquill Cat: A B C D E F G

Zero: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000

Beef Cattle Density: 8.81E-02
 Milk Cattle Density: 2.85E-02
 Land Fraction Cultivated
 for Vegetable Crops: 1.18E-02

Jun 9, 1999 9:39 am
 SYNOPSIS

P

age 4

POPULATION DATA

		Distance (m)					
		250	750	1500	2500	3500	4500
6523	Direction						
4100	N	400	400	2080	2080	3656	1084
268	NNW	400	400	2080	4160	2407	2140
2195	NW	400	400	2080	2080	2080	5840
312	WNW	400	400	2080	2080	2080	4160
10	W	400	100	10	10	10	10
1	WSW	0	0	5	5	5	5
2	SW	0	0	2	2	2	2
2	SSW	0	0	2	2	2	2
1	S	0	0	2	2	2	2
0	SSE	0	0	2	2	2	2
1	SE	0	0	2	2	2	2
2	ESE	0	0	2	2	2	2
1900	E	0	0	0	208	208	1588
13980	ENE	105	105	520	1248	1352	4264
300	NE	400	300	104	1201	7496	3970
12	NNE	400	400	2900	2912	2900	10

Distance (m)

Direction 9023

N	1082
NNW	104
NW	78
WNW	104
W	52
WSW	0
SW	0
SSW	0
S	0
SSE	2
SE	2
ESE	2
E	1
ENE	418
NE	156
NNE	2

Response to DOE Comments
First Draft, Radionuclide Air Emission Annual Report, Calendar Year 1998, May 14, 1999, Rev. B.

Radionuclide Air Emission Annual Report Section	Comment	Response/Explanation
1. Section 1.1	Page 1-2 first paragraph, typo: 40% f the agricultural... should be "40% of".	The typo was corrected.
2. Section 1.1	Page 1-2 second paragraph: The site encompasses approximately 15 LEHR site" the sum of all the % = 95% (e.g., 40% + 30% + 5% + 20% = 95%). What happen to the remaining 5%?	The percentages were corrected. The total is now 100%; 45% was estimated as paved vs. the 40% value stated in the <i>First Draft, Radionuclide Air Emission Annual Report</i> .
3. Section 1.2.3 & Section 2.2	Page 1-4, third paragraph; and page 2-1, end of first paragraph in section 2.2 (discussion of modeling assumptions). Did the ambient air samples collected during the trench removal activities verify/justify the significant increase in exposure being reported for 1998 over 1997? The increase in exposure reported for 1998 is significant enough that it will likely be questioned by DOE/EH (LEHR will now rank fairly high relative to other DOE facilities), therefore we need to make sure that the conservative assumptions used for modeling are really justified. I don't have any specific suggestions on what (if anything) to change, but please think about each assumption again to ensure that we're not being unnecessarily overly conservative.	<p>The ambient air samples did not verify/justify the increased exposure calculation included in the <i>First Draft, Radionuclide Air Emission Annual Report</i>. After receiving DOE's comment and comparing the 1997 and 1998 ambient air results, we reviewed the soil data used to calculate the air emissions. Weiss found that the effective dose equivalent (EDE) calculation in the first draft included an inappropriate value for the Sr-90 maximum concentration in waste for the Southwest Trenches emission calculation. The value used in the initial EDE calculation was for a small quantity of sludge that had been removed prior to 1998. This error was corrected, and the EDE was re-calculated as shown below with the value for 1997.</p> <p>Calendar year 1997 EDE = 1.8×10^{-3} mrem/yr Calendar year 1998 EDE = 4.2×10^{-3} mrem/yr (corrected)</p>

Response to DOE Comments
First Draft, Radionuclide Air Emission Annual Report, Calendar Year 1998, May 14, 1999, Rev. B.

Radionuclide Air Emission Annual Report Section	Comment	Response/Explanation
4. Section 1.2.3	Page 1-4: second paragraph: " C-14 was below its detection limit and the Cs-137 activities were 1.18 pCi/g or less" should it be clear if you provide the acceptable limit for Cs-137 for the purpose of comparison and illustrate that the Cs detected is below limit? and provide the detection limit for C-14?	The paragraph was modified to include the detection limit for C-14 and clarify the Cs-137 data results. Cs-137 was detected above the detection limit, above background, and in one instance above the RBAS value. Therefore, the wording was not revised to say Cs-137 was less than an "acceptable limit."
5. Section 1.2.3	Page 1-4, third paragraph : you provide the PM10 concentration was 93ug/m ₃ . you also explain in section 3 all the calculations. Could you explain all the conversion and how did you derive 93ug/m ₃ ?	Yes, the conversion calculation has been included in Section 2 with the other calculations (see newly added Section 2.3).
6. Section 1.2.3	Page 1-4, second paragraph, " Table 1" should it be "Table 2"?	Yes, this paragraph was corrected to reference Table 2.
7. Section 1.2.4	Page 1-5, end of section 1.2.4. Regarding the statement "No additional surface soil data were collected in 1997 for the Ra/Sr Treatment System Area", should also state if this was the case again in 1998 (or just change to 1998).	The statement in Section 1.2.4 was modified to state that in 1998 there was additional surface soil data collected for the Ra/Sr Treatment System Area.
8. Section 1.2.4	Page 1-4, section 1.2.4, second paragraph: insert "each" between tanks and containing. Should the sentence be: "The system consisted of two septic tanks each containing two compartments..."	The two tanks contained multiple compartments; one had up to 9 compartments. The sentence was re-worded as follows: <i>The system consisted of two septic tanks each containing multiple compartments separated by weirs, ...</i>
9. Section 1.2.5	Page 1-5, end of section 1.2.5. Same as above (Section 1.2.4), summarize any activity for 1998 or state that there was none.	The statement in Section 1.2.5 was modified to reference that in 1998 there was additional surface soil data collected in the western dog pens during Phase C.

Response to DOE Comments
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Radionuclide Air Emission Annual Report Section	Comment	Response/Explanation
10. Section 5	Page 5-1, third paragraph. Should begin with "The collective equivalent dose..." rather than "The equivalent dose.", just for clarification.	The statement was modified to reference the collective population dose as determined in the CAP88-PC program.

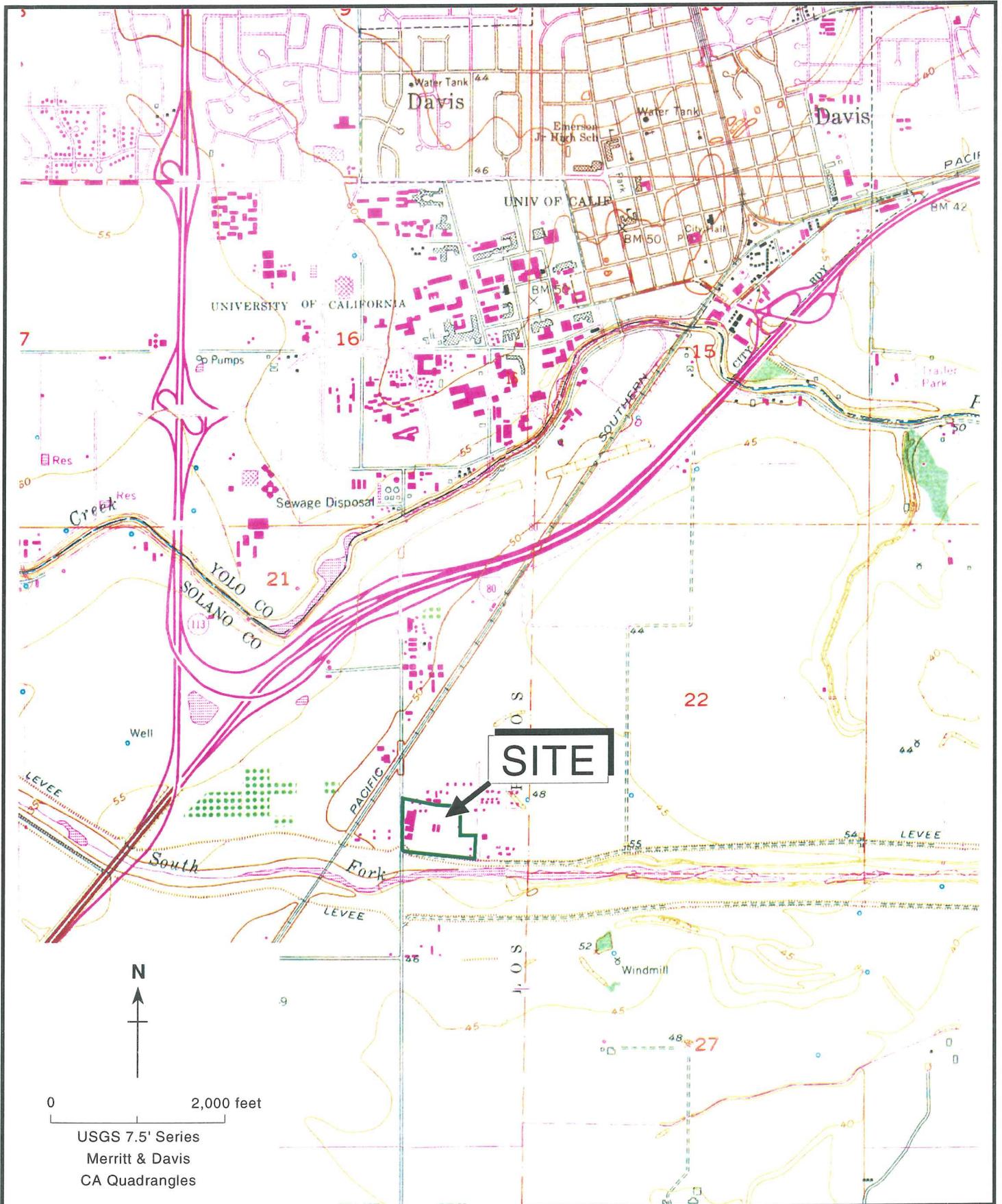


Figure 1. LEHR Site Location Map, UC Davis, California

Weiss Associates

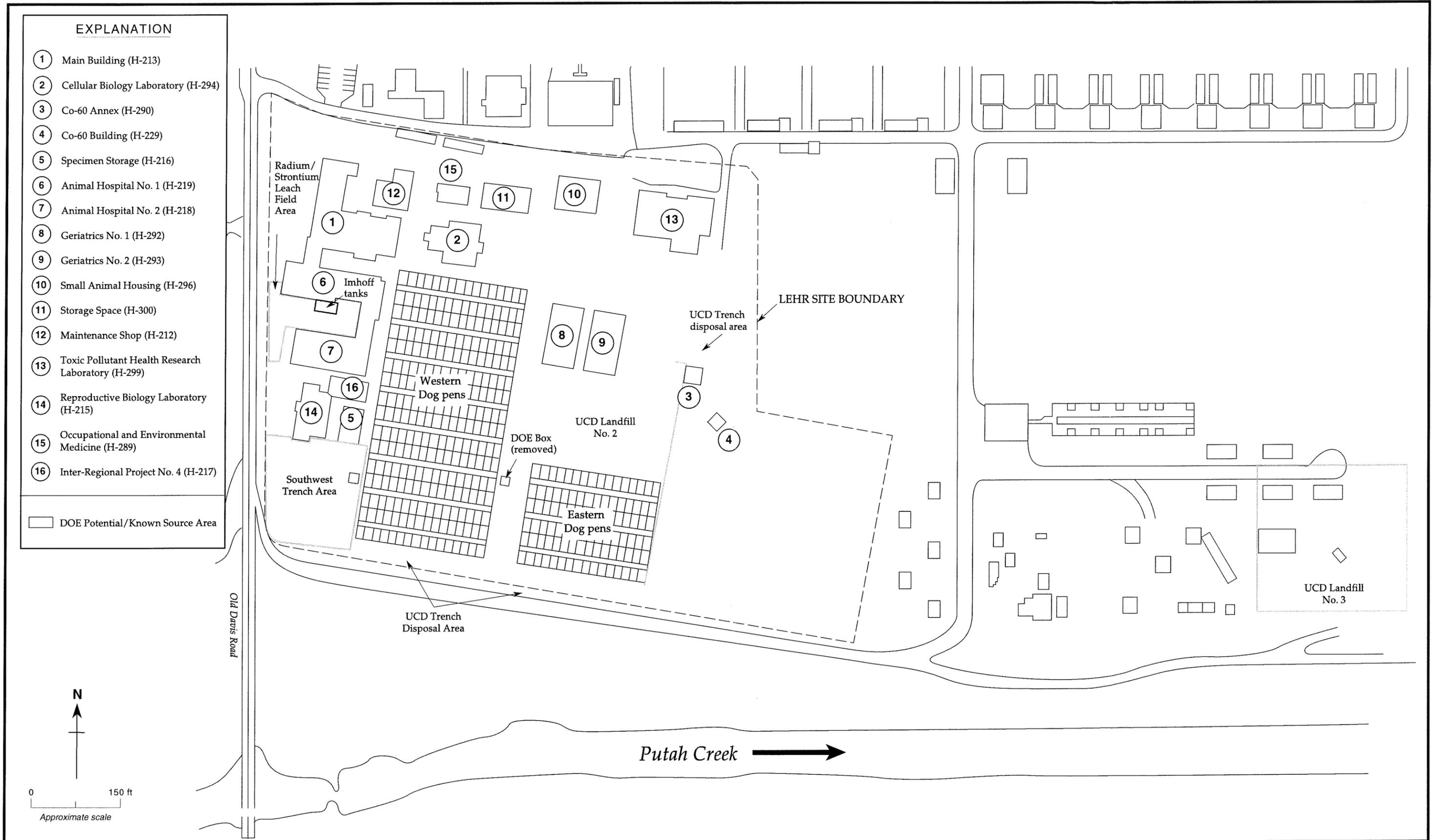


Figure 2. Potential and Known DOE Source Areas, LEHR Facility, UC Davis, California