Department of Health Services
Radiologic Health Branch
Radiologic Assessment Unit

Preliminary Radiological Survey

Of

Mercury Contaminated Soils

East of the Former SRE Building

Survey Date: July 26, 2001

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Tables and Maps

1. Introduction

The Santa Susana Field Laboratory (SSFL) located in the hills above Chatsworth, California has been in operation since the early 1950's. The area designated as the Energy Technology Engineering Center (ETEC), Area IV of SSFL, has been historically used for nuclear energy related research projects. One of these was the Sodium Reactor Experiment (SRE) project. The SRE was built between 1955 and 1957. The 2-megawatt sodium-cooled, graphite-moderated, thermal reactor was operated from April 1957 through February 15, 1964. From 1964 to 1976, the reactor was in a protective storage mode. Decontamination of the SRE began in 1976 and was completed in 1982 by Rockwell International personnel. Between November 1979 and September 1982 Argonne National Laboratory Radiological Survey Group (ANL) conducted a series of radiological measurements and analyses at SRE to survey for residual radioactive contamination. The results of the ANL survey are reported in the DOE document DOE-EV-0005-46, "Post Remedial Action Survey Report for Sodium Reactor Experiment (SRE) facility, Santa Susana Field Laboratory, Rockwell International, Ventura County, California," dated February 1984. The SRE was officially terminated from the DOE radiologically contaminated Surplus Facilities Program and released to Rockwell International, Rocketdyne Division for unrestricted use on September 24, 1985.

Boeing-Rocketdyne, the current site owner/operator, has begun the process for an expedited excavation request submittal to the Department of Toxic Substance Control. The proposed excavation will be performed as an interim measure to mitigate trace mercury levels. Samples with elevated measurements of mercury exceeding monthly limits were collected from the surface runoff sampling point below SRE (NPDES Outfall #4). As an initial part of gathering the necessary data for the request Boeing-Rocketdyne planed a radiological survey of the affected area and asked the Radiologic Health Branch (RHB) to consider collecting split samples for analysis. RHB agreed to perform a concurrent preliminary radiological survey of the mercury-affected area as delineated by Boeing-Rocketdyne.

2. Scope

The scope of this survey is to perform a preliminary radiological survey of the mercury-contaminated area near the former SRE facility. The area surveyed included the level area east of the green field of the SRE, the drainage north of the level upper area, the drainage leading to and including the lower area. The lower area is located between the level upper area and the SRE retention pond. The indicator isotope for this site is Cs-137. The site release concentration value for Cs-137 associated with a dose limit of 15 millirem per year is 9.2 pCi/g. This preliminary survey was performed upon the informal request of Boeing-Rocketdyne.

3. Instrument and Personnel

The RHB survey team of Roger Lupo and Jerry Hensley performed the radiological survey of the affected area. A Radiation Mapping System (RMS) was used to collect count rate data with associated global positioning system (GPS) datum at one-second

intervals. When analyzed and plotted with appropriate software, a mapping of the radiation field with indicated areas of elevated count rate relative to a reference radiation field is generated. This combined data is used to identify specific locations for further investigation. In addition, the Ludlum model-19 microR meter was used to obtain exposure rate data of the survey area. The Ludlum model 18 connected to a sodium iodide (NaI) detector was used to localize the areas indicated by the RMS prior to collecting soil samples.

Table 1: Survey Instruments

Instrument	S/N	Probe s/n	Calibration date
TSA GPRS-104 Radiation Mapping System	104001	#1 - Small #2 - Large	07/23/01
Ludlum model 19 microR meter	80382	Internal NaI	02/15/01
Ludlum model 18 w/44-2 (1"x1" NaI)	158504	PR162272	07/02/01

4. Description of survey

The RHB team began on, July 26, 2001, with the collection of an offsite soil sample from the Sage Ranch Park adjacent to the SSFL on the east. The instruments were function checked and the initial background measurements for the equipment were recorded. A soil sample location was selected approximately 20 feet southeast from the residence access gate amongst the citrus trees. A measurement using both the small and large detector of the RMS was taken prior to a soil sample being collected.

Upon entering the SSFL site the RHB team was escorted to the mercury contaminated area near the former SRE site. At the survey site the instruments were again function checked, onsite background measurements taken and check source measurements collected prior to beginning the survey. The survey area was first walked down with the RMS small detector followed by a walk down with the RMS large detector. The survey team mapped the radiation field of the level upper area, the drainage north of the upper area, the drainage leading to the lower area and the lower area.

The radiation mapping indicated the drainage north of the upper area, a rock to the east of the upper area and what look like sand bags in the lower area as having slightly elevated gamma radiation levels. The areas with elevated radiation levels as indicated by the RMS using the large (better sensitivity) detector during the survey were selected for soil sampling. In addition, several other areas were selected for soil sampling. A total of eight soil samples were collected from the designated mercury contaminated area. See Table 2 for a listing of the sample locations.

Boeing was investigating the drainage north of the upper area for elevated radiation at the time of the RHB site visit. No samples were collected from the drainage north of the upper area by RHB during this site visit.

5. Sample collection

The soil samples were collected from the surface to a depth of six inches, approximately one kilogram in weight each.

Each sample was placed into a poly bag, sealed with a wire tie then placed into a second poly bag and sealed with duct tape. These samples were identified with sample identification numbers and sample analysis request numbers. The samples were transported to the Department of Health Services Sanitation & Radiation Laboratory in Berkeley, California for gamma spectral scan and isotopic analyses.

Table 2: Soil Sample Locations

Soil Sample	Request for sample analysis #	Location	Latitude	Longitude	Dose Rate μR/h
BKGND-1	76230	Sage Ranch near residence gate	NA	NA	13.0
SRE-1	76231	Lower area	34.23575763	-118.7073597	14.0
SRE-2	76232	Lower area drainage	34.23585670	-118.7074524	14.5
SRE-3	76233	Drainage	34.23580529	-118.7078859	14.5
SRE-4	76234	Upper flat area	34.23569707	-118.7079017	13.0
SRE-5	76235	Upper flat area	34.23557358	-118.7080604	13.5
SRE-6	76236	Upper flat area	34.23554741	-118.7075619	13.0
SRE-7	76237	Upper flat area	34.23556548	-118.7078699	14.0
SRE-8	76238	Upper flat area	34.23538730	-118.7078810	13.5
BKGND-2	76239	West of Building 100 near site boundary	34.22778184	-118.7180288	12.0

NA➔ Not available

6. Laboratory Analysis Results

Table 3: Gamma Spectral Results from SRLB

Soil Sample	Gamma Analysis*						
	K-40	Cs-137	U-238	Ra-226	Th-232 /Ra-228	Th-228	U-235
BKGND-1	25.2±0.53	0.165±0.021	1.98±0.745	0.925±0.052	1.42±0.111	1.29±0.077	N.D.
SRE-1	24.6±0.506	0.065±0.014	1.46±1.010	0.910±0.048	1.46±0.084	1.34±0.074	N.D.
SRE-2	23.9±0.570	0.334±0.020	1.32±1.190	0.813±0.050	1.20±0.072	1.04±0.072	0.149±0.093
SRE-3	25.9±0.635	0.056±0.017	N.D.	0.989±0.061	1.51±0.110	1.41±0.084	0.197±0.093
SRE-4	22.4±0.530	N.D.	2.04±0.531	0.853±0053	1.15±0.097	1.11±0.078	N.D.
SRE-5	22.5±0.540	0.033±0.015	1.32±0.545	0.945±0.055	1.31±0.110	1.20±0.078	N.D.
SRE-6	22.0±0.527	0.018±0.013	1.77±1.070	0.721±0.051	1.11±0.079	1.39±0.124	0.139±0.124
SRE-7	22.7±0.480	0.121±0.018	1.02±0.486	0.852±0.048	1.22±0.088	1.20±0.071	N.D.
SRE-8	22.9±0.456	0.099±0.014	1.81±0.847	0.993±0.045	0.987±0.070	0.911±0.062	0.109±0.096
BKGND-2	20.8±0.605	N.D.	0.899±0.649	0.782±0.067	1.22±0.120	1.14±0.089	N.D.

* ➔ Values in the table are in units of pCi/g (dry weight)
N.D. ➔ Not Detected

Table 4: Isotopic Analysis for Uranium and Thorium from SRLB

Soil Sample	Isotopic Analysis*							
	Th-228	Th-230	Th-232	U-234	U-235	U-238	Gross Alpha	Gross Beta
BKGND-1	1.58±0.231	1.0±0.160	1.30±0.185	0.806±0.094	0.038±0.019	0.860±0.097	13.5±1.7	30.6±2.3
SRE-1	1.53±0.236	1.01±0.168	1.13±0.176	0.852±0.070	0.038±0.011	0.798±0.066	11.4±2.3	30.3±3.2
SRE-2	1.27±0.242	0.795±0.160	0.921±0.168	0.864±0.090	0.048±0.018	0.847±0.088	10.9±1.6	26.4±2.2
SRE-3	1.35±0.155	0.885±0.108	1.18±0.128	0.753±0.067	0.031±0.011	0.768±0.067	13.4±2.4	24.8±3.1
SRE-4	1.31±0.170	0.947±0.128	0.918±0.122	0.912±0.076	0.037±0.011	0.932±0.077	11.7±2.3	25.9±3.1
SRE-5	1.42±0.147	0.919±0.010	1.07±0.109	0.816±0.092	0.033±0.016	0.826±0.092	11.3±1.6	23.4±2.13
SRE-6	1.19±0.210	0.750±0.140	0.867±0.150	0.747±0.086	0.036±0.017	0.769±0.087	10.2±2.2	25.2±3.1
SRE-7	1.52±0.200	0.932±0.130	1.22±0.153	0.893±0.096	0.040±0.018	0.892±0.095	10.7±2.2	22.9±3.0
SRE-8	1.54±0.263	1.72±0.252	1.25±0.200	1.43±0.109	0.064±0.014	1.44±0.109	12.6±2.4	29.0±3.2
BKGND-2	1.35±0.142	0.841±0.096	1.16±0.116	0.704±0.060	0.045±0.012	0.736±0.062	11.4±2.3	22.8±3.0

* ➔ Values in the table are in units of pCi/g (dry weight)

7. Survey Maps

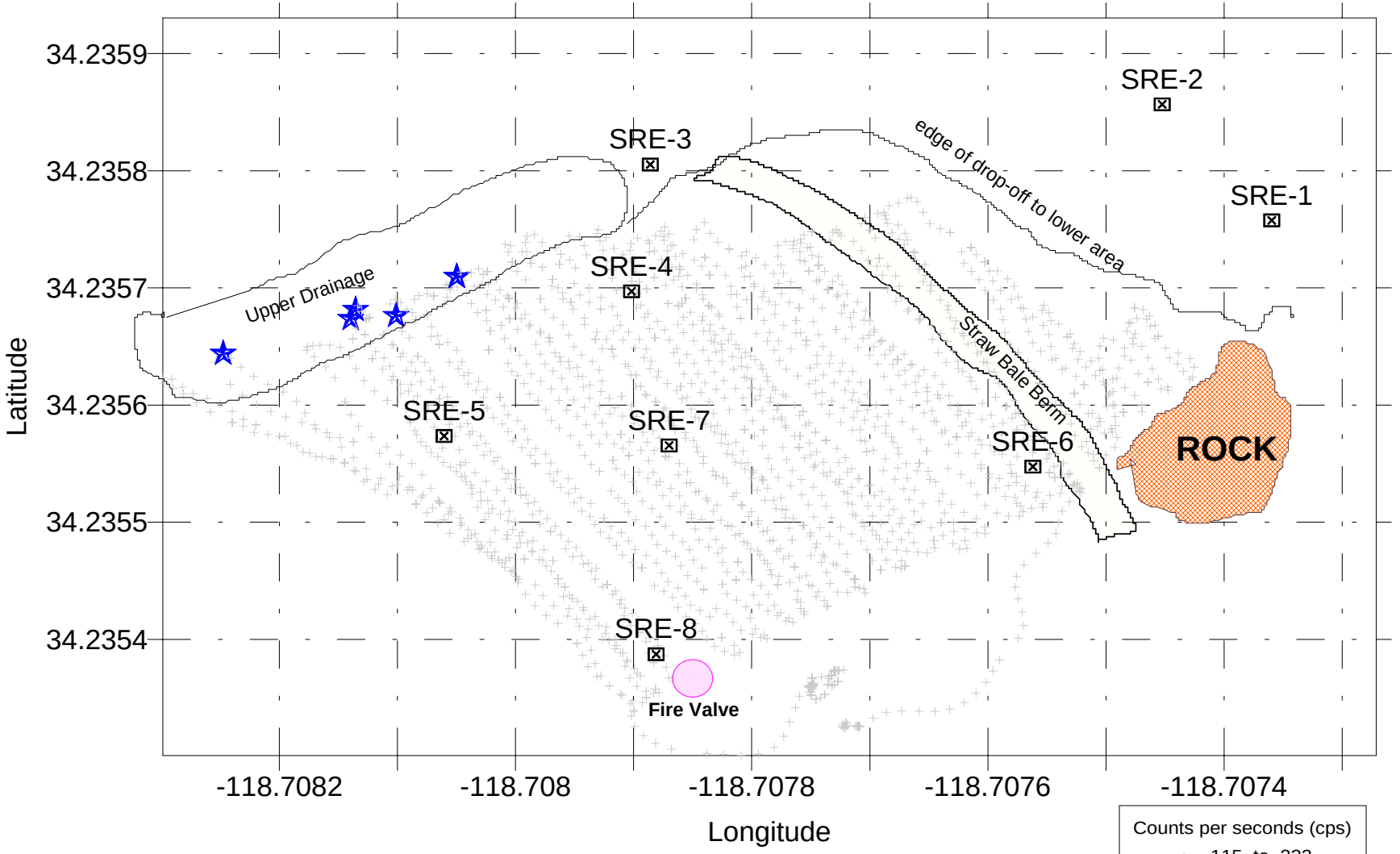
The following maps indicate the area surveyed using the RMS. The first map is of the data collected using the small detector and the second map is of the data collected using the large detector. The map generated from the large detector data was used to select some of the soil sampling points.

The following guideline was used to analyze the raw data from the RMS:

- Import the raw RMS data to the Surfer graphing software.
- Select value ranges for data groupings based on a reference data set (Sage Range). The groupings are as follows:
    - 1.) All values up to reference average count rate plus three-sigma, values are indicated by a gray plus sign,
    - 2.) Values above the reference average count rate plus three-sigma, and less than the reference average count rate plus four-sigma, values are indicated by blue stars, and
    - 3.) Values above the reference average count rate plus four-sigma with a cutoff value that includes the maximum data point, values are indicated by red dots.
- Render the raw data from the RMS using the Surfer graphing software.
- Based upon the generated visual representation of the rendered data and a review of the raw data set values, locations were selected for further investigation.

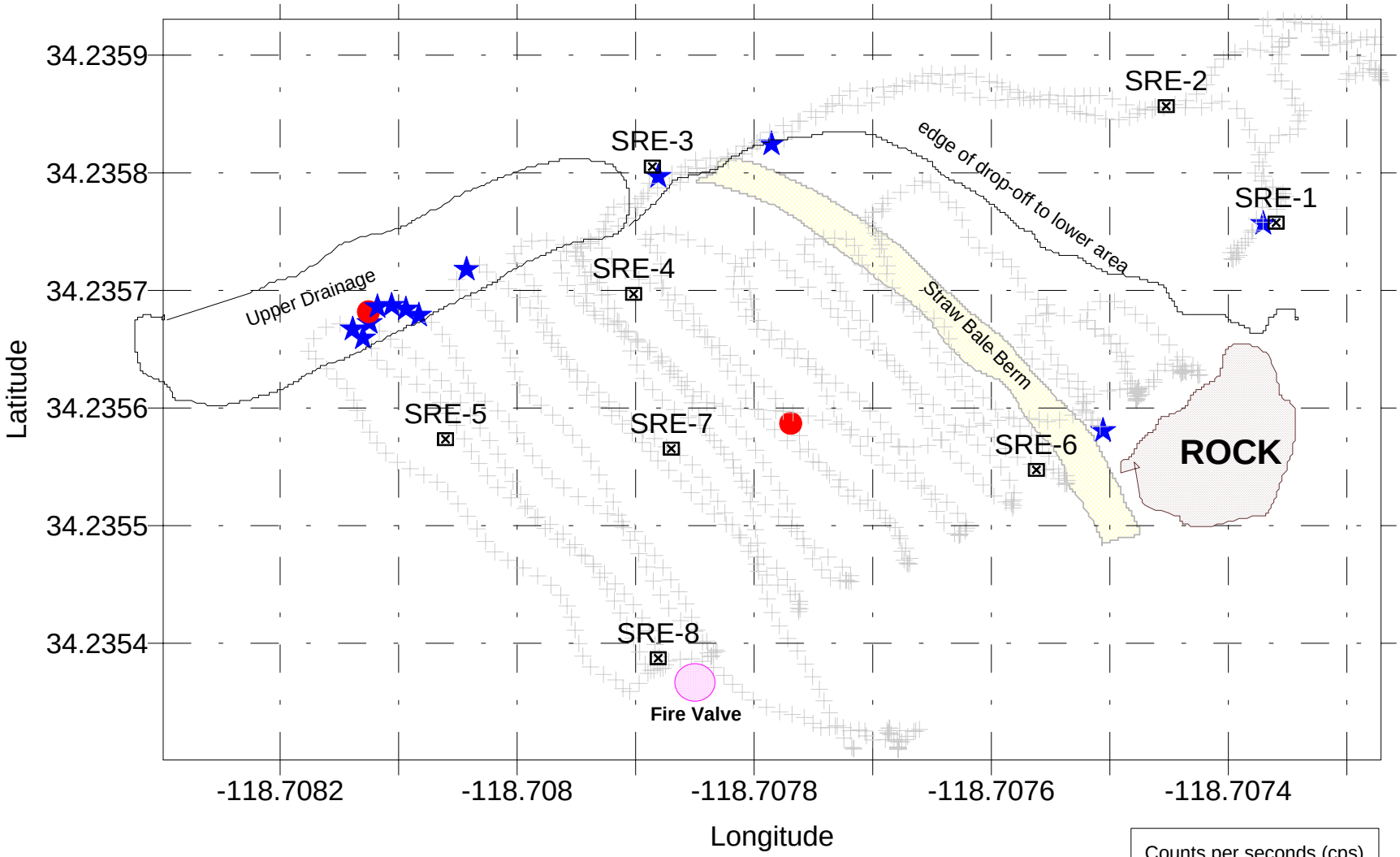
In general there would need to be multiple data points in close proximity to reliably indicate an area of elevated gamma radiation. Single data points within the data groupings (three-sigma or four-sigma) may be an indication of elevated gamma radiation but it may also just reflect the inherent uncertainties associated with detection equipment.

Radiological Mapping - SRE Mercury Contaminated Soil (small detector)



note: 1. Soil sample locations indicated by a rectangle with an X inside and sample ID (i.e. SRE-1)

Radiological Mapping - SRE Mercury Contaminated Soil (large detector)



note: 1. Soil sample locations indicated by a rectangle with an X inside and sample ID (i.e. SRE-1)

8. Summary / Conclusion

The samples collected from the affected area have isotopic concentrations below the Site Wide Release Criteria. At the time of this survey, Boeing-Rocketdyne was conducting an investigation of the drainage channel north of the upper level area for elevated Cs-137 concentrations. No samples have been collected by RHB in the area under investigation.

RHB understands that, following the RHB site visit, Boeing-Rocketdyne has remediated the drainage channel mentioned above. The soil from the subject area was placed into 'B' boxes and stored in the Radioactive Materials Handling Facility on site.

After remediation of the mercury contaminated area by Boeing-Rocketdyne a verification survey of the area will need to be preformed by Boeing-Rocketdyne and RHB prior to release of the excavated area for unrestricted use.

References:

1. Letter dated July 3, 2001, from Phil Rutherford to Roger Lupo, Subject: SRE Post Remedial Action Survey Report, attachment DOE-EV-0005-46.

2. DOE-EV-0005-46, “Post Remedial Action Survey Report for Sodium Reactor Experiment (SRE) facility, Santa Susana Field Laboratory, Rockwell International, Ventura County, California,” Argonne National Laboratory, Dated February 1984.