T-A-00

ENVIRONMENTAL RESTORATION PROJECT

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Date: March 26, 2002
Refer to: ER2002-0227

2002

Mr. John Young, Corrective Action Project Leader
Permits Management Program
NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East
Building 1
Santa Fe, NM 87505-6303

SUBJECT: SUBMITTAL OF RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION (RSI), VOLUNTARY CORRECTIVE ACTION (VCA) COMPLETION REPORT FOR POTENTIAL RELEASE SITE (PRS) 0-019, LOS ALAMOS NATIONAL LABORATORY, NM0890010515 HWB-LANL-01-023

Dear Mr. Young:

Enclosed are two copies of the Los Alamos National Laboratory (LANL) Environmental Restoration (ER) Project's Response to your RSI on the VCA Completion Report for PRS 0-019. The ER Project Office received the RSI on February 5, 2002. A 30-day extension was requested February 11, 2002 (ER2002-0108). Your office granted a 30-day extension to April 1, 2002 in a letter dated February 22, 2002.

If you have any questions, please contact Terry Rust at (505) 665-8843 or David Gregory at (505) 667-5808.

Sincerely,

Warren Neff for

Julie A. Canepa, Program Manager
Environmental Restoration Project
Los Alamos National Laboratory

Sincerely,

David R. Gregory for

Mat Johansen, Project Manager
Department of Energy
Office of Los Alamos Site Operations

7613

JC/MJ/NR/vn

Enclosure: Response to RSI (ER2002-0192)

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Response to
"Request for Supplemental Information,
Voluntary Corrective Action Completion Report for Potential Release Site 0-019,
Los Alamos National Laboratory, NM0890010515, HWB-LANL-01-023"

INTRODUCTION

To facilitate review of this response, the New Mexico Environment Department Hazardous Waste Bureau (HWB) comments are included verbatim. The comments are divided into general and specific categories as presented in the letter. Los Alamos National Laboratory (LANL) responses follow each HWB comment.

GENERAL COMMENTS

HWB Comment

1. *Mesa Top Area*

   Although construction is anticipated on the mesa top, surface sample results should have been run against Ecological Screening Levels (ESLs) to determine if there even would be potential for risk, rather than relying on an argument that construction will "cap" the whole mesa. LANL shall compare surface soil concentrations to ESLs to determine if there would be a potential risk to ecological receptors if some areas of the mesa top were not covered by new construction.

   There is some question about whether the proposed future site use will require excavation that may expose receptors to the subsurface contamination left in place at the site. The potential for exposure to contamination under these structures needs to be addressed. LANL shall develop a construction worker risk number for the short-term exposure to the subsurface lead and nickel.

LANL Response to first paragraph

1. It was specified in the voluntary corrective action (VCA) plan for potential release site (PRS) 0-019 (LANL 1999, 63397), and agreed to by NMED during preliminary site visits, that no mesa-top surface sampling and ecological assessment was needed. This decision was based on the clear evidence of extensive mesa-top use for the 35 years after the Central Waste Water Treatment plant (CWWTP; the solid waste management unit) went out of service and the property was released to the current owner. The question of adding chemicals of potential ecological concern (COPECs) for the ecological screening assessment based on mesa-top sample results was discussed briefly on pages 91 and 92 of the VCA completion report. The conclusion was that no additional COPECs would be identified by considering the mesa-top data.

   An important consideration that led to the agreement not to perform an ecological screening assessment is that most of the mesa top is covered by fill of unknown origin and of varying depths; thus plants and animals would primarily be exposed to fill that is not associated with the former CWWTP operations. The depth of the various former CWWTP structures below the ground surface at the time of the investigation was discussed on page 19 of the VCA completion report and is summarized below:

   - Sludge drying beds—noted to be below ground surface (bgs)
   - Sludge digestion tank—5 ft bgs on south to 1 ft bgs on north

- Trickling filter—11 ft bgs on south to 0 ft bgs on north
- Primary settling tank—8 ft bgs on south to 5 ft bgs on north
- Final settling tank—9 ft bgs on south to 6 ft bgs on north
- Chlorine contact tank—approximately 4 ft bgs based on sample depths in Table 2.4-1 of the VCA completion report

It was specified in the approved VCA plan for PRS 0-019 (approved February 2, 2000; 64334), and agreed to by NMED during the preliminary site visit, that surface samples would not be collected from the mesa top and that, due to the depth of potential releases and because the property was scheduled for immediate and extensive development which, based on preliminary drawings, provided no reasonable pathway, no ecological assessment was needed for the mesa-top area.

To provide clarification regarding the question of potential ecological risks, the maximum concentrations for mesa-top chemicals of potential concern (COPCs) detected in samples collected with starting depths less than 5 ft (considered to be the maximum reasonable depth for which ecological screening is done) are summarized in Table 1 [5 ft bgs has been proposed as the default depth for screening exposure to ecological receptors (LANL 1999, 64783; NMED 2000, 70107)]. Out of 73 total mesa-top samples, 7 soil samples and 12 tuff samples had starting depths of less than 5 ft; this emphasizes the fact that the predominant surface material on the mesa top is fill imported to the site after the CWWTP became inactive. A limited number of COPCs were detected in these samples, and the maximum concentrations of inorganics, PCBs, pesticides, and radionuclides detected in these mesa-top soil samples were less than the weighted-average concentration for the hillside. In the mesa-top soil samples, 7 semivolatile organics were detected that were not detected in the hillside samples. However, the maximum concentration of these mesa-top COPCs is less than the minimum soil ecological screening level (ESL) (LANL 2000, 67823). The maximum detected concentration of pentachlorophenol (0.94 mg/kg) is greater than the soil ESL (0.32 mg/kg) in a sample collected at 4.5–5.5 ft, or the depth limit considered for possible adverse ecological effects. Pentachlorophenol was detected in two samples (both from 4.5–5.5 ft bgs) and was not detected in the other soil samples. The detection limits for pentachlorophenol in these other five samples were greater than either reported detected value.

This information shows that most of the mesa-top COPCs were also detected in the hillside data and that maximum concentrations of these COPCs were less than the hillside weighted-average concentrations. The few COPCs that were detected in the mesa-top soil samples and not detected in the hillside would not be identified as COPECs for PRS 0-019 since the hillsides were representative of the maximum variety of potential PRS-related contaminants and since the hillsides were, relative to the mesa top, undisturbed. This analysis supports the assertion in the uncertainty analysis that no additional COPECs would be identified by considering COPCs identified in the mesa-top samples. The generally lower concentrations of COPCs on the mesa top indicate that potential adverse ecological effects due to COPCs would be less for receptors on the mesa top. In addition, no COPECs were retained for the hillside in the VCA report (LANL 2001, ER2001-0603); therefore, no COPECs would be expected to be retained for the mesa top.

Table 1
Maximum Sample Results for Mesa-Top COPCs Collected from Depths Less Than 5 Ft Compared to the Hillside Weighted Average

Suite	Mesa-Top COPC	Units	Maximum Detected Concentration in Mesa-Top Soil	Hillside Weighted-Average Concentration	Soil Minimum ESL
Inorganic	Lead	mg/kg	48	90.2	20
	Mercury, inorganic	mg/kg	0.2	2.30	0.05
	Silver	mg/kg	6.7	32.7	0.2
	Zinc	mg/kg	62	176	10
PCB	Aroclor-1260	mg/kg	0.093	0.39	0.05
Pesticide	Chlordane[alpha-]	mg/kg	0.0028	0.022	2.1
	Chlordane[gamma-]	mg/kg	0.005	0.023	2.1
	DDE[4,4'-]	mg/kg	0.0039	0.014	0.0018
	DDT[4,4'-]	mg/kg	0.015	0.047	0.0028
Radiological	Plutonium-239	pCi/g	0.223	0.81	18
SVOC	Acenaphthylene	mg/kg	0.059	Not detected	160
	Anthracene	mg/kg	0.067	Not detected	220
	Benzo(a)anthracene	mg/kg	0.035	0.31	3.3
	Benzo(a)pyrene	mg/kg	0.04	0.32	1.8
	Benzo(b)fluoranthene	mg/kg	0.079	0.34	7.4
	Benzo(g,h,i)perylene	mg/kg	0.097	Not detected	12
	Benzo(k)fluoranthene	mg/kg	0.11	Not detected	13
	Bis(2-ethylhexyl)phthalate	mg/kg	0.027	0.30	0.24
	Chrysene	mg/kg	0.062	0.29	3.3
	Dibenz(a,h)anthracene	mg/kg	0.03	Not detected	2.3
	Fluoranthene	mg/kg	0.063	0.28	26
	Indeno(1,2,3-cd)pyrene	mg/kg	0.083	Not detected	12
	Pentachlorophenol	mg/kg	0.94	Not detected	0.32
	Phenanthrene	mg/kg	0.047	0.30	110
	Pyrene	mg/kg	0.074	0.30	15

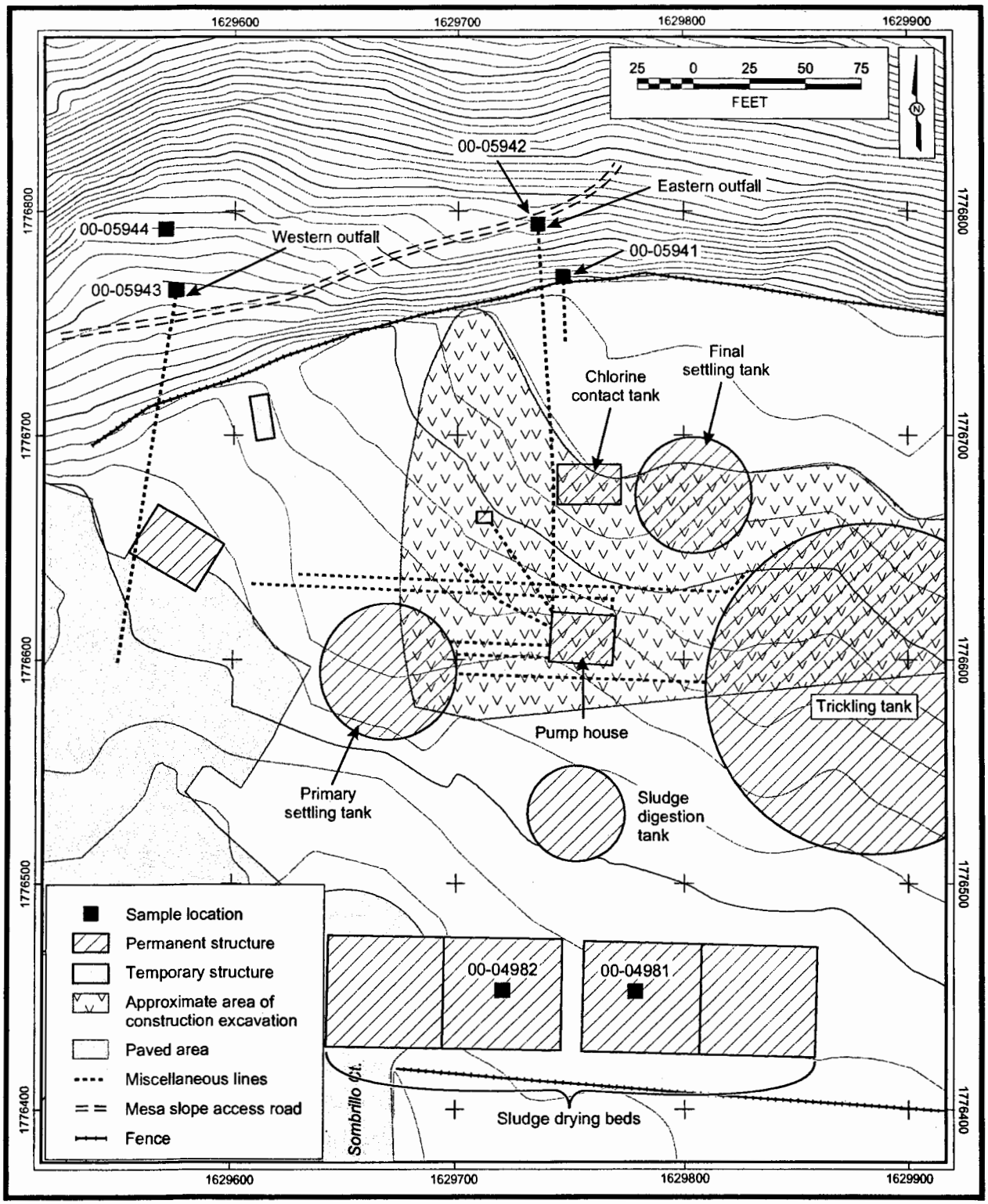
LANL Response to second paragraph

1. Exposure-point concentrations for the mesa top were based on a 95% upper confidence limit (UCL) of the mean for all samples collected. The reason for considering the mesa-top data as a whole is that some excavation is required before people could come into direct contact with any mesa-top COPCs (this is due to the fill that covered the entire site). In no areas of the mesa top were releases from former CWWTP structure at the ground surface. Because COPCs were detected at depth, excavation of fill, soil, and/or tuff is required for human exposure. During excavation it is assumed that blending of this material would occur. Thus, the exposure-point concentrations developed for the mesa top are as applicable to the short-term construction worker scenario as they are to potential residential exposure.

In one sample, lead was detected at a concentration greater than the SAL (1800 mg/kg in sample RE00-99-0235, location 00-10298, depth 13–14 ft, versus SAL of 400 mg/kg). The maximum concentration of nickel for the mesa top was 13 mg/kg, which is less than the SAL of 1500 mg/kg. For the mesa top, no further assessment or discussion of nickel is needed.

The noncarcinogenic health risks associated with lead are discussed on page 105 of the VCA completion report. The lead exposure-point concentration of 243 mg/kg is discussed in relation to the residential screening of 400 mg/kg developed by EPA and adopted by NMED as a residential screening value. Screening values also exist for lead for industrial workers from NMED (1000 mg/kg) and EPA Region 6 (1400 mg/kg). The EPA Region 6 screening level is based on fetal blood levels calculated from soil ingestion and inhalation for a pregnant woman. Because these industrial screening levels are greater than the residential screening level, it appears that the residential assessment of noncarcinogenic effects of lead is also protective of worker exposures.

Lastly, the actual construction on the PRS 0-019 property has started, and the maximum depth in the area of location 00-10298 is less than 12 ft bgs, which was verified during the ongoing excavation. Therefore, construction workers will not come into contact with the location at which the elevated lead was detected. There are currently no pregnant construction workers and no pregnant workers are expected on the PRS 0-019 property (all of the construction workers thus far are male). The maximum excavation area is represented on Figure 1.



PRS 00-019 RSI Response, F2.3-1 / 032602 / lcf

Figure 1. Maximum area of excavation

HWB Comment

2. *Western and Eastern Outfall Areas*

LANL used area-weighted averages for each "geomorphic package" (subarea) to represent the mean value. An average for each subarea was calculated and multiplied by a weighting factor corresponding to the size of each subarea compared to the overall area. The average of these weighted averages was used to represent the entire area. It appears that LANL averaged values from the eastern outfall, western outfall, and canyon bottom together. This approach was used for both human health and ecological risk screening. As explained in the comments on the Acid Canyon Interim Action Plan by both HWB and U.S. Environmental Protection Agency (EPA), our agencies do not support the use of weighted averages for risk screening because the 95% upper confidence level (UCL) statistics are not designed for averaging of weighted means and because the use of weighted means requires the demonstration of a strong correlation between the defined subareas and the contaminants. The weighted means are inappropriate for the site because 1) all contaminants are assumed to distribute in the environment throughout the package, even though they have very different chemical properties, and 2) there is probably not adequate sampling within some packages (lower benches and canyons) to calculate a valid 95% UCL of the mean, the maximum concentration of contaminants detected should be used for comparison to the screening values and for initial risk assessments. The different subareas should not be averaged together to come up with one set of means for contaminants for calculating risk. The risk associated with each subarea should be examined to see if contaminants in some subareas may represent an unacceptable level of excess risk.

The use of an Area Use Factor (AUF) as part of the ecological risk assessment is acceptable, but area-weighted averages should not be used for this assessment either.

LANL asserts in this document that Hazard Quotients (HQs) between 1 and 10 are acceptable because it is assumed that the Lowest Observed Adverse Effect Level (LOAEL) is 10 times the No Observed Adverse Effect Level (NOAEL), so effects are actually seen only at HQs above 10. Current ecological risk guidance does not support this assertion as a general guideline, and states that HQs greater than 1 should trigger a more in-depth analysis to see if there is a potential for risk to ecological receptors. In this report, LANL also asserts that HQs less than 100 are acceptable since an HQ of 100 would equal a 50% lethal concentration (LC50) and effects on populations occur only at LC50s. LC50s correspond to the immediate death of half of the population and this is obviously well beyond an acceptable population impact.

Uncertainty analysis eliminates some high HQs based on the probability of a chemical not occurring in the toxic or bioavailable form. To eliminate contaminants on this basis, one needs sampling information on the forms of the contaminant in the soil at the site and one needs to present how these forms are less toxic than the one used to generate the ESL.

LANL shall reanalyze the data using the following guidance:

- *Calculate 95% UCL of mean for each outfall for each contaminant. Record maximum values for those for which a UCL cannot be calculated or for which a UCL of mean would exceed the maximum value.*
- *Compare contaminant concentrations on NMED Soil Screening Levels (SSLs) or EPA Region 6 SSLs, and LANL ESLs for receptors.*

- *AUFs from Table 2.5-8 can be used for calculating ecological risk. Present HQs for each receptor for each contaminant. HQs nominally equal to or less than one indicate no potential for ecological risk. Contrary to the statements in this VCA report, HQs between 10 and 100 are not accepted as an indication of no risk.*

LANL Response

2. Two issues are raised by this comment. One relates to the appropriateness of pooling the hillside data for exposure assessment, and the second relates to the statistical approaches for calculating exposure-point concentrations.

   Exposure Assessment

   - **Human health**. A recreational scenario was evaluated to assess potential adverse effects on human health from COPCs on the hillside. The kind of recreational use envisioned is trail use or other associated outdoor recreational activities. Some of the activities would be expected to occur along or near existing trails on the hillside or in Graduation Canyon. As mentioned on page 105 of the VCA completion report, there is a trail in the canyon bottom area of Graduation Canyon that runs through or is adjacent to the "canyon" sampling subarea. Thus, exposure to COPCs in canyon samples is more likely than samples collected below the western or eastern outfalls. Because concentrations were greatest at the western outfall, consideration of human exposure to the average from all three areas was expected to be protective of potential adverse health effects. A more realistic assessment would consider greater exposure duration in the canyon and lesser exposure duration on the hillside. It would also be appropriate to consider exposure to the entire hillside, not just the spatially separate outfall areas. Another consideration may be the steepness of the terrain, which would further limit the exposure duration at the slope area of the western outfall. Thus, it is appropriate and protective to consider trail user exposure to the average concentration across the subareas of the hillside identified in the VCA completion report.

   - **Ecological**. For ecological assessments it is appropriate to consider the area of the wildlife home range relative to the subareas identified on the hillside. The home range of one screening receptor is smaller than the total hillside area. The deer mouse has a home range of 0.075 ha (see Table 2.5-8 in the VCA completion report), which is roughly equal to the area of the three major subareas identified on the hillside (eastern outfall, western outfall, and canyon). Thus, it is appropriate to consider the potential for adverse ecological effects on the deer mouse from each subarea. In future assessments, an evaluation of the home range of the receptor will occur before calculating exposure-point concentrations so that exposure is not underestimated by averaging areas of low concentration with areas of greater concentration. To provide additional information about the potential for adverse ecological effects on deer mice, Table 2 presents hazard index (HI) values by subareas and Table 3 presents HQ values by subarea. The nonradiological deer mouse HI values are greater than 1 in all subareas, and barium contributes most of the HQ to these HI values. As discussed on page 93 of the VCA completion report, barium is a COPEC due to potential adverse effects on mammalian receptors. The analysis of the deer mouse by subarea does not change this conclusion or increase the importance of other COPCs with respect to adverse effects on small mammals. Also, as discussed on page 93 of the VCA completion report, the toxicity of barium is based on its presence in a soluble and therefore bioavailable form. It is unlikely that barium could persist in a soluble form on the hillside for the nearly 40 years since releases ceased. Lastly, the adverse effects from elevated soil concentrations of barium on small mammals are being investigated in Cañon de Valle. Initial results of these field studies show no adverse effects from higher concentrations of barium.

Table 2
Deer Mouse HI Values for Hillside Subareas

Hillside Subarea	Area (ha)	Nonradiological HI	Radiological HI
Eastern outfall	0.084	25.8	<0.01
Western outfall	0.073	140.8	<0.01
Canyon	0.072	25.8	<0.01
Entire hillside	0.23	62.6	<0.01

Table 3
Deer Mouse HQ Analysis Results for the Hillside Subareas

Suite	Analyte	Deer Mouse ESL	Weighted Averages				Deer Mouse HQ			
			Eastern Outfall	Western Outfall	Canyon	Overall	Eastern Outfall	Western Outfall	Canyon	Overall
Radiological	Uranium-234	4200	1.33	28.1	2.52	10.3	<0.01	0.01	<0.01	<0.01
Inorganic	Antimony	1	0.27	3.17	0.78	1.36	0.27	3.17	0.78	1.36
	Barium	4.6	108	531	103	242	23.4	115	22.4	52.6
	Cadmium	8.4	0.23	4.13	0.92	1.69	0.03	0.49	0.11	0.20
	Chromium, total	150	9.23	37.9	14.2	20.0	0.06	0.25	0.09	0.13
	Copper	110	7.34	153.1	27.3	60.2	0.07	1.39	0.25	0.55
	Lead	340	39.3	170	68.0	90.2	0.12	0.50	0.20	0.27
	Mercury, inorganic	63	0.13	6.50	0.52	2.29	<0.01	0.10	0.01	0.04
	Nickel	640	6.33	258	9.33	87.8	0.01	0.40	0.01	0.14
	Silver	15	4.49	90.5	6.70	32.7	0.30	6.03	0.45	2.18
	Zinc	860	51.9	360	133	176	0.06	0.42	0.15	0.20
PCB	Aroclor-1254	0.26	0.030	1.59	0.28	0.61	0.12	6.12	1.07	2.33
	Aroclor-1260	0.15	0.20	0.95	0.033	0.39	1.32	6.36	0.22	2.59
Pesticide	DDD[4,4'-]	35	0.004	0.12	0.019	0.046	<0.01	<0.01	0.00	<0.01
	DDE[4,4'-]	35	0.003	0.029	0.011	0.014	<0.01	<0.01	0.00	<0.01
	DDT[4,4'-]	2.9	0.013	0.12	0.018	0.047	<0.01	0.04	0.01	0.02
	Endrin	0.38	0.003	0.029	0.003	0.012	0.01	0.08	0.01	0.03
SVOC	Bis(2-ethylhexyl)phthalate	60	0.21	0.41	0.30	0.30	<0.01	0.01	0.01	0.01
	Di-n-butylphthalate	2600	0.23	0.37	0.33	0.30	<0.01	<0.01	<0.01	<0.01
VOC	Bromomethane	n/a	0.011	0.016	0.01	0.012	n/a	n/a	n/a	n/a
	Chloromethane	n/a	0.011	0.016	0.01	0.012	n/a	n/a	n/a	n/a

n/a = ESL not available and HQ undefined.

Statistical Approaches

There are several possible statistical approaches to calculating representative concentrations. In the VCA completion report for PRS 0-019, two different approaches were used: one for the mesa top and one for the hillside.

For the mesa top, all the sample results were pooled into one data set and statistics were calculated from this set. Thus, the inherent exposure model was based on exposure to all mesa-top material which might be associated with excavation and redistribution of surface material during construction. The rationale behind this approach is that all the releases on the mesa top are subsurface and that some excavation and blending are likely before exposure could occur.

For the hillside, area weighted-average calculations were based on a subset of the samples. Samples were selected to represent the maximum at a location, and the bounding samples were excluded from the weighted-average calculation. Thus, the average of each subarea was an overestimate of the average of all COPC concentrations in that subarea, and the overall weighted average was, therefore, also an overestimate. The weighted averages presented in the VCA completion report were intended to represent an upper bound of the central tendency of COPC concentrations in the same way that UCL is an upper bound of the mean. It is recognized that the weighted average calculated in this manner is a non-standard approach to an upper bound on the central tendency; alternate statistical approaches were evaluated but found to be less satisfactory than the approach used.

Before discussing the alternate approaches, it is worth considering the statistical concepts behind the weighted-average calculations. Weighted-average calculations are based on stratified random sampling formulae. As discussed in Gilbert (1987 56179, pp. 45–57), stratified random sampling takes advantage of prior information to divide a population into subgroups that are more homogeneous than the entire population. In the case of PRS 0-019, the two outfall areas were recognized in the VCA plan as having different likelihoods of releases, as well as different concentrations. The differences between the outfall areas and the canyon area are documented in the VCA completion report (see Appendix E). Stratified random sampling ensures that adequate sampling is conducted for each subgroup, and greater emphasis may be placed on more variable subgroups than less variable subgroups. Because estimates of the mean and the standard error of the mean can be weighted based on a relevant physical factor (like spatial extent), these statistics are more representative of potential exposure to people or animals than are calculations that weight each sample equally.

There is a simple method for calculating an approximate UCL of the weighted average. Barnett (1974 71481, p. 82) presents a formula to calculate the confidence interval of the weighted (or stratified random) mean:

$$UCL_{weighted} = mean_{weighted} + z_{\alpha/2} SE_{weighted}$$

where:

$UCL_{weighted}$ = the upper confidence limit on the weighted mean

$mean_{weighted}$ = the weighted mean (Barnett 1974, 71481, p. 80)

$SE_{weighted}$ = the weighted standard error (Barnett 1974, 71481, p. 80)

$z_{\alpha/2}$ = z-score for desired two-sided confidence limit (e.g., for α=5% $z_{\alpha/2}$ = 1.96).

This approximate solution assumes homogeneity of variance between strata, which is often not observed and is not the case for the PRS 0-019 data. However, the weighted UCL is a reasonable comparison to other methods for calculating an upper bound on the central tendency of these data.

Another method is the bootstrap, which is described in Appendix E of the PRS 0-019 VCA completion report. The bootstrap is a "distribution free" method and is applicable to data that do not appear to be derived from a single continuous statistical distribution.

Table 4 presents a comparison of the results obtained from the three approaches: weighted UCL, bootstrap UCL, and weighted average. For the weighted UCL and the bootstrap UCL calculations, all of the hillside data were included (to include multiple samples from the same location and bounding sample results). The weighted UCL was based on three composite subareas rather than the six subareas used for the weighted average, to provide more samples within each resultant larger subarea and an improved estimate of the standard error. The largest exposure-point concentration was highlighted for each hillside COPC. A review of Table 4 shows that no one method leads to the largest exposure-point concentration. The original method had the highest concentration for 17 COPCs (only two samples were available for the detected VOCs, which are insufficient samples for the alternate methods). The largest ratio between the maximum and minimum exposure-point concentration is 2.3, but ratios are mostly less than 1.3. The largest difference was noted for the analyte with the least sample support (methyl mercury).

For the seven COPECs with HQ values greater than 10 (see Table 2.5-9 of the VCA completion report), the original weighted average was larger than the values calculated by the other methods for five COPECs: barium, chromium, zinc, DDD, and DDT. Thus, potential risk was overestimated for these COPECs. For the other two COPECs (mercury and silver), the bootstrap UCL concentration was about one-quarter to one-third larger than the original value. These differences would not change the conclusions of the ecological screening assessment.

For the human health assessment, no other COPCs would be identified in the screening assessment by using the maximum values highlighted in Table 4. The conclusions of the human health risk-assessment calculations would also not differ because the same range of carcinogenic risk and non-carcinogenic risk would exist no matter which measure of the central tendency were used from Table 4.

In conclusion, the choice of the statistical method makes a difference in exposure-point concentrations, although not a difference larger than a factor of 2 in the exposure-point concentrations used for the hillside. The most appropriate method for calculating the upper bound on the central tendency of concentrations on the hillside is the weighted UCL method. The bootstrap method is also applicable but it is potentially biased when sampling intensity is not proportional to area.

Table 4
Summary of Statistics for the Hillside Areas

Suite	Analyte	Canyon				Eastern Outfall				Western Outfall				Three Subareas			One Area	Six Subareas	Max./ Min.
		Count	Mean	Standard Deviation	Standard Error	Count	Mean	Standard Deviation	Standard Error	Count	Mean	Standard Deviation	Standard Error	Weighted Average	Weighted Standard Error	Weighted UCL	Bootstrap Resampling UCL of the Mean	Weighted Average	
Inorganic	Antimony	11	0.395	0.293	0.0882	19	0.214	0.103	0.0236	26	2.12	4.14	0.813	0.882	0.262	1.40	1.86	1.36	1.37
	Barium	11	73.9	27.0	8.15	20	72.7	47.2	10.5	28	296	335	63.3	145	20.8	186	238	242	1.30
	Cadmium	11	0.399	0.515	0.155	20	0.221	0.272	0.0608	28	2.22	2.68	0.506	0.918	0.171	1.26	1.67	1.69	1.35
	Chromium, total	11	11.0	5.13	1.55	20	8.94	4.28	0.956	28	21.3	21.0	3.96	13.6	1.40	16.4	18.8	20.0	1.22
	Copper	11	14.0	13.1	3.94	20	7.23	5.17	1.16	28	99.9	120	22.6	39.0	7.34	53.7	73.6	60.2	1.37
	Lead	11	36.5	29.0	8.73	20	32.3	20.4	4.57	28	106	118	22.3	57.3	7.83	73.0	88.8	90.2	1.24
	Mercury	11	0.247	0.244	0.0737	20	0.127	0.243	0.0544	28	4.36	5.10	0.964	1.52	0.310	2.14	3.08	2.29	1.44
	Methylmercury (+1) Ion	3	0.0015	0.0013	0.0008	0	NA[a]	NA	NA	5	0.0074	0.0063	0.0028	NA	NA	NA	0.00838	0.00360	2.33
	Nickel	11	7.09	2.88	0.868	20	5.90	2.42	0.540	28	51.0	225	42.6	20.7	13.6	48.0	67.9	87.8	1.83
	Silver	11	3.50	3.54	1.07	20	4.63	6.77	1.51	28	51.1	79.4	15.0	19.1	4.84	28.8	40.4	32.7	1.40
	Zinc	11	71.6	52.1	15.7	20	51.4	22.0	4.93	28	209	198	37.3	108	13.0	134	165	176	1.31
Radiological	Cobalt-60	0	NA	NA	NA	20	0.0273	0.0578	0.0129	12	0.0752	0.0755	0.0218	NA	NA	NA	0.0653	0.0479	1.36
	Plutonium-239	11	0.125	0.144	0.0433	19	0.0925	0.151	0.0347	22	1.63	1.40	0.299	0.595	0.0973	0.790	1.03	0.807	1.30
	Ruthenium-106	0	NA	NA	NA	20	0.630	1.07	0.240	12	0.121	0.381	0.110	NA	NA	NA	0.719	0.426	1.69
	Uranium-234	11	1.68	0.825	0.249	19	1.30	1.33	0.306	22	22.1	28.4	6.05	8.07	1.94	12.0	15.2	10.3	1.48
	Uranium-235	11	0.0984	0.0558	0.0168	20	0.0924	0.0595	0.0133	22	0.98	1.14	0.243	0.378	0.0782	0.535	0.664	0.463	1.43
	Uranium-238	11	1.49	0.542	0.163	19	1.16	0.908	0.208	22	8.85	10.4	2.21	3.72	0.713	5.15	6.30	4.45	1.42
PCB	Aroclor-1254	11	0.145	0.147	0.0442	19	0.0359	0.0545	0.0125	24	1.05	2.02	0.413	0.394	0.133	0.660	0.845	0.607	1.39
	Aroclor-1260	11	0.0247	0.0076	0.0023	20	0.0836	0.141	0.0315	24	0.725	0.928	0.189	0.270	0.0617	0.394	0.516	0.388	1.33

Table 4 (continued)

Suite	Analyte	Canyon				Eastern Outfall				Western Outfall				Three Subareas			One Area	Six Subareas	Max./ Min.
		Count	Mean	Standard Deviation	Standard Error	Count	Mean	Standard Deviation	Standard Error	Count	Mean	Standard Deviation	Standard Error	Weighted Average	Weighted Standard Error	Weighted UCL	Bootstrap Resampling UCL of the Mean	Weighted Average	
Pesticide	BHC[delta-]	11	0.0012	0.0004	0.0001	19	0.0027	0.0052	0.0012	24	0.0083	0.0067	0.0014	0.00402	0.000622	0.00526	0.00630	0.00625	1.20
	BHC[gamma-]	11	0.0012	0.0004	0.0001	19	0.0027	0.0052	0.0012	24	0.0131	0.0237	0.0048	0.00556	0.00161	0.00878	0.0112	0.00625	1.79
	Chlordane [alpha-]	11	0.0095	0.0094	0.0028	19	0.0032	0.0051	0.0012	24	0.0175	0.024	0.0049	0.00975	0.00185	0.0135	0.0152	0.0223	1.66
	Chlordane [gamma-]	11	0.008	0.0084	0.0025	20	0.0033	0.005	0.0011	24	0.0186	0.0262	0.0053	0.00964	0.00193	0.0135	0.0154	0.0226	1.68
	DDD[4,4'-]	11	0.0095	0.009	0.0027	19	0.0054	0.0104	0.0024	24	0.0441	0.0655	0.0134	0.0191	0.00445	0.0280	0.0347	0.0456	1.63
	DDE[4,4'-]	11	0.0059	0.0057	0.0017	19	0.0052	0.0104	0.0024	24	0.0141	0.0131	0.0027	0.00825	0.00134	0.0109	0.0120	0.0139	1.27
	DDT[4,4'-]	11	0.0133	0.0152	0.0046	20	0.0091	0.0114	0.0026	24	0.0552	0.0999	0.0204	0.025191	0.00675	0.0387	0.0467	0.0474	1.22
	Endrin	11	0.0025	0.0008	0.0002	19	0.0054	0.0104	0.0024	24	0.0127	0.0131	0.0027	0.00681	0.00122	0.00926	0.0107	0.0115	1.24
	Heptachlor epoxide	11	0.0012	0.0004	0.0001	19	0.0027	0.0052	0.0012	24	0.0088	0.0073	0.0015	0.004214	0.000649	0.00551	0.00666	0.00677	1.23
SVOC	Benzo(a)-anthracene	11	0.2473	0.0765	0.0231	15	0.274	0.199	0.0513	12	0.2571	0.110	0.0316	0.260	0.0226	0.305	0.299	0.305	1.02
	Benzo(a)pyrene	11	0.247	0.0765	0.0231	15	0.260	0.194	0.0502	12	0.276	0.131	0.0379	0.261	0.0232	0.308	0.303	0.316	1.04
	Benzo(b)-fluoranthene	11	0.185	0.0698	0.0211	15	0.259	0.195	0.0503	12	0.361	0.326	0.0942	0.268	0.0359	0.340	0.334	0.339	1.02
	Benzoic Acid	11	1.23	0.374	0.113	15	2.23	2.15	0.556	12	1.12	0.657	0.190	1.56	0.216	2.00	2.02	1.86	1.08
	Bis(2-ethylhexyl)phthalate	11	0.233	0.0824	0.0248	15	0.221	0.0847	0.0219	12	0.264	0.154	0.0446	0.238	0.0181	0.275	0.269	0.300	1.12
	Butylbenzyl-phthalate	11	0.231	0.0405	0.0122	15	0.261	0.194	0.0501	12	0.260	0.110	0.0317	0.251	0.0214	0.294	0.290	0.286	1.03
	Chrysene	11	0.219	0.0491	0.0148	15	0.265	0.194	0.0502	12	0.25	0.106	0.0305	0.246	0.0213	0.289	0.286	0.285	1.01
	Di-n-butylphthalate	11	0.247	0.0765	0.0231	15	0.260	0.194	0.0502	12	0.247	0.126	0.0363	0.252	0.0229	0.298	0.293	0.303	1.04
	Fluoranthene	11	0.214	0.0390	0.0118	15	0.260	0.194	0.0502	12	0.273	0.119	0.0342	0.250	0.0217	0.293	0.291	0.277	1.06
	Phenanthrene	11	0.247	0.0765	0.0231	15	0.260	0.194	0.0502	12	0.252	0.110	0.0317	0.253	0.0222	0.298	0.295	0.301	1.02
	Pyrene	11	0.230	0.0442	0.0133	15	0.274	0.199	0.0513	12	0.288	0.136	0.0392	0.264	0.0230	0.310	0.307	0.302	1.03

Table 4 (continued)

Suite	Analyte	Canyon				Eastern Outfall				Western Outfall				Three Subareas			One Area	Six Subareas	Max./ Min
		Count	Mean	Standard Deviation	Standard Error	Count	Mean	Standard Deviation	Standard Error	Count	Mean	Standard Deviation	Standard Error	Weighted Average	Weighted Standard Error	Weighted UCL	Bootstrap Resampling UCL of the Mean	Weighted Average	
VOC	Bromomethane[b]	0	NA	NA	NA	1	0.015	NA	NA	1	0.0195	NA	NA	NA	NA	NA	NA	0.0124	
	Chloromethane[c]	0	NA	NA	NA	1	0.014	NA	NA	1	0.0195	NA	NA	NA	NA	NA	NA	0.0123	

Note: areas used in the weight statistics: eastern outfall [area=9027 ft^2, weight= 0.367], western outfall [area=7866 ft^2, weight= 0.320], canyon [area=7699 ft^2, weight= 0.313].

[a] NA = insufficient data for this statistic.

[b] Bromomethane had one detect at 0.015 mg/kg and one non-detect at 0.039 mg/kg.

[c] Chloromethane had one detect at 0.014 mg/kg and one non-detect at 0.039 mg/kg.

HWB Comment

3. *LANL states that it removed a limited amount of process pipes at PRS 0-019 during the period of February through mid-July 1999 and that some of the process pipes may still remain. If pipes remain at the site, LANL shall provide a map indicating the locations of the removed pipes and the locations of the remaining pipes. LANL shall also indicate the depths below the current ground surface at which the remaining pipes lie.*

LANL Response

3. All WWTP process piping that could be located, and/or that was identified on the construction drawings, was removed during the VCA activities. Prior to the construction activities now in progress, the Townsites Team Leader met with the construction supervisor to advise that person of the possibility of additional subsurface piping and what steps to take if any were found. Since excavation is now complete at the site, and no additional process pipes were found, it can now be directly stated that LANL did remove all WWTP process piping during the VCA.

SPECIFIC COMMENTS

HWB Comment

1. *Section 2.4.3.2.3, Evaluation of Organic Chemicals, page 62, paragraph 5:*

   LANL Statement: "although a majority of the data were rejected in the eastern outfall lower bench samples, the other data indicate that there is no reason to believe that these SVOCs would have been detected."

   HWB Comment: Since so much data were rejected from the 3 sampling locations and the only data available from this part of the lower bench is from a sample collected outside of the channel, LANL shall ensure that the Graduation Canyon investigation includes analyses for SVOCs.

LANL Response

1. LANL agrees to this and will forward this requirement to the Canyons Focus Area.

HWB Comment

2. *Appendix H: Concrete and Fill Data Tables, Tables H-1 through H-3:*
   LANL shall provide the location IDs and sampling depths for the fill material samples. If this information cannot be provided, LANL shall provide an explanation as to why the information is unavailable.

LANL Response

2. The samples presented in Tables H-1 through H-3 of the VCA completion report were collected, at the request of the AA, to provide information about material being left in place (as stated in section 2.4.1 of the VCA report). Because the samples were neither investigation samples nor confirmation samples, no location IDs were assigned (the two exceptions are samples RE00-00-0029 and RE00-00-0044). For the same reason, actual sample depths were not recorded. Depths for these samples have been estimated from sample collection logs and field notes and are presented, along with comments for each sample, in Table 5. The depths presented are relative to the existing grade of the

site at the time of sampling, and may no longer apply. The approximate locations of these samples can be judged from the comments in Table 5 and the locations of the structures on site maps (i.e., Figure 2.4-1 in the VCA report).

HWB Comment

3. *Appendix H: Concrete and Fill Data Tables, Tables H-4 through H-6:*
LANL shall distinguish between the samples collected from underneath the structures and the samples collected above the structures by providing sampling depths.

LANL Response

3. Tables H-4 through H-6 of the VCA report contain data for concrete samples only (collected at the request of the AA, as stated in section 2.4.1 of the VCA report). These samples were collected from the floors of the concrete structures (core samples of the concrete itself). As such, these samples are neither underneath nor above the structures. The approximate depths of the samples are presented in the Table 5. The depths presented are relative to the grade of the site at the time of sampling, and may no longer apply.

Table 5
Approximate Depths of Samples from Concrete and Fill Material

Sample ID	Location	Material	Comments	Estimated Depth (ft)
RE00-00-0019	00-10327	Concrete	Concrete sample from floor of sludge digestion tank structure	2–2.5
RE00-00-0022	00-10328	Concrete	Concrete sample from floor of sludge digestion tank structure	5–5.5
RE00-00-0036	00-10333	Concrete	Concrete sample from floor of trickling filter structure	10–10.5
RE00-00-0041	00-10331	Concrete	Concrete sample from floor of trickling filter structure	5–5.5
RE00-00-0042	00-10330	Concrete	Concrete sample from floor of trickling filter structure	9–9.5
RE00-00-0043	00-10329	Concrete	Concrete sample from floor of trickling filter structure	5–5.5
RE00-00-0045	00-10334	Concrete	Concrete sample from floor of trickling filter structure	13–13.5
RE00-00-0056	00-10341	Concrete	Concrete sample from floor of chlorine contact tank structure	7.5–8
RE00-00-0057	00-10342	Concrete	Concrete sample from floor of final settling tank structure	7.5–8
RE00-00-0072	00-10349	Concrete	Concrete sample from floor of primary settling tank structure	4.5–5
RE00-00-0029	00-10332	Fill	No location ID assigned; waste-characterization sample of fill above trickling filter; clayey organic material	5–6
RE00-00-0044	00-10336	Fill	No location ID assigned; waste-characterization sample of fill from above chlorine contact tank; silty	1–2
RE00-99-0251	n/a[a]	Fill	No location ID assigned; waste-characterization sample of fill from chlorine contact tank	5–5.5
RE00-99-0252	n/a	Fill	No location ID assigned; waste-characterization sample of fill inside sludge digestion tank (north end, bottom of tank)	0.5–1
RE00-99-0253	n/a	Fill	No location ID assigned; waste-characterization sample from inside south end, bottom of sludge digestion tank; black organic sludge	4.5–5
RE00-99-0254	n/a	Fill	No location ID assigned; waste-characterization sample of fill, 2 ft from bottom of primary settling tank, north end	4–4.5

Table 5 (continued)

Sample ID	Location	Material	Comments	Estimated Depth (ft)
RE00-99-0255	n/a	Fill	No location ID assigned; waste-characterization sample, 3 ft from bottom, center of primary settling tank; dark fill	3.5–4
RE00-99-0256	n/a	Fill	No location ID assigned; waste-characterization sample, 2 ft from bottom, south end of primary settling tank; wet organic sludge	4.5–5
RE00-99-0257	n/a	Fill	No location ID assigned; waste-characterization sample, inside bottom west side of trickling filter; dark fill	9–9.5
RE00-99-0258	n/a	Fill	No location ID assigned; waste-characterization sample, inside south end, bottom of trickling filter; dark fill	12.5–13
RE00-99-0259	n/a	Fill	No location ID assigned; waste-characterization sample, inside east end, middle of trickling filter tank; dark organic soil	5–5.5
RE00-99-0260	n/a	Fill	No location ID assigned; waste-characterization sample, inside center of trickling filter tank, at bottom; dry dark soil	8.5–9
RE00-99-0261	n/a	Fill	No location ID assigned; waste-characterization sample, inside north end of trickling filter tank, middle; dry, dark organic soil	2.5–3
RE00-99-0262	n/a	Fill	No location ID assigned; waste-characterization sample of fill inside south end, final settling tank; dark organic soil	5–5.5
RE00-99-0263	n/a	Fill	No location ID assigned; waste-characterization sample of fill inside final settling tank	7–7.5
RE00-00-0046	00-10337	Tuff	Sample taken 0–2 ft beneath the final settling tank	8.5–10.5
RE00-00-0047	00-10337	Tuff	Sample taken 2–4 ft beneath the final settling tank	10.5–12.5
RE00-00-0048	00-10336	Tuff	Sample taken 0–2 ft beneath the chlorine contact tank	8.5–10.5
RE00-00-0049	00-10336	Tuff	Sample taken 2–4 ft beneath the chlorine contact tank	10.5–12.5
RE00-00-0052	00-10339	Tuff	Sample taken 0–2 ft beneath the final settling tank	8.5–10.5
RE00-00-053	00-10339	Tuff	Sample taken 2–4 ft beneath the final settling tank	10.5–12.5
RE00-00-0054	00-10340	Tuff	Sample taken 0–2 ft beneath the final settling tank	8.5–10.5
RE00-00-0055	00-10340	Tuff	Sample taken 2–4 ft beneath the final settling tank	10.5–12.5
RE00-00-0058	00-10343	Tuff	Sample taken 0–2 ft beneath the primary settling tank	6–8
RE00-00-0059	00-10343	Tuff	Sample taken 2–4 ft beneath the primary settling tank	8–10
RE00-00-0064	00-10346	Tuff	Sample taken 0–2 ft beneath the primary settling tank	6–8
RE00-00-0065	00-10346	Tuff	Sample taken 2–4 ft beneath the primary settling tank	8–10
RE00-00-0066	00-10347	Tuff	Sample taken 0–2 ft beneath the primary settling tank	6–8
RE00-00-0067	00-10347	Tuff	Sample taken 2–4 ft beneath the primary settling tank	8–10
RE00-00-0068	00-10348	Tuff	Sample taken 0–2 ft beneath the primary settling tank	6–8
RE00-00-0069	00-10348	Tuff	Sample taken 2–4 ft beneath the primary settling tank	8–10

[a] n/a = not applicable.

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