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Date: November 10, 2005
Refer to: ER2005-0849

Mr. James Bearzi
NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

SUBJECT: RESPONSE TO THE SECOND NOTICE OF DISAPPROVAL FOR THE COMPLETION REPORT FOR THE VOLUNTARY CORRECTIVE ACTION AT SOLID WASTE MANAGEMENT UNITS 0-030(A), 0-030(B), AND 0-033(A) AND AREAS OF CONCERN 0-029(A, B, C,) AND 0-010(A,B) AND FOR THE INTERIM ACTION AT SOLID WASTE MANAGEMENT UNIT 21-021-99

Dear Mr. Bearzi:

Attached are two hard copies with electronic files of the "Response to the Second Notice of Disapproval on the Completion Report for the Voluntary Corrective Action at Solid Waste Management Units 0-030(a), 0-030(b)-00, and 0-033(a) and Areas of Concern 0-029(a,b,c) and 0-010(a,b) and for the Interim Action at Solid Waste Management Unit 21-021-99."

If you have questions, please contact Terry Rust at (505) 665-8843 (trust@lanl.gov) or Bob Enz at (505) 667-7640 (renz@doeal.gov).

Sincerely,

David McInroy, Deputy Program Director
Environmental Remediation & Surveillance
Los Alamos National Laboratory

Sincerely,

David Gregory, Federal Project Director
Department of Energy
Los Alamos Site Office

TR/jk

Enclosures: Two hard copies with electronic files - Response to the Second Notice of Disapproval on the Completion Report for the Voluntary Corrective Action at Solid Waste Management Units 0-030(a), 0-030(b)-00, and 0-033(a) and Areas of Concern 0-029(a,b,c) and 0-010(a,b) and for the Interim Action at Solid Waste Management Unit 21-021-99 (ER2005-0790)

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**Response to the Second Notice of Deficiency [NOD]
for the "Completion Report for the Voluntary Corrective Action
at SWMUs 0-030(a), 0-030(b)-00, and 0-033(a) and
AOCs 0-029(a,b,c) and 0-010(a,b) and for the IA at SWMU 21-021-99,
Los Alamos National Laboratory,
EPA ID #NM0890010515, NMED Task 03-013"**

INTRODUCTION

The Los Alamos National Laboratory (LANL or the Laboratory) information provided herein is in response to the New Mexico Environment Department (NMED) second notice of deficiency (NOD) for the "Completion Report for the VCA [Voluntary Corrective Action] at SWMUs [Solid Waste Management Units] 0-030(a), 0-030(b)-00, and 0-033(a) and AOCs [Areas of Concern] 0-029(a,b,c) and 0-010(a,b) and for the IA [Interim Action] at SWMU 21-021-99" (September 2003, ER2003-0445, LA-UR-03-4326). The second NOD was dated October 5, 2005. On July 15, 2005, a supplement to the NOD response of April 27, 2004, and to the approval with modifications of June 21, 2004, was submitted to NMED.

For each NMED comment that required additional or revised information, the relevant chronology, the applicable text of NMED comments, and any of LANL's previous responses are provided below. Comments have been separated by shading.

This response contains data on radioactive materials, including source, special nuclear, and by-product material. The management of these materials is regulated under the Atomic Energy Act and is specifically excluded from regulation under the Resource Conservation and Recovery Act (RCRA) and the New Mexico Hazardous Waste Act. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy (DOE) policy.

SPECIFIC COMMENTS

NMED Comment

1. *In the supplemental response, the Permittees provided data for inorganic chemicals detected above background values and summarized revised risk assessments for these sites. The Permittees must provide all of the data (including non-detected values, detection limits, and minimum detectable activities) and the actual risk assessments in addition to figures depicting new sample locations and any excavated areas.*

LANL Response #1

The data are included as Attachment 1 on a separate compact disc.

Figure 1 shows all the RCRA facility investigation (RFI) and VCA sampling locations for the 6th Street Warehouse AOCs and SWMU. Figure 2 shows the two AOC 0-033(b) areas where soil was excavated and confirmatory samples were collected.

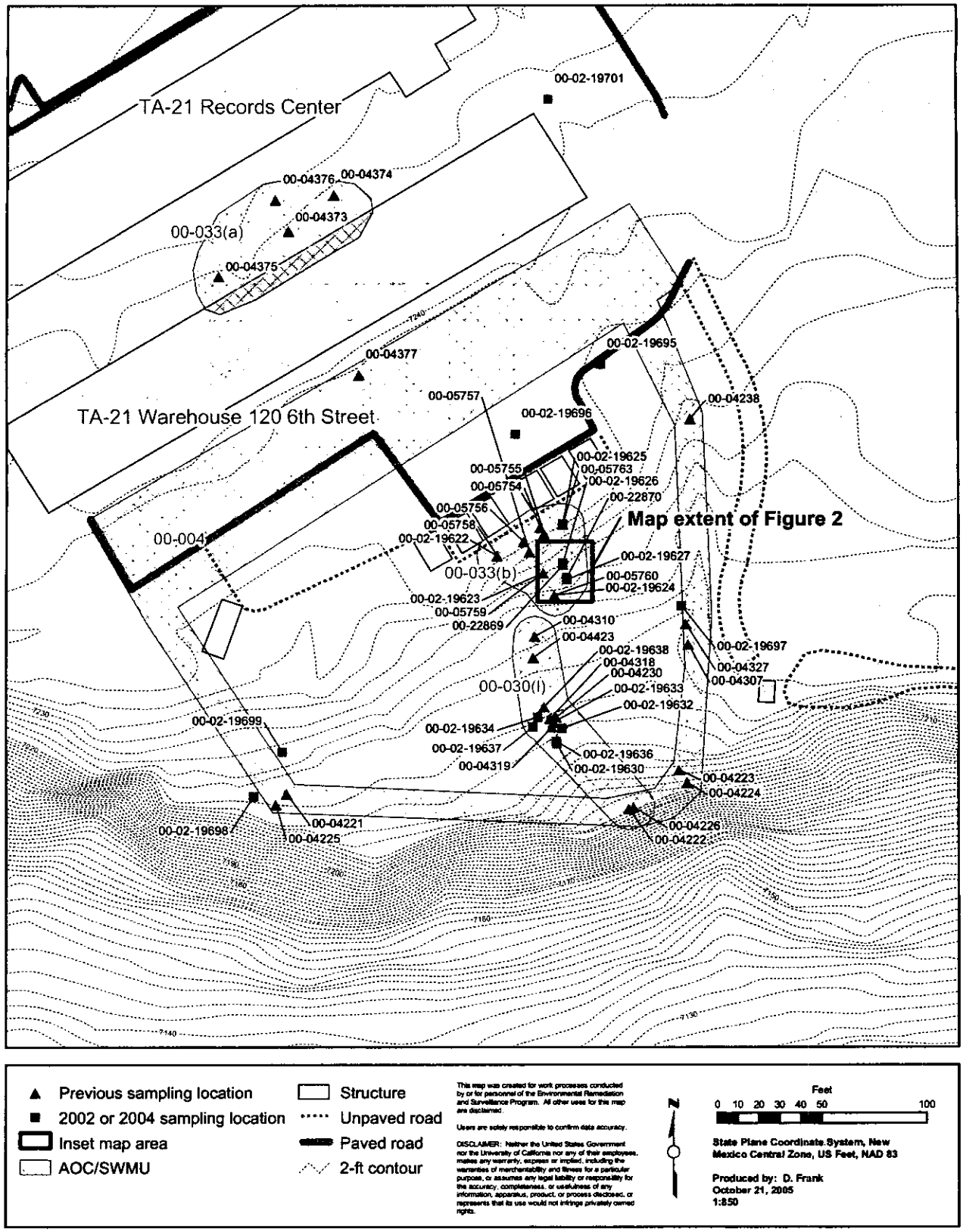

Figure 1. AOCs 0-004 and 0-033(a,b) and SWMU 0-030(l) RFI and VCA sampling locations

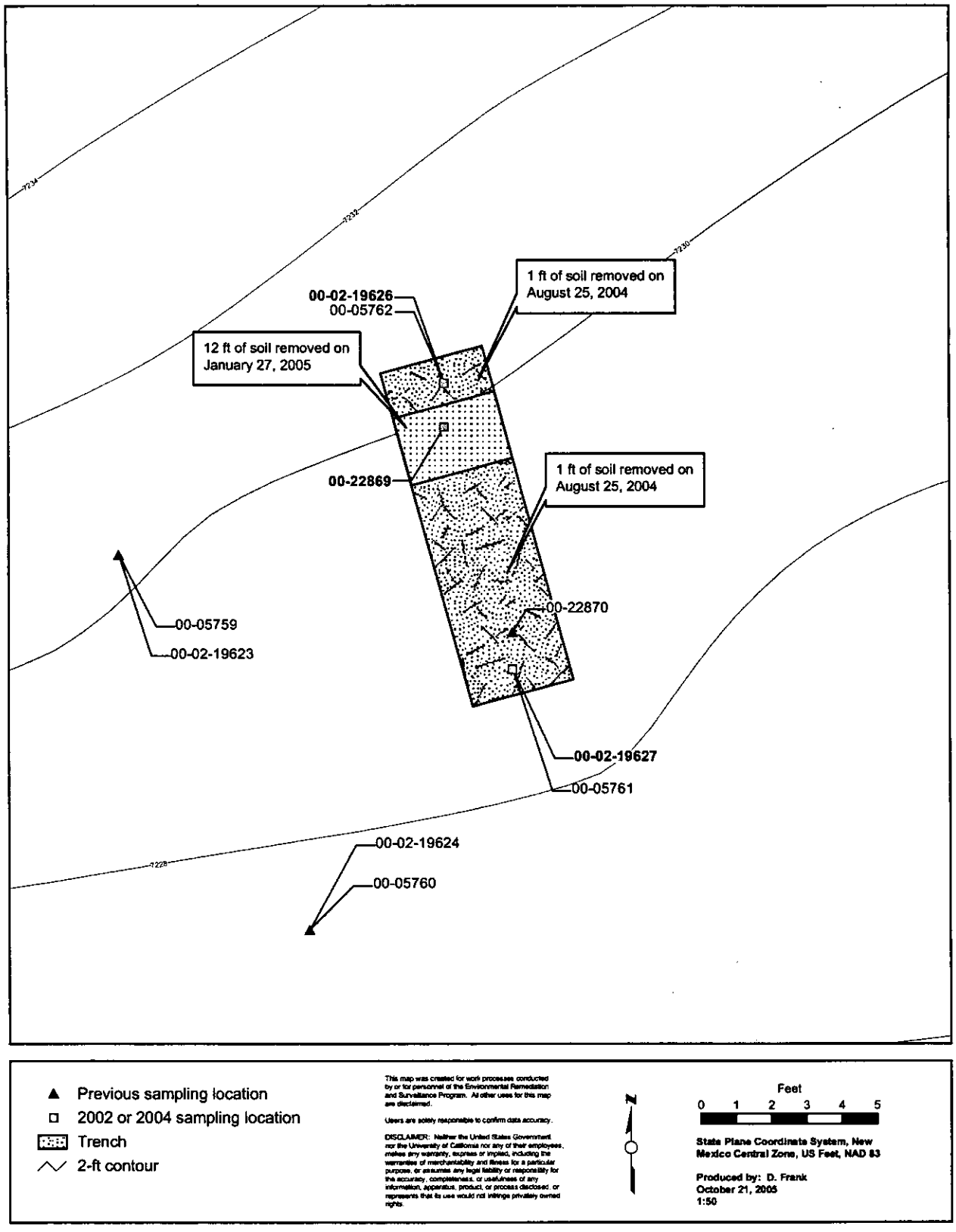

Figure 2. Areas of soil removal at AOC 0-033(b)

The revised screening assessments are provided below.

Screening Assessments for the 6th Street Warehouse AOCs and SWMU

Human Health Screening Assessment

The human health screening assessment for AOCs 0-004 and 0-033(b) and SWMU 0-030(l) was performed according to guidance outlined in the draft installation work plan (LANL 2000, 66802) and in the "Human Health Risk-Based Screening Methodology" (LANL 2002, 72639). The screening assessment for AOC 0-033(a) was conducted according to NMED guidance on screening guidelines for total petroleum hydrocarbons (TPH) (NMED 2003, 89372). Because the DP Road VCA completion report (LANL 2003, 87625) was submitted to NMED in September 2003, the revised screening assessments, which include the data collected in 2004, use the screening action levels (SALs) and ecological screening levels (ESLs) from 2003 for consistency with the other screening assessments in the report.

Scoping

Current land use at the 6th Street Warehouse AOCs and SWMU [AOCs 0-004 and 0-033(a,b) and SWMU 0-030(l)] is currently industrial, and is expected to remain industrial for the foreseeable future.

The potential for human exposure to residual concentrations of chemicals and radionuclides in the environment at the site is moderate because the site has restricted access at night and weekends (i.e., the site is fenced and locked). During the work day, the site is open.

Currently, the people who work in the 6th Street warehouses do not work outside in the area where AOCs 0-004 and 0-033(a,b) and SWMU 0-030(l) are located. The areas may be used when an employee is on a break, but probably are visited infrequently.

Sampling results to a depth of 12 ft were assessed because media (soil and tuff) from that depth could potentially be excavated and brought to the surface. No samples were collected deeper than 13.5 ft at AOCs 0-004 and 0-033(b) and SWMU 0-030(l). At AOC 0-033(a), samples were collected to a maximum depth of 40 ft.

The 6th Street Warehouse area is a small hillside leading down to a relatively flat area; the mesa drops off abruptly to Los Alamos Canyon. AOC 0-004 consists of two drainages on the eastern and western side of the hillside, which join a drainage below AOC 0-033(b). Although a residential scenario is unlikely under current and projected future site conditions, the potential present-day risks were evaluated using the residential scenario because it is protective of human health. The SALs used in the screening evaluation reflect a residential scenario that is based on an exposure of 24 hr/day and 350 days/yr.

From the spills that occurred at AOC 0-004, the contaminants are expected to have washed into the unlined drainages, which either flowed to the drainage below AOC 0-033(b) or over the mesa edge to Los Alamos Canyon. The SWMU 0-030(l) septic tank was removed, and samples were collected from beneath it, as well as from the sides, to determine whether the tank had leaked. AOC 0-033(b) included pipes that drained to an unlined drainage ditch south of the Material Testing Laboratory. AOC 0-033(a) was an underground storage tank (UST) that stored heating fuel oil and was removed in November 1995. As described in section 2.3.2.2 of the VCA completion report (LANL 2003, 87625), the chemicals of potential concern (COPCs) from these sites generally are not mobile and likely remain within the surface soil. If the UST were to leak, the COPCs likely will remain close to the tank.

Screening Evaluation

The representative concentration used in this screening assessment was the 95% upper confidence level (UCL) of the mean or the maximum detected concentration (see Appendix F of the VCA completion report [LANL 2003, 87625]). The 95% UCL (calculated by the U.S. Environmental Protection Agency's [EPA's] ProUCL 3.0 software [EPA 2004, 90033]) was determined using all available data from both soil and tuff at depths from 0 to 12 ft. For AOC 0-033(a), an average TPH concentration from 0 to 12 ft was used in the screening assessment because the site is small and there were not enough samples to calculate a 95% UCL.

A total of 61 analytes, plus TPH, were identified as COPCs at the 6th Street Warehouse AOCs/SWMU based on the data review. These COPCs are evaluated further in this section by comparing the representative concentration with the appropriate SAL for each chemical. The chemical SALs are calculated based on the methodology provided in Appendix C of the draft installation work plan (LANL 2000, 66802) and in the "Human Health Risk-Based Screening Methodology" (LANL 2002, 72639) and are based on guidance from NMED (NMED 2000, 68554) and EPA Region 6 (EPA 2002, 73691). For radionuclides, the SALs are derived according to LANL's "Derivation and Use of Radionuclide Screening Action Levels" (LANL 2001, 69683) using the residual radioactive material (RESRAD) computer code, Version 6.21 (LANL 2002, 73705). The SALs for noncarcinogens are based on a hazard quotient (HQ) of 1.0. The SALs for carcinogens are based on a cancer risk level of 10^{-6}. The SALs for radionuclides are based on a dose of 15 mrem/yr.

Some chemicals [benzo(g,h,i)perylene, alpha-chlordane, gamma-chlordane, endrin ketone, endosulfan II, and 4-isopropyltoluene] do not have toxicity values published in EPA's Integrated Risk Information System (IRIS) database, Health Effects Assessment Summary Tables (HEAST), or by EPA's National Center for Environmental Assessment (NCEA). Surrogate chemicals used in this assessment were based on similarity of chemical structure [in the case of benzo(g,h,i)perylene, alpha-chlordane, gamma-chlordane, endosulfan II, and 4-isopropyltoluene] or because they were a breakdown product of the parent compound (as for endrin ketone).

The representative concentrations of noncarcinogenic COPCs were all less than their respective SALs. The hazard index (HI), the sum of the ratios of representative concentration divided by the SAL, is approximately 1.0 (Table 1) and is equivalent to NMED's target HI of 1.0 (NMED 2000, 68554). This indicates that no unacceptable potential human health risk is expected from residual concentrations of noncarcinogenic COPCs at the 6th Street Warehouse AOCs/SWMU.

The representative concentrations of most of the carcinogenic COPCs were less than their respective SALs [arsenic, Aroclor-1254, Aroclor-1260, benzo(a)pyrene, dibenz(a,h)anthracene, and N-nitroso-di-n-propylamine exceeded their SALs]. The total potential excess cancer risk from exposure to carcinogenic COPCs at the 6th Street Warehouse AOCs/SWMU [AOCs 0-004 and 0-033(b) and SWMU 0-030(l)] is approximately 2.3×10^{-5} (Table 2), which is above NMED's target risk level for carcinogenic risk of 1 in 100,000 (1×10^{-5}) (NMED 2000, 68554).

Table 1
Calculation of HI for Noncarcinogenic COPCs
at 6th Street Warehouse AOCs/SWMU

Chemical	95% UCL (mg/kg)	Residential SAL[a] (mg/kg)	HQ
Arsenic	2.73	22[b]	0.12
Copper	9.12	2800	3.26E-02
Lead	29.02	400	0.07
Mercury	0.11	23	4.78E-03
Nickel	6.10	1500	4.07E-03
Selenium	0.39	380	1.03E-03
Zinc	49.70	23000	2.16E-03
Acenaphthene	0.17	2800	6.07E-05
Acetone	0.06	1600[b]	3.75E-05
Anthracene	0.23	16000	1.44E-05
Aroclor-1254	0.62	1.1	0.56
Benzo(g,h,i)perylene[c]	0.23	1800	1.28E-04
Benzoic acid	1.01	1.0E+05[b]	1.01E-05
Butanone[2-]	0.013	37000	3.51E-07
Butylbenzylphthalate	0.12[d]	240[b]	5.00E-04
Dibenzofuran	0.02[d]	290[b]	6.21E-04
Dimethyl phthalate	0.18[d]	1.0E+05	2.00E-06
Di-n-butylphthalate	0.23	6100	3.77E-05
Endosulfan II[e]	0.059	370	1.59E-04
Endrin	0.059	18	3.28E-03
Endrin ketone[f]	0.003[d]	18	1.67E-04
Fluoranthene	0.26	2300	1.17E-04
Fluorene	0.23	2100	1.10E-04
Isopropyltoluene[4-][g]	0.0045	370[b]	8.65E-06
Methoxychlor[4,4-]	0.175	310[b]	5.65E-04
Nitroaniline[2-]	0.88[d]	3.7[b]	2.38E-01
Phenanthrene	0.17	1800	9.44E-05
Pyrene	0.29	1800	1.61E-04
Styrene	0.0028	1700[b]	1.65E-06
Toluene	0.0029	180	1.61E-05
		HI	**1.0**

[a] Values from NMED 2000, 68554.
[b] Values from EPA Region 6 (EPA 2002, 73691).
[c] Pyrene used as a surrogate for benzo(g,h,i)perylene.
[d] Maximum detected concentration.
[e] Endosulfan used as a surrogate for Endosulfan II.
[f] Endrin used as a surrogate for Endrin ketone.
[g] Isopropylbenzene used as a surrogate for isopropyltoluene.

Table 2
Calculation of Carcinogenic COPCs at 6th Street Warehouse AOCs/SWMU

Chemical	95% UCL (mg/kg)	Residential SAL [a] (mg/kg)	Cancer Risk
Arsenic	2.73	0.39	7.00E-06
Aldrin	0.016	0.029	5.52E-07
Aroclor-1242	0.01[c]	0.22	5.00E-08
Aroclor-1254	0.34	0.22[b]	1.55E-06
Aroclor-1260	0.36	0.22[b]	1.64E-06
Benzene	0.0007[c]	0.64	1.09E-09
Benzo(a)anthracene	0.16	0.62	2.58E-07
Benzo(a) pyrene	0.16	0.062	2.58E-06
Benzo(b)fluoranthene	0.26	0.62	4.19E-07
Benzo(k)fluoranthene	0.16	6.2	2.58E-08
Bis(2-ethylhexyl)phthalate	0.50	35[b]	1.43E-08
BHC[alpha-]	0.016	0.09	1.78E-07
BHC[gamma-]	0.0002[c]	0.44	2.00E-07
Chlordane [alpha-][d]	0.23	1.6	1.44E-07
Chlordane [gamma-][d]	0.32	1.6	2.00E-07
Chrysene	0.16	61	2.62E-09
DDD[4,4'-]	0.031	2.4	1.29E-08
DDE[4,4'-]	0.18	1.7	1.06E-07
DDT[4,4'-]	0.27	1.7	1.59E-07
Dibenz(a,h)anthracene	0.23[c]	0.062	3.71E-06
Dieldrin	0.031	0.03	1.03E-06
Heptachlor	0.016	0.11	1.45E-07
Heptachlor epoxide	0.016	0.053[b]	3.02E-07
Indeno(1,2,3-cd)pyrene	0.164	0.62	2.65E-07
N-nitroso-di-n-propylamine	0.22[c]	0.07[b]	3.14E-06
Trichloroethene	0.0047	1.6	2.94E-09
Total Incremental Cancer Risk			**2.3E-05**

[a] Values from NMED (2000, 68554), adjusted to reflect a 10^{-6} risk.

[b] Values from EPA Region 6 (EPA 2002, 73691).

[c] Maximum detected concentration.

[d] Total chlordane used as a surrogate for alpha-chlordane and gamma-chlordane.

The representative concentrations for radionuclide COPCs were less than their respective SALs. The total estimated radionuclide dose is approximately 1.3 mrem/yr (Table 3), mainly from cesium-137. The dose is less than DOE's target dose of 15 mrem/yr (LANL 2000, 67489).

Table 3
Calculation of Radionuclide Dose at 6th Street Warehouse AOCs/SWMU

Radionuclide	95% UCL (pCi/g)	Residential SAL* (pCi/g)	Dose (mrem/yr)
Americium-241	0.041	39	0.02
Cesium-137	0.23	5.3	0.65
Plutonium-238	0.005	49	0.002
Plutonium-239	0.077	44	0.03
Uranium-234	1.28	63	0.30
Uranium-235	0.099	17	0.09
Uranium-238	1.31	86	0.23
		Total Dose	**1.3**

*Values from LANL 2001, 69683.

Table 4 shows the maximum detected concentration and average concentration of TPH from 0 to 12 ft at AOC 0-033(a) compared with the residential and industrial screening guidelines for #3 and #6 fuel oil (NMED 2003, 89372). The HQ for the average concentration and the residential screening guideline is approximately 0.5, which is less than NMED's target HQ of 1.0 (NMED 2000, 68554). Using the industrial screening guideline, the HQ is 0.1 for the average concentration. The HQ for the maximum detected concentration from 0 to 12 ft using the residential screening guidelines is approximately 5, while the comparison with the industrial screening guideline produces an HQ of approximately 2.0. However, the maximum detected concentration used in this assessment is from a depth of 11 ft from one of five boreholes and is not likely to result in direct exposure to either a residential or industrial receptor. These results indicate that a human health hazard is not expected from residual concentrations of TPH at AOC 0-033(a).

Table 4
Calculation of Hazard Quotients for TPH at AOC 0-033(a)

Depth	TPH (mg/kg)	Residential Screening Guideline* (mg/kg)	HQ	Industrial Screening Guideline* (mg/kg)	HQ
Average value from 0 to 12 ft	424	860	0.49	2150	0.20
Maximum value from 0 to 12 ft	4237	860	4.93	2150	1.97

*Values for #3 and #6 fuel oil from NMED 2003, 89372.

Uncertainty Analysis

The analysis presented in this human health screening assessment is subject to varying degrees and kinds of uncertainty. The uncertainties associated with the background data, the data evaluation, exposure assessment, toxicity assessment, and the use of surrogates may affect the results.

Data evaluation and COPC identification process. Uncertainties associated with the data can include sampling errors, laboratory analysis errors, and data analysis errors. For this site, these uncertainties are expected to have no effect on the results even though the detected concentrations of some organic COPCs were qualified J, because the values were less than the estimated quantitation limits (EQLs).

Arsenic background concentrations range from 0.3 mg/kg to 9.3 mg/kg in soil and from 0.25 mg/kg to 5 mg/kg in tuff (LANL 1998, 59730). The representative concentration for arsenic (2.68 mg/kg) and the maximum detected concentration (4.61 mg/kg) are within the range of background concentrations, so exposure across the 6th Street Warehouse AOCs/SWMU is similar to the background and does not represent a potential risk to receptors. Removal of arsenic as a COPC from the screening assessment reduces the total incremental cancer risk to 1.6×10^{-5} and the HI to 0.9.

Using the 95% UCL as the representative concentration for dieldrin overestimates the risk as a result of elevated detection limits. Dieldrin has detection limits of 0.36 mg/kg and 0.18 mg/kg in three samples, while the rest of the detection limits were less than 0.072 mg/kg. Because the 95% UCL uses one-half the detection limit, the elevated detection limits bias the 95% UCL high and overestimate the potential risk. If the maximum detected concentration for dieldrin (0.0096 mg/kg) is used instead of the 95% UCL (0.031 mg/kg), dieldrin's cancer risk is reduced to 3.2×10^{-7}.

In addition, N-nitroso-di-n-propylamine was detected in only one of 44 samples at a depth of 6–6.5 ft and does not pose a potential risk. Eliminating this chemical as a COPC because of infrequent detection, further reduces the total incremental cancer risk for the site.

Based on the uncertainties described above, which result in the elimination of arsenic and N-nitroso-di-n-propylamine as COPCs and reduce the cancer risk of dieldrin, the carcinogenic risk is overestimated. The revised total incremental cancer risk for this site is approximately 1.3E-05.

Exposure assessment. Uncertainties and biases were identified in four areas of the exposure assessment process.

- *Identification of receptors.* Land-use and activity patterns are not represented by those activities assumed by the residential land-use scenario; therefore, biases are introduced. Because the potentially exposed individual is an industrial worker who does not conduct any work around the AOCs/SWMU, the screening assessment overestimates the exposure and subsequently overestimates the current potential hazard, risk, and dose.
- *Exposure pathway assumptions.* For each exposure pathway, assumptions are made concerning the parameters, the routes of exposure, the amount of contaminated media to which an individual can be exposed, and the intake rates of different routes of exposure. In the absence of site-specific data, the assumptions used are consistent with EPA-approved parameters and default values (EPA 2002, 73691). When several upper-bound values are combined to estimate exposure for any one pathway, the resulting risks can be in excess of the 99th percentile and therefore outside the range that may be reasonably expected.

Analytical data from 0 to 12 ft were used in the screening assessment. If the site remains undisturbed, receptors would be exposed to only the surface soil. Therefore, pathways to subsurface contamination are incomplete.

Use of direct exposure screening guidelines. The use of the residential and industrial direct exposure screening guidelines for TPH (NMED 2003, 89372) overestimates the potential exposure to human health at AOC 0-033(a). TPH was not detected in samples shallower than 10 ft but was detected at a concentration of 4237 mg/kg at 11 ft. At this depth, no potential for direct exposure to receptors exists.

Use of surrogate chemicals. Some chemicals do not have EPA-approved or provisional toxicity values. In these cases, a similar chemical with available toxicity values is used as a surrogate. Pyrene was used as a surrogate for benzo(g,h,i)perylene because the two chemicals have similar structures. The difference between the two chemicals is the additional two benzene rings in benzo(g,h,i)perylene. The additional

benzene rings add stability to the structure, making the surrogate pyrene more reactive than benzo(g,h,i)perylene. Because benzo(g,h,i)perylene is less reactive than its surrogate, the risk is overestimated for this analyte.

Endrin was used as a surrogate for endrin ketone, which is a breakdown product of endrin when it is exposed to light. Photochemical isomerization of endrin, primarily to the pentacyclic ketone commonly called endrin ketone, was observed after exposure to sunlight of thin layers of solid endrin on glass (Agency for Toxic Substances and Disease Registry [ATSDR] 1997, 56531). Results of seasonal studies indicated that this isomerization proceeds with a half-life of 5 to 9 days in intense summer sunlight, with complete conversion to endrin ketone in 15 to 19 days. Endrin was only detected in 2 of 49 samples, and endrin ketone was detected only once in 43 samples; as a result, the risk from both of these analytes is minimal.

Endosulfan was used as a surrogate for endosulfan II because endosulfan II is an isomer of endosulfan. These chemicals have the same chemical weight and the same molecules. The risk from these chemicals is potentially the same.

Isopropylbenzene was used as a surrogate for 4-isopropyltoluene based on its structural similarity. The difference between the two chemicals is a carbon molecule for 2-isopropyltoluene, which makes this chemical more reactive. Although this underestimates the risk from 4-isopropyltoluene, it is not a major contributor to the risk at the site because it was detected in only 6 of the 22 samples.

Total chlordane was used as a surrogate for alpha and gamma chlordane, two of the components that make up total chlordane. Alpha chlordane was detected in 16 of 49 samples and gamma chlordane was detected in 17 of 49 samples. As a result, alpha and gamma chlordane are not major contributors to the risk at the site.

Toxicity values. The primary uncertainty associated with the SALs is related to the derivation of toxicity values used in the calculation. EPA toxicity values (reference doses [RfDs] and slope factors [SFs]) were used to derive the SALs in this risk screening assessment (EPA 2001, 70109; EPA 1997, 58968). Uncertainties were identified in the following three areas with respect to the toxicity values:

- *Extrapolation from other animals to humans.* The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist in chemical absorption, metabolism, excretion, and toxic response between such animals and humans. EPA takes into account differences in body weight, surface area, and pharmacokinetic relationships between the animals and humans to minimize the potential to underestimate the dose-response relationship. However, more conservatism is usually incorporated into these steps.

- *Extrapolation from one route of exposure to another route of exposure.* The SFs and RfDs can often contain extrapolations from one route of exposure to another. The extrapolation from the oral route to the inhalation and/or the dermal route is used and is based on EPA's IRIS database (EPA 2001, 70109). Differences between the two exposure pathways could result in an overestimation of the risk.

- *Interindividual variability in the human population.* For noncarcinogenic effects, the amount of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the no-observed-adverse-effect level (NOAEL). The NOAEL/uncertainty-factor approach incorporates a 10-fold factor to reflect the possible

interindividual variability in the human population and is generally considered a conservative estimate.

Additive approach. For noncarcinogens, the effects of a mixture of chemicals are generally unknown and possible interactions could be synergistic or antagonistic, thereby overestimating or underestimating the risk. Additionally, the RfDs for different chemicals are not based on the same severity, effect, or target organ. Therefore, the potential for the occurrence of noncarcinogenic effects can be overestimated for chemicals that act by different mechanisms and on different target organs but are addressed additively.

DDT spraying. The U.S. National Forest Service was involved in spraying DDT in the 1950s in the Jemez Mountains (LASL 1963, 64879). Documentation does not state whether the spraying occurred in the Los Alamos townsite, but it is possible that it did. If such spraying did occur in this area, then that would be an explanation for the detection of DDT, DDE, and DDD in the samples, overestimating the risk from non-site-related activities.

Interpretation

Based on a residential scenario, the HI (1.0) is equivalent to NMED's target level of 1.0, the carcinogenic risk (2.3×10^{-5}) is above NMED's target risk of 1×10^{-5}, and the total radiological dose (1.3 mrem/yr) is less than DOE's target dose of 15 mrem/yr. The conditions described in the uncertainty analysis indicate that the potential cancer risk and HI for a resident are overestimated and are likely equivalent to, or less than, NMED's target levels. The total dose for a resident is equivalent to a total risk of 6×10^{-6} based on a comparison with EPA's preliminary remediation goals for radionuclides (available online at http://epa-prgs.ornl.gov/radionuclides/). The HI (0.5) for TPH is less than NMED's target level of 1.0 for a resident. The screening assessment indicates that there is no potential unacceptable risk to human health at AOCs 0-004 and 0-033 [combines AOCs 0-033(a and b)] and SWMU 0-030(l).

Ecological Screening Evaluation

The approach for conducting ecological assessments is described in the "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783). The assessment consists of the following four parts: a scoping evaluation, a screening evaluation, an uncertainty analysis, and an interpretation of the results.

The scoping portion of the assessment indicated that terrestrial receptors were appropriate for evaluating the concentrations of contaminants in soil and tuff. Aquatic receptors were not evaluated because there are no aquatic communities in this area. This process evaluated eight terrestrial receptors representing several trophic levels. These receptors included

- a plant,
- soil-dwelling invertebrates (represented by the earthworm),
- the deer mouse (mammalian omnivore),
- the vagrant shrew (mammalian insectivore),
- desert cottontail (mammalian herbivore),
- red fox (mammalian carnivore),
- American robin (avian insectivore, avian omnivore, and avian herbivore), and
- American kestrel (avian invertebrate and carnivore, surrogate for threatened and endangered [T&E] species).

The rationale for these receptors is presented in "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783). Soil ESLs were derived for each of these receptors where information was available. The ESLs were based on similar species and derived from experimentally determined NOAELs, lowest-observed-adverse-effect levels (LOAELs), or lethal doses to 50% of the population (LD_{50}). The derivation of ESLs is based on the approach presented in "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783). All relevant information necessary to calculate HQs and HIs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values, are presented in "Screening Level Ecological Risk Assessments" (LANL 1999, 64783).

Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value to be protected. These endpoints are ecologically relevant and help sustain the natural structure, function, and biodiversity of an ecosystem or its components (EPA 1998, 62809). In a screening-level assessment, assessment endpoints are any adverse effects on ecological receptors, where receptors are populations and communities (EPA 1997, 59370).

The ecological screening assessment is designed to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species or treaty-protected species (EPA 1999, 70086). The protection of individuals within these designated protected species may also be protected at the population level: the populations of these species tend to be small, and the loss of an individual adversely affects the species.

In accordance with this guidance, the Laboratory developed generic assessment endpoints (LANL 1999, 64137) to ensure that values at all levels of ecological organization are considered in the ecological screening process. These general assessment endpoints may be measured by using impacts on reproduction, growth, and survival to represent categories of effects that may adversely impact populations. In addition, specific receptor species were chosen to represent each functional group. The receptor species were chosen based on their presence at the site, their sensitivity to the COPCs, and their potential for exposure to those COPCs. These categories of effects and the chosen receptor species were used to select the types of effects seen in toxicity studies considered in the development of the toxicity reference values (TRVs). Toxicity studies issued in the development of TRVs included only studies in which the adverse effect evaluated affected reproduction, survival, and/or growth.

The selection of receptors and assessment endpoints is designed to be protective of both the representative species used as screening receptors and the other species within their feeding guilds and the overall food web for the terrestrial and aquatic ecosystems. Focusing the assessment endpoints on these general characteristics of species that affect populations (rather than the biochemical and behavioral changes that may affect only the studied species) also ensures the applicability to the ecosystem of concern.

Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening assessment. The ecological scoping checklist, which is included in Appendix F of the VCA completion report (LANL 2003, 87625), is a useful tool for organizing existing ecological information. The information was used to determine whether ecological receptors might be affected, identify the types of receptors that might be present, and develop the ecological site conceptual model.

AOCs 0-004 and 0-033(a,b) and SWMU 0-030(l) include the areas between and behind the 6th Street warehouses. While the buildings themselves and the paved parking area are considered an industrial area, the surrounding top of East Mesa has an almost continuous vegetative cover, numerous shrubs, and a number of mature trees. A number of animal burrows on the site indicate the presence of burrowing animals, such as gophers. Although previous heavy disturbance through bulldozing, excavation, and backfilling at the site has led to the site having the characteristics of disturbed sites undergoing secondary succession, the habitat represents primarily meadow with some ponderosa pine and abundant signs of wildlife use. The proximity to Los Alamos Canyon provides additional opportunities for wildlife to access the site. Potential receptors include plants, soil invertebrates, deer mice, rabbits, gophers, deer, and all types of birds.

The mesa top does not provide an aquatic habitat, and a potential impact to aquatic habitat in Los Alamos Canyon is unlikely because there are no established aquatic communities in the canyon below the area of the AOCs/SWMU. The ephemeral nature of the stream within this section of the canyon prevents aquatic communities from becoming established. Therefore, impacts on aquatic communities are not considered as part of this ecological screening assessment. More detailed information on habitat is presented in the ecological scoping checklist in Appendix F-3.0 of the VCA completion report (LANL 2003, 87625).

Ecological Risk Screening Results

Representative concentrations are determined from samples collected between 0 and 5 ft bgs (LANL 1999, 64783). The tuff was included in the screening assessment because some of the tuff may be crushed tuff, which is easier to burrow into than welded tuff. In addition, some plant roots are able to extend into the tuff, and their root system will break up small sections of the tuff, thereby gradually allowing easier access for ecological receptors.

The data collected at AOC 0-033(a) indicated that TPH was not detected in the top 5 ft; therefore, there is no potential risk to ecological receptors at AOC 0-033(a).

The purpose of the ecological screening evaluation is to identify chemicals of potential ecological concern (COPECs) for the 6th Street Warehouse AOCs/SWMU. The evaluation involves the calculation of HQs for all COPCs and all screening receptors (LANL 1999, 64783). The HQs are the ratios of the representative concentrations (95% UCLs or maximum detected concentration) to the ESLs. The HI is the sum of HQs for chemicals with common toxicological endpoints for a given receptor. COPCs with HQs greater than 0.3 are identified as COPECs and evaluated further. ESLs for terrestrial receptors were obtained from the Laboratory's ECORISK Database, Version 1.5 (LANL 2002, 73702).

Results of the comparison of the representative concentrations with the final ESLs for 6th Street Warehouse AOCs/SWMU are presented in Table 5. Arsenic, copper, lead, mercury, nickel, selenium, and zinc are retained as inorganic COPECs, and acenaphthene; Aroclor-1242; Aroclor-1254; Aroclor-1260; bis(2-ethylhexyl)phthalate; 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; dieldrin; di-n-butylphthalate; endrin; heptachlor; and heptachlor epoxide are retained as organic COPECs.

There are no ESLs for aldrin, isopropyltoluene(4-), and styrene, nor are there appropriate surrogates with ESLs. Therefore, these analytes are retained as COPECs and discussed in the uncertainty section.

The COPECs were evaluated further in Table 6. The HQ for each COPEC/receptor combination, as well as the HIs for each receptor, was calculated. For the purposes of ecological screening, it is assumed that nonradionuclides have common toxicological effects. The HI analysis provides a clearer picture of the potential adverse impacts by determining how many receptors may be affected and provides information on T&E species.

Table 5
Final ESL Comparison for AOCs 0-004 and 0-033(b) and SWMU 0-030(l)

COPEC	95% UCL (mg/kg)	Final Soil ESL (mg/kg)	Receptor for Final ESL	HQ
Inorganic chemicals				
Arsenic	3.02	0.83	shrew	**3.64**
Copper	11.94	10	plant	**1.19**
Lead	39.92	100	shrew	**0.40**
Mercury (total as inorganic)	0.15	0.05	earthworm	**3.0**
Nickel	6.81	1.5	shrew	**4.54**
Selenium	0.41	0.1	plant	**4.10**
Zinc	52.33	0.19	shrew	**275**
Radionuclides				
Americium-241	0.02	44	earthworm	<0.01
Cesium-137	0.45	680	red fox	<0.01
Plutonium-238	0.001	44	earthworm	<0.01
Plutonium-239	0.073	47	earthworm	<0.01
Uranium-234	1.79	51	earthworm	0.03
Uranium-235	0.19	55	earthworm	<0.01
Uranium-238	1.88	55	earthworm	0.03
Organic chemicals				
Acenaphthene	0.17	0.25	plant	**0.68**
Acetone	0.08	3.8	deer mouse	0.02
Anthracene	0.16	220	shrew	<0.01
Aroclor-1242	0.41	0.041	insectivorous robin	**10.0**
Aroclor-1254	0.43	0.022	shrew	**19.54**
Aroclor-1260	0.46	0.44	red fox	**1.05**
Benzene	0.0029	55	deer mouse	<0.01
Benz(a)anthracene	0.19	3	shrew	0.06
Benzo(a)pyrene	0.20	9.6	shrew	0.02
Benzo(b)fluoranthene	0.31	18	plant	0.02
Benzo(g,h,i)perylene	0.16	12	shrew	0.01
Benzo(k)fluoranthene	0.16	62	shrew	<0.01
Benzoic acid	1.07	7.3	deer mouse	0.15
BHC[alpha-][a]	0.02	0.97	shrew	0.02
Bis(2-ethylhexyl)phthalate	0.61	1	insectivorous robin	**0.61**
Butanone[2-]	0.013	1300	deer mouse	<0.01
Butylbenzylphthalate	0.26	340	shrew	<0.01
Chlordane[alpha-]	0.31	2.1	shrew	0.15
Chlordane[gamma-]	0.42	2.1	shrew	0.20

Table 5 (continued)

COPEC	95% UCL (mg/kg)	Final Soil ESL (mg/kg)	Receptor for Final ESL	HQ
Organic chemicals (continued)				
Chrysene	0.21	2.4	shrew	0.09
DDD[4,4'-][b]	0.04	0.0026	insectivorous robin	**15.4**
DDE[4,4'-]	0.23	0.0026	insectivorous robin	**88.5**
DDT[4,4'-]	0.35	0.0026	insectivorous robin	**135**
Di-n-butylphthalate	0.25	0.17	insectivorous robin	**1.47**
Dibenz(a,h)anthracene	0.17	12	shrew	0.01
Dibenzofuran	0.26	6.1	plant	0.04
Dieldrin	0.04	0.04	shrew	**1.00**
Dimethyl Phthalate	0.26	10	earthworm	0.03
Endosulfan II[c]	0.039	0.35	shrew	0.11
Endrin	0.04	0.0034	plant	**11.76**
Fluoranthene	0.30	26	shrew	0.01
Fluorene	0.17	1.7	earthworm	0.10
Heptachlor	0.02	0.059	shrew	**0.34**
Heptachlor Epoxide[d]	0.02	0.059	shrew	**0.34**
Indeno(1,2,3-cd)pyrene	0.18	62	shrew	<0.01
Methoxychlor(4,4'-)	0.20	8.4	shrew	0.02
Phenanthrene	0.20	11	shrew	0.02
Pyrene	0.33	15	shrew	0.02
Toluene	0.002	70	shrew	<0.01
Trichloroethene	0.006	270	shrew	<0.01

Note: Bold = HQ >0.3.

[a] BHC[beta] used as a surrogate compound.

[b] DDE used as a surrogate compound.

[c] Endosulfan used as a surrogate.

[d] Heptachlor used as a surrogate.

Table 6
HI Analysis of COPECs at AOCs 0-004 and 0-033(b) and SWMU 0-030(l)

Analyte	95% UCL (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Inorganic chemicals												
Arsenic	3.02	0.03	<0.01	0.02	0.03	0.09	0.16	0.14	**3.64**	**1.78**	**0.44**	0.30
Copper	11.94	<0.01	0.01	0.06	**0.70**	**0.60**	**0.48**	0.01	0.02	0.02	**0.92**	**1.19**
Lead	39.92	0.01	0.01	0.03	0.13	0.20	0.27	0.04	**0.40**	0.18	0.02	0.08
Mercury (inorganic)	0.15	<0.01	0.01	0.03	0.11	0.17	0.25	<0.01	0.01	0.00	**3.00**	<0.01
Nickel	6.81	0.13	<0.01	<0.01	0.01	0.02	0.02	**0.52**	**4.54**	**1.89**	0.07	**0.34**
Selenium	0.41	<0.01	<0.01	0.05	0.04	0.21	**0.37**	0.01	**0.45**	0.22	0.05	**4.10**
Zinc	52.33	**4.36**	0.01	0.08	0.25	**0.40**	**0.54**	**52.33**	**275.42**	**186.89**	0.15	**5.23**
Organic chemicals												
Acenaphthene	0.17	<0.01	na*	na	na	na	na	<0.01	0.00	0.00	na	**0.68**
Aroclor-1242	0.41	0.14	0.29	**1.58**	**0.93**	**5.47**	**10.00**	0.23	**6.03**	**3.42**	na	na
Aroclor-1254	0.43	**2.87**	**1.95**	**2.53**	**0.31**	**5.38**	**10.49**	0.15	**19.55**	**9.56**	na	0.04
Aroclor-1260	0.46	0.01	0.21	0.26	0.03	**0.53**	**1.05**	<0.01	0.09	0.05	na	na
Bis(2-ethylhexyl)phthalate	0.61	0.01	**0.36**	0.27	0.03	**0.32**	**0.61**	<0.01	0.02	0.01	na	na
DDD[4,4'-]	0.04	0.01	**4.35**	**4.30**	**0.33**	**7.69**	**15.38**	<0.01	0.04	0.02	na	na
DDE[4,4'-]	0.23	0.01	**31.08**	**27.71**	**1.77**	**44.23**	**88.46**	<0.01	0.03	0.02	na	na
DDT[4,4'-]	0.35	0.08	**38.04**	**37.63**	**2.92**	**67.31**	**134.62**	<0.01	**0.35**	0.17	na	na
Di-n-butyl phthalate	0.25	<0.01	0.07	0.23	0.28	**0.86**	**1.47**	<0.01	<0.01	<0.01	na	<0.01
Dieldrin	0.04	0.08	0.04	0.08	0.05	0.25	**0.45**	0.04	**1.00**	**0.51**	na	<0.01
Endrin	0.04	0.01	0.25	**0.58**	**0.47**	**1.90**	**3.64**	0.01	0.21	0.11	na	**11.76**
Heptachlor	0.02	0.06	0.02	0.02	<0.01	0.03	0.07	<0.01	**0.34**	0.18	na	0.05
Heptachlor Epoxide	0.02	0.06	0.02	0.02	<0.01	0.03	0.07	<0.01	**0.34**	0.18	na	0.05
	HI	**7.9**	**76.7**	**75.5**	**8.4**	**136**	**268**	**53.5**	**312**	**205**	**4.7**	**23.8**

Note: Bold = HQ >0.3 or HI >1.
*na = No ESLs available.

According to Table 6, all of the receptors may be potentially impacted by COPECs because they have HIs greater than 1.0.

Uncertainty Analysis

The uncertainty analysis describes the key sources of uncertainty related to the screening assessment. This analysis can result in either adding or removing chemicals from the list of COPECs for the 6th Street Warehouse AOCs/SWMU. This narrative contains a qualitative uncertainty analysis of the issues relevant to evaluating the potential ecological risk for the 6th Street Warehouse AOCs/SWMU.

Chemical Form

The assumptions used in the ESL derivations were conservative and not necessarily representative of actual conditions. These assumptions include maximum chemical bioavailability, maximum receptor ingestion rates, minimum bodyweight, and additive effects of multiple COPECs. Most of these factors tend to result in conservative estimates of the ESLs, which may lead to an overestimation of the potential risk. The assumption of additive effects for multiple COPECs may result in an over- or underestimation of the potential risk to receptors.

The chemical form of the individual COPECs was not determined as part of this investigation. This is largely a limitation on analytical quantitation of individual chemical species. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not likely found in the environment. The inorganic and organic COPECs are generally not 100% bioavailable to receptors in the natural environment because of the adsorption of chemical constituents to matrix surfaces (e.g., soils) or because of rapid oxidation or reduction changes that render harmful chemical forms unavailable to biotic processes. The ESLs were calculated to ensure a conservative indication of potential risk (LANL 1999, 64783) and the values were biased toward overestimating the potential risk to receptors.

Exposure Concentrations

The COPEC concentrations used in the exposure calculations of HQs were the 95% UCLs or the maximum detected concentrations in the soil/tuff to a depth of 5 ft, thereby conservatively estimating the site concentrations of each COPEC. As a result, the exposure of individuals within a population was evaluated using this concentration, which was assumed constant throughout the exposure area. This results in an overestimation of the potential risk because concentrations of COPECs varied across the site and some were infrequently detected.

Background Concentrations

The ecological screening is based on the exposure of ecological receptors to surficial contamination (i.e., to a depth of 5 ft). Table 7 shows the range of soil and tuff background values for inorganic chemicals (LANL 1998, 59730). Based on a comparison of the 95% UCLs and the range of background concentrations, arsenic, copper, mercury, nickel, selenium, and zinc are similar to background concentrations and are eliminated as COPECs.

Table 7
Comparison with Background Concentrations

Inorganic Chemicals	95% UCL (mg/kg)	Soil Background Concentrations (mg/kg)	Tuff Background Concentrations (mg/kg)
Arsenic	3.1	0.3–9.3	0.25–5
Copper	10.8	0.25–16	0.25–6.2
Lead	36.6	2–28	1.6–15.5
Mercury	0.12	0.05–0.1	na*
Nickel	6.86	1–29	0.5–7
Selenium	0.34	0.1–1.7	0.1–0.105
Zinc	54.4	14–75.5	5.5–65.6

*na = Background concentrations not available.

Area Use Factors

In addition to the direct comparison of the 95% UCL or the maximum detected concentration with the ESL, area use factors (AUFs) are used to account for the amount of time that the receptor is likely to spend within the contaminated areas based on the size of the receptor's home range. The AUFs for individual receptors were developed by dividing the size of the area (0.25 ha) of the site by the home range for that receptor. The home range for the Mexican Spotted Owl (T&E species) is 366 ha, and the AUF is 6.8×10^{-4}. Based on the application of the Mexican Spotted Owl AUF to the HI for the kestrel (100% carnivore), there is no potential for ecological risk to the Mexican Spotted Owl (AUF-adjusted HI = 0.06).

Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of T&E species (EPA 1999, 70086). One approach to address the potential effects on populations of the 6th Street Warehouse AOCs/SWMU is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for a receptor is based on the individual receptor home range and its dispersal distance (Bowman et al. 2002, 73475). Bowman et al. (2002, 73475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the home range (i.e., the square root of the home range area). If only the dispersal distances for the mammals with home ranges within the range of the screening receptors are used (Bowman et al. 2002, 73475), the median dispersal distance becomes 3.6 times the square root of the home range (R^2=0.91). If it is assumed that the receptors can disperse the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The area of the 6th Street Warehouse AOCs/SWMU is approximately 0.25 ha. The population area use factors (PAUFs) are estimated by dividing the site area by the population area of each receptor population (Table 8). The resulting PAUF is multiplied by the receptor HI to determine whether there is a potential impact on the population (Table 9).

Table 8
PAUFs

Receptor	Home Range (ha)	Assessment Population Area (40*HR) (ha)	PAUF for 0.25-ha Site
Mexican Spotted Owl	366	n/a[a]	6.8×10^{-4} [b]
American kestrel	106	4240	5.90E-05
American robin	0.42	16.8	0.01
Deer mouse	0.077	3.08	0.08
Vagrant shrew	0.39	15.6	0.02
Desert cottontail	3.1	124	2.02E-03
Red fox	1038	41520	6.02E-06

[a] n/a = Not applicable.

[b] Value for Mexican Spotted Owl is the AUF based on individual home range.

Table 9
HI Analysis Using PAUF for the 6th Street Warehouse AOCs/SWMU

Analyte	95% UCL (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Lead	39.92	0.01	0.01	0.03	0.13	0.20	0.27	0.04	**0.40**	0.18	0.02	0.08
Acenaphthene	0.17	<0.01	na[a]	na	na	na	na	<0.01	0.00	0.00	na	**0.68**
Aroclor-1242	0.41	0.14	0.29	**1.58**	**0.93**	**5.47**	**10.00**	0.23	**6.03**	**3.42**	na	na
Aroclor-1254	0.43	**2.87**	**1.95**	**2.53**	**0.31**	**5.38**	**10.49**	0.15	**19.55**	**9.56**	na	0.04
Aroclor-1260	0.46	0.01	0.21	0.26	0.03	**0.53**	**1.05**	<0.01	0.09	0.05	na	na
Bis(2-ethylhexyl)phthalate	0.61	0.01	**0.36**	0.27	0.03	**0.32**	**0.61**	<0.01	0.02	0.01	na	na
DDD[4,4'-]	0.04	0.01	**4.35**	**4.30**	**0.33**	**7.69**	**15.38**	<0.01	0.04	0.02	na	na
DDE[4,4'-]	0.23	0.01	**31.08**	**27.71**	**1.77**	**44.23**	**88.46**	<0.01	0.03	0.02	na	na
DDT[4,4'-]	0.35	0.08	**38.04**	**37.63**	**2.92**	**67.31**	**134.62**	<0.01	**0.35**	0.17	na	na
Di-n-butyl phthalate	0.25	<0.01	0.07	0.23	0.28	**0.86**	**1.47**	<0.01	<0.01	<0.01	na	<0.01
Dieldrin	0.04	0.08	0.04	0.08	0.05	0.25	**0.45**	0.04	**1.00**	**0.51**	na	<0.01
Endrin	0.04	0.01	0.25	**0.58**	**0.47**	**1.90**	**3.64**	0.01	0.21	0.11	na	**11.76**
Heptachlor	0.02	0.06	0.02	0.02	<0.01	0.03	0.07	<0.01	**0.34**	0.18	na	0.05
Heptachlor Epoxide	0.02	0.06	0.02	0.02	<0.01	0.03	0.07	<0.01	**0.34**	0.18	na	0.05
HI		**3.34**	**76.68**	**75.23**	**7.25**	**134.21**	**266.56**	0.47	**28.40**	**14.40**	0.02	**12.66**
HI Adjusted by PAUF		<0.01	<0.01	<0.01	0.11	**2.0**	**4.0**	<0.01	0.46	**1.2**	n/a[b]	n/a

Note: Bold = HQ >0.3 or HI >1.0.

[a] na = Not available.

[b] n/a = Not applicable.

The HIs are recalculated, minus the inorganic COPECs eliminated because of similarity to background, and adjusted by the PAUFs (Table 9). The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have home ranges. Based on the reassessment, the HIs for the 6th Street Warehouse AOCs/SWMU are <0.01 for the red fox, kestrel, and the cottontail, 0.02 for the earthworm, 0.11 for the herbivorous robin, 2.0 for the omnivorous robin, 4.0 for the insectivorous robin, 0.46 for the shrew, 1.2 for the deer mouse, and 12.7 for the plant (Table 9). The HIs for the red fox, kestrel, herbivorous robin, cottontail, shrew, and earthworm are less than 1.0; therefore, these receptors are not adversely affected by the COPECs.

The HI for the plant may not be a good indicator of risk to receptors at the site because vegetation at the site was abundant and did not appear stressed.

DDE[4,4'-] and DDT[4,4'-]. DDE[4,4'-] and DDT[4,4'-] were detected in 24 of 35 samples and 20 of 35 samples, respectively, and are the primary contributors to the HIs for the robin. An examination of the distribution of 4,4'-DDE and 4,4'-DDT concentrations within the 0.25-ha site shows that detected concentrations represent two subareas. Figure F-2.0-1 in Appendix F of the VCA completion report (LANL 2003, 87625) shows the two subareas. The two subareas were combined (0.014 ha in size) for the following assessment. The maximum detected 4,4'-DDE and 4,4'-DDT concentrations within the subareas were used to generate a hazard quotient adjusted by the PAUF. The maximum detected concentration was used because there were too few sample concentrations to calculate a 95% UCL. The PAUFs are given in Table 10 and the adjusted HQs and HIs are provided in Table 11.

Table 10
PAUFs for Combined Subarea of AOCs 0-004 and 0-033(b) and SWMU 0-030(l)

Receptor	Assessment Population Area (ha)	PAUF for 0.014-ha Site
American robin	16	0.00087
Vagrant shrew	15	0.00093

Table 11
PAUF-Adjusted HIs for Combined Subareas of AOCs 0-004 and 0-033(b) and SWMU 0-030(l)

Receptor	Maximum Concentrations (mg/kg)	Insectivorous Robin Adjusted HQ	Omnivorous Robin Adjusted HQ
4,4'-DDE	1.3	0.44	0.22
4,4'-DDT	1.8	0.60	0.30
	HI for DDT and DDE	**1.0**	**0.52**

The PAUF-adjusted HIs for 4,4'-DDT and 4,4'-DDE for the two subareas combined are less than, or equal to, 1 for the receptors representing both feeding guilds. PAUFs were also developed for the remainder of the sampled area, excluding the two subareas to determine the potential for population-level risk to avian receptors from the residual levels of DDT and DDE outside the two subareas. These PAUFs are presented in Table 12. The 95% UCLs for 4,4'-DDE and 4,4'-DDT were calculated for the larger area. The 95% UCLs and the PAUF-adjusted HIs of 1.7 and 0.84 for the insectivorous robin and the omnivorous robin, respectively, are presented in Table 13. These calculations show hazard indices of less than 2 for 4,4'-DDE and 4,4'-DDT.

Table 12
PAUFs for AOCs 0-004 and 0-033(b) and SWMU 0-030(l), Excluding the Two Subareas

Receptor	Assessment Population Area (ha)	PAUF for 0.24-ha Site
American robin	16	0.015
Vagrant shrew	15	0.016

Table 13
PAUF-Adjusted HQs for AOCs 0-004 and 0-033(b) and SWMU 0-030(l), Excluding the Two Subareas

Receptor	95% UCL (mg/kg)	Insectivorous Robin	Omnivorous Robin
4,4'-DDE	0.09	0.48	0.24
4,4'-DDT	0.21	1.21	0.60
	HI for DDT and DDE	**1.7**	**0.84**

Dourson and Stara (1983, 73474) conducted a study of uncertainty factors incorporated in calculating ESLs for ecological receptors. Based on their study, the LOAEL-to-NOAEL adjustment indicates that HIs

up to 10 may not adversely affect ecological receptors. To maintain conservatism, they state that HIs less than 3 will not adversely affect ecological receptors. Therefore, the summed hazard quotients of 4,4'-DDE and 4,4'-DDT for the area outside of the two smaller areas does not provide a potentially unacceptable risk to avian receptors.

For several organic COPECs (Aroclor-1242; 4,4'-DDD; dieldrin; di-n-butyl phthalate; endrin; heptachlor; heptachlor epoxide), the maximum detected concentration is less than the 95% UCL. If the maximum detected concentration for these organic COPECs is used in the ecological screening assessment, the HQs are less than 0.3 for Aroclor-1242, dieldrin, heptachlor, and heptachlor epoxide. These organic chemicals are eliminated as COPECs. Table 14 shows the remaining COPECs and their respective representative concentration (95% UCL or maximum detected concentration), with the HIs adjusted for PAUF.

Table 14
HI Analysis of Remaining COPECs at the 6th Street Warehouse AOCs/SWMU

Analyte	95% UCL (mg/kg)	Omnivorous Robin	Insectivorous Robin	Shrew	Deer Mouse	Plant
Lead	39.92	0.20	0.27	**0.40**	0.18	0.08
Acenaphthene	0.17	na[a]	na	<0.01	<0.01	**0.68**
Aroclor-1254	0.43	**5.38**	**10.49**	**19.55**	**9.56**	0.04
Aroclor-1260	0.46	**0.53**	**1.05**	0.09	0.05	na
Bis(2-ethylhexyl)phthalate	0.61	**0.32**	**0.61**	0.02	0.01	na
DDD[4,4'-]	0.019[b]	**3.65**	**7.31**	0.02	0.01	na
Di-n-butyl phthalate	0.12[b]	**0.41**	**0.71**	<0.01	<0.01	<0.01
Endrin	0.011[b]	**0.52**	**1.00**	0.06	0.03	**3.24**
HI		**11.0**	**21.4**	**20.1**	**9.8**	**3.9**
HI Adjusted by PAUF[c]		0.16	0.32	0.32	0.79	n/a[d]

Note: Bold = HQ >0.3 or HI >1.0.

[a] na = Not available.

[b] Maximum detected concentration.

[c] PAUFs used are from Table 8.

[d] n/a = Not applicable.

Chemicals without ESLs

Because there are no ESLs available for aldrin, this chemical cannot be assessed quantitatively for potential ecological risk. Aldrin was detected in 4 of 35 samples within 0 to 5 ft bgs, at a maximum concentration of 0.0075 mg/kg. The residential SAL for aldrin is 0.029 mg/kg, resulting in a HQ of 0.25. This chemical was detected infrequently across the site, at trace levels, and has a low HQ based on the residential SAL. Therefore, this chemical does not present a potential ecological risk to receptors at this site.

There are no ESLs available for 4-isopropyltoluene and this chemical cannot be assessed quantitatively for potential ecological risk. Isopropyltoluene[4-] was detected in 6 of 16 samples at concentrations less than 0.0094 mg/kg. If toluene is used as a surrogate, a maximum HQ <0.01 is generated for all receptors,

indicating that 4-isopropyltoluene is not a risk to receptors. Therefore, this chemical does not present a potential ecological risk to receptors at this site.

There are no ESLs available for styrene and this chemical cannot be assessed quantitatively for potential ecological risk. Styrene was detected in 6 of 16 samples within 0 to 5 ft bgs, at a maximum concentration of 0.0027mg/kg. The residential SAL is 1800 mg/kg, which indicates low potential toxicity from this chemical. Therefore, this chemical does not present a potential ecological risk to receptors at this site.

Interpretation

Twenty-six COPECs (including three COPECs without ESLs) were identified based on the ecological screening assessment for AOCs 0-004 and 0-033(b) and SWMU 0-030(l). No COPECs were identified for AOC 0-033(a) because no release was found from 0 to 5 ft bgs and there are no ecological receptors in the area of this AOC. All of the COPECs were eliminated in the uncertainty analysis by considering a number of factors, including background concentrations, field observations on effects at the outfalls, the likely chemical form of the COPECs, and the analysis of the potential effects to populations (individuals for T&E species). The decision criteria were no adverse effects on individuals of T&E species and populations of other receptors. As stated previously, these decision criteria are consistent with EPA guidance on risk management for ecological risk assessments (EPA 1999, 70086).

Screening Assessments for SWMU 21-021-99

Human Health Screening Assessment

The human health screening assessment was performed according to guidance outlined in the draft installation work plan (LANL 2000, 66802) and in the "Human Health Risk-Based Screening Methodology" (LANL 2002, 72639).

Scoping

Current land use at this section of SWMU 21-021-99 is industrial. The expected land use for the foreseeable future is also industrial. The potential for human exposure to residual concentrations of chemicals and radionuclides in the environment at the site is currently low.

Although a residential scenario is unlikely under current and projected future site conditions, the potential present-day risks were evaluated using this scenario because it is protective of human health. The SALs used in the screening evaluation reflect a residential scenario that is based on an exposure of 24 hr/day and 350 days/yr.

Screening Evaluation

The representative concentration used in this screening assessment was the 95% UCL of the mean, or the maximum detected concentration (see Appendix F of the VCA completion report [LANL 2003, 87625]). The 95% UCL (calculated by EPA's ProUCL 3.0 software [EPA 2004, 90033]) was determined by using all available data from both soil and tuff.

A total of 15 COPCs were identified in this section of SWMU 21-021-99 based on the data review. These COPCs are evaluated further here by comparing the representative concentration with the appropriate SAL for each chemical. The chemical SALs are calculated based on the methodology provided in Appendix C of the draft installation work plan (LANL 2000, 66802) and in the "Human Health Risk-Based

Screening Methodology" (LANL 2002, 72639), and they are based on guidance from NMED (NMED 2000, 68554) and EPA Region 6 (EPA 2002, 73691). For radionuclides, the SALs are derived according to LANL's "Derivation and Use of Radionuclide Screening Action Levels" (LANL 2001, 69683) using RESRAD Version 6.21 (LANL 2002, 73705). The SALs for noncarcinogens are based on an HQ of 1.0. SALs for radionuclides are based on a dose of 15 mrem/yr.

Calcium does not have a published toxicity value but is among those elements identified in Section 5.9.4 of the Risk Assessment Guidance for Superfund (RAGS) (EPA 1989, 08021) as an essential macronutrient. Following the guidance in RAGS, the maximum value of calcium in the samples is 9860 mg/kg, which is less than twice the background value (BV) of 6120 mg/kg. Therefore, calcium is not expected to result in adverse health effects and is not discussed further.

The representative concentrations of noncarcinogenic COPCs were all less than their respective SALs. The HI (the sum of the ratios of representative concentration divided by the SAL) is approximately 0.23 (Table 15), which is less than NMED's target HI of 1.0 (NMED 2000, 68554). This indicates that a human health hazard is not expected from residual concentrations of noncarcinogenic COPCs in this section of SWMU 21-021-99.

Table 15
Calculation of HI for
Noncarcinogenic COPCs at SWMU 21-021-99

Chemical	95% UCL (mg/kg)	Residential SAL[a] (mg/kg)	HQ
Cadmium	0.49	70	0.01
Copper	150.61	2800	0.05
Lead	42.02	400	0.11
Lithium	23.1	1600[b]	0.01
Mercury	0.078	23	0.003
Silver	4.08	380	0.01
Strontium	76.5	37000	0.002
Uranium	7.77	230	0.03
Zinc	82.48	23000	0.004
		HI	**0.23**

[a] Values from NMED 2000, 68554.

[b] Value from EPA Region 6 (EPA 2002, 73691).

No carcinogenic COPCs were identified in the data review (LANL 2003, 87625).

The 95% UCLs for radionuclide COPCs were less than their respective SALs. The total estimated radionuclide dose is approximately 3.0 mrem/yr (Table 16), which is less than DOE's target dose of 15 mrem/yr (LANL 2000, 67489). This site does not pose an unacceptable dose to human health.

Table 16
Calculation of Radionuclide Dose at SWMU 21-021-99

Chemical	95% UCL (pCi/g)	Residential SAL[a] (pCi/g)	Dose (mrem/yr)
Americium-241	0.027	39	0.01
Cesium-137	0.92	5.3	2.60
Plutonium-238	0.0075	49	0.002
Plutonium-239	0.74	44	0.25
Tritium[b]	1.75	890	0.03
Uranium-235	0.084	17	0.07
		Total Dose	**3.0**

[a] Values from LANL 2001, 69683.
[b] Maximum value.

Uncertainty Analysis

The analysis presented in this human health screening assessment is subject to varying degrees and kinds of uncertainty. The uncertainties associated with the data evaluation, exposure assessment, toxicity assessment, and the additive approach may affect the results.

Data evaluation and COPC identification process. Uncertainties associated with the data can include sampling errors, laboratory analysis errors, and data analysis errors. For this site, these uncertainties are expected to have no effect on the results even though the detected concentrations of some organic COPCs were qualified J, indicating the values were less than EQLs.

The representative concentrations for all noncarcinogens were less than their respective SALs and less than 0.1 SAL, with the exception of lead. The representative concentration of lead (42 mg/kg) is less than the SAL of 400 mg/kg and only slightly higher than 0.1 SAL (40 mg/kg). Therefore, blood lead levels are less than 10 µg/dL from exposure at this site.

Exposure assessment. Uncertainties were identified in the following three areas of the exposure assessment process:

- *Identification of receptors.* Land-use and activity patterns are not represented by those activities assumed by the residential land-use scenario; therefore, uncertainties are introduced. Because the potentially exposed individual is an industrial worker, the screening assessment overestimates the exposure and subsequently overestimates the potential hazard, risk, and dose. In the event the site becomes commercial, recreational, or residential, then the risk to human health has been evaluated using the most conservative assumptions.

- *Exposure pathway assumptions.* For each exposure pathway, assumptions are made concerning the parameters, the routes of exposure, the amount of contaminated media to which an individual can be exposed, and the intake rates of different routes of exposure. In the absence of site-specific data, the assumptions used are consistent with EPA-approved parameters and default values (EPA 2002, 73691). When several upper-bound values are combined to estimate

exposure for any one pathway, the resulting risks can be in excess of the 99th percentile and therefore outside the range of what may be reasonably expected.

- *Derivation of representative concentrations.* The maximum detected concentration used for comparison with the tritium SAL leads to an overestimation of the exposure across the entire site for tritium. It also results in an overestimation of the potential risk to human health. The use of the 95% UCL may also lead to an overestimation of the exposure as a result of some elevated detection limits for inorganic chemicals.

Toxicity values. The primary uncertainty associated with the SALs is related to the derivation of toxicity values used in the calculation. EPA toxicity values (RfDs and SFs) were used to derive the nonradiological SALs in this risk screening assessment (EPA 2001, 70109; EPA 1997, 58968). Uncertainties were identified in the following three areas with respect to the toxicity values:

- *Extrapolation from other animals to humans.* The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist in chemical absorption, metabolism, excretion, and toxic response between such animals and humans. EPA takes into account differences in body weight, surface area, and pharmacokinetic relationships between the animals and humans to minimize the potential to underestimate the dose-response relationship. However, more conservatism is usually incorporated into these steps.

- *Extrapolation from one route of exposure to another route of exposure.* The SFs and RfDs can often contain extrapolations from one route of exposure to another. The extrapolation from the oral route to the inhalation and/or the dermal route is used and is based on EPA's IRIS database (EPA 2001, 70109). Differences between the two exposure pathways could result in an overestimation of the risk.

- *Interindividual variability in the human population.* For noncarcinogenic effects, the amount of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the NOAEL. The NOAEL/uncertainty-factor approach incorporates a 10-fold factor to reflect the possible interindividual variability in the human population and is generally considered a conservative estimate.

Additive approach. For noncarcinogens, the effects of a mixture of chemicals are generally unknown and possible interactions could be synergistic or antagonistic, thereby overestimating or underestimating the risk. Additionally, the RfDs for different chemicals are not based on the same severity, effect, or target organ. Therefore, the potential for the occurrence of noncarcinogenic effects can be overestimated for chemicals that act by different mechanisms and on different target organs but are addressed additively.

Interpretation

Based on a residential scenario, the HI (0.23) is less than NMED's target level of 1.0, there is no carcinogenic risk, and the radiological dose (3.0 mrem/yr) is less than DOE's target dose of 15 mrem/yr. The total dose for a resident is equivalent to a total risk of 1.6×10^{-5} based on a comparison with EPA's preliminary remediation goals for radionuclides (http://epa-prgs.ornl.gov/radionuclides/). The results indicate that there is no potential unacceptable risk to human health at this site.

Ecological Screening Evaluation

The approach for conducting ecological assessments is described in the "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783). The assessment consists of the following four parts: a scoping evaluation, a screening evaluation, an uncertainty analysis, and an interpretation of the results.

The scoping portion of the assessment indicated that terrestrial receptors were appropriate for evaluating the concentrations of contaminants in soil and tuff. Aquatic receptors were not evaluated because there are no aquatic communities in this area. This process evaluated eight terrestrial receptors representing several trophic levels. These receptors included

- a plant,
- soil-dwelling invertebrates (represented by the earthworm),
- the deer mouse (mammalian omnivore),
- the vagrant shrew (mammalian insectivore),
- desert cottontail (mammalian herbivore),
- red fox (mammalian carnivore),
- American robin (avian insectivore, avian omnivore, and avian herbivore), and
- American kestrel (avian invertebrate and carnivore, surrogate for T&E species).

The rationale for these receptors is presented in "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783). Soil ESLs were derived for each of these receptors where information was available. The ESLs were based on similar species and derived from experimentally determined NOAELs, LOAELs, or doses lethal to 50% of the population (LD_{50}). The derivation of ESLs is based on the approach presented in "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783). All relevant information necessary to calculate HQs and HIs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values, are presented in "Screening Level Ecological Risk Assessments" (LANL 1999, 64783).

Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value to be protected. These endpoints are ecologically relevant and help sustain the natural structure, function, and biodiversity of an ecosystem or its components (EPA 1998, 62809). In a screening-level assessment, assessment endpoints are any adverse effects on ecological receptors, where receptors are populations and communities (EPA 1997, 59370).

The ecological screening assessment is designed to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species or treaty-protected species (EPA 1999, 70086). The protection of individuals within these designated protected species may also be protected at the population level: the populations of these species tend to be small, and the loss of an individual adversely affects the species.

In accordance with this guidance, the Laboratory developed generic assessment endpoints (LANL 1999, 64137) to ensure that values at all levels of ecological organization are considered in the ecological screening process. These general assessment endpoints may be measured by using impacts on reproduction, growth, and survival to represent categories of effects that may adversely impact populations. In addition, specific receptor species were chosen to represent each functional group. The receptor species were chosen based on their presence at the site, their sensitivity to the COPCs, and

their potential for exposure to those COPCs. These categories of effects and the chosen receptor species were used to select the types of effects seen in toxicity studies considered in the development of the TRVs. Toxicity studies issued in the development of TRVs included only studies in which the adverse effect evaluated affected reproduction, survival, and/or growth.

The selection of receptors and assessment endpoints is designed to be protective of both the representative species used as screening receptors and the other species within their feeding guilds and the overall food web for the terrestrial and aquatic ecosystems. Focusing the assessment endpoints on these general characteristics of species that affect populations (rather than the biochemical and behavioral changes that may affect only the studied species) also ensures the applicability to the ecosystem of concern.

Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening assessment. The ecological scoping checklist, which is included in Appendix F of the VCA completion report (LANL 2003, 87625), is a useful tool for organizing existing ecological information. The information was used to determine whether ecological receptors might be affected, identify the types of receptors that might be present, and develop the ecological site conceptual model.

The portion of SWMU 21-021-99 included in this report has an almost continuous vegetative cover, numerous shrubs, and a number of mature trees. A number of animal burrows on the site indicate the presence of burrowing animals, such as gophers. Although heavy disturbance previously occurred near the site, this habitat represents a mixed cover with grassland areas, ponderosa pine, piñon, and juniper trees and abundant signs of wildlife use. The proximity to Los Alamos Canyon provides additional opportunities for wildlife to access the site. Potential receptors include plants, soil invertebrates, deer mice, rabbits, gophers, deer, and all types of birds. Based on a comparison of the SWMU location with Geographical Information System (GIS)-based habitat databases, the Mexican Spotted Owl (T&E species) may forage with high frequency in the area, though SWMU 21-021-99 does not lie within the potential nesting habitat for the species (LANL 2001, 76092). The kestrel screening receptor with an all-flesh diet serves as the surrogate for avian T&E receptors in the screening calculations.

The mesa top does not provide an aquatic habitat, and a potential impact to aquatic habitat in Los Alamos Canyon is unlikely considering the distance from the mesa top to the ephemeral stream in the canyon. As a result, impacts on aquatic communities are not considered as part of this ecological screening assessment.

This area of the mesa top was not a Laboratory-process area. However, historical releases from stacks at Technical Area 21 could potentially have been deposited on the surface soil in this area. For ecological risk screening, the primary impacted media is the surface soil. The primary exposure pathways through which wildlife receptors could potentially contact this contamination are ingestion of soil and ingestion through the food chain. Burrowing animals could also be exposed through dust inhalation while digging. ESLs do not include exposure to particulates in air, nor do they account for exposure through dermal contact.

Ecological Risk Screening Results

Representative concentrations are determined from samples collected between 0 and 5 ft bgs (LANL 1999, 64783). The tuff was included in the screening assessment because some of the tuff may be crushed tuff, which is easier to burrow into than welded tuff. In addition, some plant roots are able to

extend into the tuff, and their root system will break up small sections of the tuff, thereby gradually allowing easier access for ecological receptors.

The purpose of the ecological screening evaluation is to identify COPECs for SWMU 21-021-99. The evaluation involves the calculation of HQs for all COPCs and all screening receptors (LANL 1999, 64783). The HQs are the ratios of the representative concentrations (95% UCLs or maximum detected concentration) to the ESLs. The HI is the sum of HQs for chemicals with common toxicological endpoints for a given receptor. COPCs with HQs greater than 0.3 are identified as COPECs and are evaluated further. ESLs for terrestrial receptors were obtained from the Laboratory's ECORISK Database, Version 1.5 (LANL 2002, 73702).

Results of the comparison of the representative concentrations with the final ESLs for SWMU 21-021-99 are presented in Table 17. Cadmium, copper, lead, mercury, silver, strontium, and zinc are retained as inorganic COPECs.

Table 17
Final ESL Comparison at SWMU 21-021-99

COPEC	95% UCL (mg/kg)	Final Soil ESL (mg/kg)	Receptor for Final ESL	HQ
Inorganic chemicals				
Cadmium	0.49	0.67	shrew	**0.73**
Copper	150.6	10	plant	**15.06**
Lead	42	16	insectivorous robin	**2.63**
Mercury (inorganic)	0.078	0.05	earthworm	**1.56**
Silver	4.08	0.05	plant	**81.60**
Strontium (stable)	58.23	71.0	deer mouse	**0.82**
Uranium	7.35	25	plant	0.29
Zinc	82.48	10	plant	**8.25**
Radionuclides				
Americium-241	0.027	44	earthworm	<0.01
Cesium-137	0.92	680	red fox	<0.01
Plutonium-238	0.0075	44	earthworm	<0.01
Plutonium-239	0.74	47.0	earthworm	0.01
Tritium	1*	36000	plant	<0.01
Uranium-235	0.084	55	earthworm	<0.01

Note: Bold = HQ >0.3.
*Converted from 8.1 pCi/mL assuming 10% soil moisture.

There are no ESLs for lithium; this analyte is retained as a COPEC and discussed in the uncertainty section.

The COPECs were evaluated further in Table 18. The HQ for each COPEC/receptor combination, as well as the HI for each receptor, was calculated. For the purposes of ecological screening, it is assumed that nonradionuclides have common toxicological effects. The HI analysis provides a clearer picture of potential adverse impacts by determining how many receptors may be affected and provides information on T&E species.

According to Table 18, all of the receptors, except the carnivorous kestrel (surrogate for the Mexican Spotted Owl), may be potentially impacted by COPECs because they have HIs greater than 1.0.

Table 18
HI Analysis of COPECs at SWMU 21-021-99

Analyte	95% UCL (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Cadmium	0.49	0.12	0.07	**9.25**	**5.27**	**37.69**	**65.33**	**3.27**	**104.26**	**53.85**	0.05	**0.49**
Copper	150.6	0.01	0.11	**0.72**	**8.86**	**7.53**	**6.02**	0.16	0.29	0.28	**11.58**	**15.06**
Lead	42	0.01	0.01	0.03	0.14	0.21	0.28	0.05	**0.42**	0.19	0.02	0.08
Mercury	0.078	<0.01	0.01	0.02	0.06	0.09	0.13	<0.01	<0.01	<0.01	**1.56**	<0.01
Silver	4.08	<0.01	<0.01	0.04	0.14	0.21	0.29	0.01	0.05	0.03	na*	**81.60**
Strontium	58.23	<0.01	na	na	na	na	na	**0.53**	**0.53**	**0.82**	na	**na**
Zinc	82.48	**6.87**	0.02	0.12	**0.39**	**0.63**	**0.85**	**82.48**	**434.11**	**294.57**	0.24	**8.25**
HI		**7.0**	0.21	**10.2**	**14.9**	**46.4**	**72.9**	**86.5**	**540**	**350**	**13.5**	**105**

Note: Bold = HQ >0.3 or HI >1.0.
*na = No ESL available.

Uncertainty Analysis

The uncertainty analysis describes the key sources of uncertainty related to the screening assessment. This analysis can result in either adding or removing chemicals from the list of COPECs for SWMU 21-021-99. This narrative contains a qualitative uncertainty analysis of the issues relevant to evaluating the potential ecological risk for SWMU 21-021-99.

Chemical Form

The assumptions used in the ESL derivations were conservative and not necessarily representative of actual conditions. These assumptions include maximum chemical bioavailability, maximum receptor ingestion rates, minimum bodyweight, and additive effects of multiple COPECs. Most of these factors tend to result in conservative estimates of the ESLs, which may lead to an overestimation of the potential risk. The assumption of additive effects for multiple COPECs may result in an over- or underestimation of the potential risk to receptors.

The chemical form of the individual COPECs was not determined as part of this investigation. This is largely a limitation on analytical quantitation of individual chemical species. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not likely found in the environment. The inorganic COPECs are generally not 100% bioavailable to receptors in the natural environment because of the adsorption of chemical constituents to matrix surfaces (e.g., soils) or because of rapid oxidation or reduction changes that render harmful chemical forms unavailable to biotic processes. The ESLs were calculated to ensure a conservative indication of potential risk (LANL 1999, 64783) and the values were biased toward overestimating the potential risk to receptors.

Exposure Concentrations

The COPEC concentrations used in the exposure calculations of HQs were the 95% UCLs or the maximum detected concentrations in the soil/tuff, thereby conservatively estimating the site concentrations of each COPEC. As a result, the exposure of individuals within a population was evaluated using this concentration, which was assumed constant throughout the exposure area. This results in an overestimation of the potential risk because concentrations of COPECs varied across the site and some were infrequently detected.

Background Concentrations

The ecological screening is based on the exposure of ecological receptors to surficial contamination. Table 19 shows the range of soil and tuff background values for inorganic chemicals (LANL 1998, 59730). Based on a comparison of the 95% UCLs and the range of background concentrations, cadmium, mercury, and zinc are similar to background concentrations and are eliminated as COPECs.

Table 19
Comparison with Background Concentrations

Inorganic Chemicals	95% UCL (mg/kg)	Soil Background Concentrations (mg/kg)	Tuff Background Concentrations (mg/kg)
Cadmium	0.49	0.2–2.6	0.1–1.5
Copper	150.6	0.25–16	0.25–6.2
Lead	42	2–28	1.6–15.5
Mercury	0.078	0.05–0.1	na*
Silver	4.08	na	0.2–1.9
Strontium	58.23	na	na
Zinc	82.48	14–75.5	5.5–65.6

*na = Background concentrations not available.

Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of T&E species (EPA 1999, 70086). One approach to address the potential effects on the populations of SWMU 21-021-99 is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for a receptor is based on the individual receptor home range and its dispersal distance (Bowman et al. 2002, 73475). Bowman et al. (2002, 73475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the home range (i.e., the square root of the home range area). If only the dispersal distances for the mammals with home ranges within the range of the screening receptors are used (Bowman et al. 2002, 73475), the median dispersal distance becomes 3.6 times the square root of the home range ($R^2 = 0.91$). If it is assumed that the receptors can disperse the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The area of SWMU 21-021-99 being evaluated is approximately 9.84 ha. The PAUFs are estimated by dividing the SWMU area by the population area of each receptor population (Table 20). The resulting factor is multiplied by the receptor HI to determine if there is a potential impact on the population.

Table 20
PAUFs

Receptor	Home Range (ha)	Assessment Population Area (40*HR) (ha)	PAUF for 9.84-ha Site
American kestrel	106	4240	2.32E-03
American robin	0.42	16.8	0.59
Deer mouse	0.077	3.08	1
Vagrant shrew	0.39	15.6	0.63
Desert cottontail	3.1	124	7.94E-02
Red fox	1038	41520	2.37E-04

The HIs are recalculated, minus the inorganic COPECs eliminated because of similarity to background, and adjusted by the PAUFs (Table 21). The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have home ranges. The HI for the deer mouse is not adjusted because the population area for the deer mouse is smaller than the area of SWMU 21-021-99. Based on the reassessment, the adjusted HIs for SWMU 21-021-99 are <0.01 for the red fox and the kestrel, 5.4 for the herbivorous robin, 4.7 for the omnivorous robin, 3.9 for the insectivorous robin, 0.06 for the cottontail, 0.8 for the shrew, and 1.3 for the deer mouse (Table 20). The HIs for the red fox, kestrel, cottontail, and shrew are less than 1.0; therefore, these receptors are not adversely affected by the COPECs.

Table 21
HI Analysis Using PAUFs for SWMU 21-021-99

Analyte	95% UCL (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Copper	150.6	0.01	0.11	**0.72**	**8.86**	**7.53**	**6.02**	0.16	0.29	0.28	**11.58**	**15.06**
Lead	42	0.01	0.01	0.03	0.14	0.21	0.28	0.05	**0.42**	0.19	0.02	0.08
Silver	4.08	<0.01	<0.01	0.04	0.14	0.21	0.29	0.01	0.05	0.03	na[a]	**81.60**
Strontium	58.23	<0.01	na	na	na	na	na	**0.53**	**0.53**	**0.82**	na	na
HI		**0.01**	0.11	0.79	**9.1**	**8.0**	**6.6**	**0.74**	**1.3**	**1.3**	**11.6**	**96.7**
HI Adjusted by PAUF		<0.01	<0.01	<0.01	**5.4**	**4.7**	**3.9**	0.06	0.81	n/a[b]	n/a	n/a

Note: Bold = HQ >0.3 or HI >1.0.

[a] na = Not available.

[b] n/a = Not applicable.

COPECs Contributing to PAUF-Adjusted HIs Greater Than 1

The use of the PAUF does not take into account a few high concentrations at some of the sampling locations but assumes that the COPECs are distributed uniformly across the site. COPECs detected once or only in a few locations are unlikely to impact a receptor population.

Copper. Copper had one detected concentration of 3430 mg/kg, but was detected at less than 64 mg/kg across the rest of the site. The 95% UCL for copper with the value of 3430 mg/kg is 150.6 mg/kg, and without this concentration is 13.42 mg/kg. This concentration (3430 mg/kg) of copper was detected at only one location (00-02-19713) at a depth of 0.5–1.0 ft. The sample collected above this depth (0–0.08 ft) indicated a concentration of copper at 63.3 mg/kg, and the sample collected below (2–2.5 ft) indicated a concentration of copper of 8.17 mg/kg. The maximum copper concentration is therefore not representative of exposure and risk across the site. Using the 95% UCL of 13.42 reduces the HQs to 0.79 for the herbivorous robin, 0.67 for the omnivorous robin, 0.54 for the insectivorous robin, 0.03 for the deer mouse, 1.03 for the earthworm, and 1.3 for the plant. This concentration is also similar to background concentrations for copper.

Lead. The 95% UCL for lead is affected by one sample with a concentration of 290 mg/kg; the rest of the samples detected lead at concentrations less than half of the 290 mg/kg concentration. The 95% UCL for lead generated an HQ for the shrew of 0.42, but the shrew was eliminated as a receptor because its PAUF-adjusted HI was less than 1.0. Therefore, lead is eliminated as a COPEC.

Silver. The 95% UCL for silver (4.08 mg/kg) generates an HQ of 81.6 for the plant and HQs less than 0.3 for the other receptors. The plant ESL may not be a good indicator of risk to the receptors at the site for silver because vegetation at the site is abundant and does not appear stressed. Therefore, silver is eliminated as a COPEC.

Table 22 shows the remaining COPECs (copper and strontium) and receptors with the HI adjusted for PAUF. The revised representative concentration is used for copper in Table 22. The robin and the deer mouse have HIs less than 1.0, while the earthworm and the plant have HIs of approximately 1.0 (HI = 1.03 for the earthworm and 1.3 for the plant). The HI for the plant may not be a good indicator of risk to receptors at the site because the vegetation at the site was abundant and did not appear stressed.

Table 22
HI Analysis of Remaining COPECs at SWMU 21-021-99

Analyte	95% UCL (mg/kg)	Herbivorous Robin	Omnivorous Robin	Insectivorous Robin	Deer Mouse	Earthworm	Plant
Copper	13.42	**0.79**	**0.67**	**0.54**	0.03	**1.03**	**1.34**
Strontium	58.23	na[a]	na	na	**0.82**	na	**na**
HI		0.79	0.67	0.54	0.85	1.0	**1.3**
HI Adjusted by PAUF		0.46	0.39	0.32	n/a[b]	n/a	n/a

Note: Bold = HQ >0.3 or HI >1.0.

[a] na = Not available.

[b] n/a = Not applicable.

There are no ESLs for lithium; this chemical cannot be assessed quantitatively for potential ecological risk. Lithium was detected in 24 of 61 samples within 0 to 5 ft bgs at concentrations less than 27 mg/kg. The EPA Region 6 residential SAL is 1600 mg/kg, which indicates relatively low potential toxicity from this chemical. Therefore, this chemical does not pose a potential ecological risk to receptors at the site.

Interpretation

Based on the ecological screening assessment for SWMU 21-021-99, nine COPECs (including one COPEC without an ESL) were identified. All of these COPECs, except copper and strontium, were eliminated in the uncertainty analysis by considering a number of factors, including background concentrations, the analysis of the potential effects to populations (individuals for T&E species), and the relative toxicity of related compounds. Although copper and strontium were not eliminated as COPECs, they do not pose a potential risk to ecological receptors at SWMU 21-021-99 based on further analysis.

NMED Comment

2. *While[,] the Permittees calculated the total dose from radionuclides for part of SWMU 21-021-99, the Permittees must calculate and report total risk from radionuclides as well as dose in accordance with the letter from Everet Beckner to Ron Curry regarding radionuclide data.*

LANL Response #2

The total dose for a resident is equivalent to a total risk of 1.6×10^{-5} based on a comparison with EPA's preliminary remediation goals (http://epa-prgs.ornl.gov/radionuclides/).

NMED Comment

3. *The Permittees have requested a no further action (NFA) determination from NMED for SWMU 0-033(a) (part of SWMU 0-033). The data from the underground storage tank removal and the contaminated underlying tuff revealed total petroleum hydrocarbon (TPH) contamination to 35 feet (as reported in the 45-day report). Residual contamination remains at a depth of 11 feet following tank and soil removal. In order to grant a NFA determination for SWMU 0-033 (including AOC 0-033(b), NMED must assess the human health risk for this site given the remaining contamination. The Permittees must include the TPH data in a revised human health risk assessment (residential and construction worker scenarios). The Permittees must also resubmit "Enclosure Five" of the 45-day report because the logs are illegible.*

LANL Response #3

As described in the 45-day report (LANL 1996, 56101), the contents of the UST was heating fuel oil. The samples were analyzed for TPH in LANL's CST-12 mobile analytical laboratory, and these results are shown in Tables 2, 3, 4, 5, and 6 in the 45-day report (LANL 1996, 56101, pp. 3–7). The components of TPH were not analyzed. Following the guidance from NMED (NMED 2003, 89372), the residential direct exposure and industrial direct exposure values for #3 and #6 fuel oil were used in the human health screening assessment. A construction-worker scenario was not evaluated because the NMED guidance does not provide screening guidelines for a construction worker; instead, an industrial scenario was assessed. The screening assessment is included as part of LANL Response #1.

The 45-day report is resubmitted as Attachment 2.

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Attachment 1

Analytical Results (on attached CD)

Attachment 2

Forty-Five-Day Report for Fuel Oil UST Release at Technical Area 0, 6th Street

Los Alamos
NATIONAL LABORATORY

Hazardous & Solid Waste Group
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Date: January 11, 1996
In Reply Refer To: ESH-19:96-0015
Mail Stop: K498
Telephone: (505) 665-2505

Anthony Moreland, Geologist
Remedial Action Section
Underground Storage Tank Bureau
New Mexico Environment Department
1190 St. Francis Drive
Harold Runnels Building
Santa Fe, New Mexico 87502

Dear Mr. Moreland:

SUBJECT: FORTY-FIVE DAY REPORT FOR FUEL OIL UST RELEASE AT TECHNICAL AREA 0, 6TH STREET

This letter transmits a forty-five day investigation report involving petroleum soil contamination associated with an underground storage tank (UST) located at Technical Area (TA) 0, 6th Street, near Warehouse Number Three. On November 13, 1995, the New Mexico Environment Department was notified that heating fuel oil contamination was discovered in the soil beneath the UST during a routine UST removal. The UST is owned by the Department of Energy.

The enclosed forty-five day investigation report and its associated enclosures will show that Los Alamos National Laboratory has determined the extent of the fuel oil contaminated soil at the TA-0, 6th Street UST site. If you have questions concerning this report, please contact me at (505) 665-2505.

The foregoing report was prepared under my supervision by qualified staff who are personally familiar with the information submitted in the report and the enclosed documents.

Sincerely,

Jeff Carmichael
Hazardous & Solid Waste

JAC:es

Enclosure: UST TA-0, 6th, Street Forty-Five Day Report

Cy: T. Grieggs, ESH-19, MS K498, w/o enc.
L. Hartman, EM/ER, MS E525, w/enc.
T. Taylor, LAAO, MS A316, w/enc.
RPF, EM/ER, MS M707, w/enc.
ESH-19 Circ File
C. Fesmire, LAAO, MS A316, w/enc.
J. Vozella, LAAO, MS A316, w/enc.
S. Calhoun, ERM/Golder, MS M327. w/enc.
CIC-10, MS A150

Los Alamos
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Hazardous & Solid Waste Group
Los Alamos National Laboratory
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UNDERGROUND STORAGE TANK

TA-0, 6TH STREET

FORTY-FIVE DAY REPORT

1.0 INTRODUCTION

The purpose of this report is to fulfill the forty-five day reporting requirements of Part XII, Section 1206 B., of the New Mexico Underground Storage Tank Regulations (USTR). Under this regulation, the forty-five day report was due on January 4, 1995. However, an extension of time was granted to January 11, 1996.

On November 13, 1995, Los Alamos National Laboratory (LANL) notified the New Mexico Environment Department (NMED) of a confirmed petroleum release. The release was discovered during a scheduled underground storage tank (UST) removal located at LANL's Technical Area (TA) 0. See *Enclosure One* for maps of LANL's property boundary, Technical Areas, and of the UST site. The UST is owned by the Department of Energy and was taken out of operation in the late 1960's. This UST was discovered by LANL's Environmental Management/Environmental Restoration Project. Listed below is a data summary regarding this UST and its removal:

UST DATA

• Name of UST	TA-0, 6th Street
• Physical Location of UST:	TA-0, North West Side of Warehouse # 3
• Age of UST:	Unknown
• UST Capacity:	5,000 Gallons
• Contents of UST:	Heating Fuel Oil
• Date Removed:	11-13-95
• NMED Inspector Present:	None

A visual inspection of the UST revealed one hole, approximately 2 inches in diameter, in the lower west end of the tank. The soil surrounding and beneath the UST was contaminated with fuel oil, but not highly contaminated. Soil samples collected beneath the UST have total petroleum hydrocarbons (TPH) concentrations ranging from approximately 3,000 to 10,800 mg/kg (ppm).

The excavation was backfilled with clean fill material to avoid structural damage to the adjacent warehouse foundation. Pursuant to Part XII, Section 1206 (B.), of the USTR, five boreholes were drilled and sampled. Analytical data from these boreholes was sufficient to define both the horizontal and vertical extent of the TPH affected area.

2.0 UST REMOVAL DETAILS

Excavation support during the UST removal was provided by Keers Environmental of Albuquerque, New Mexico. Oversight of the operations was provided by the Morrison Knudsen Corporation of Los Alamos, New Mexico, ERM/Golder Los Alamos Project Team, and LANL's Hazardous and Solid Waste Group (ESH-19).

An initial inspection found the UST to contain approximately 3,500 gallons of water and fuel oil, with approximately one foot of fuel oil floating on top of the water. These liquids were pumped out of the tank prior to commencing excavation activities and transported to Mesa Oil, Inc. for recycling *(See Manifest in Enclosure Two)*.

A visual inspection of the UST revealed one hole, approximately 2 inches in diameter, in the lower west end of the tank. The piping associated with this tank, rose straight up from the tank approximately 18 inches, then made a 90 degree turn south, and penetrated the wall of the adjacent warehouse. The total length of pipe was approximately 15 feet. The UST's piping condition was only slightly corroded except for where the fill pipe attached to the UST. This area had significant corrosion. Furthermore, the fill pipe was found loose where it connected to the tank. It is speculated that surface water from rain events collected on the ground above the UST and over time penetrated into the UST through the loose fill pipe connection filling the tank.

A sufficient amount of tank pit backfill material was excavated to remove the tank and piping. The backfill material was obviously contaminated with fuel oil. Therefore, the remaining backfill material and concrete cradles on which the tank was resting were removed, and the tuff below the tank was excavated to a depth of approximately 11 feet. This tuff removal was voluntary because the tuff was not highly contaminated. The excavation was eventually stopped because of potential structural damage to the warehouse foundation to the south and the concrete utility corridor to the west. The final excavation was approximately 15 feet wide, 30 feet long, and 11 feet deep.

The UST and the concrete cradles were transported off-site by Keers. The UST was shipped to Eidson Steel Products, Inc. for recycling. The concrete cradles were disposed of by Keers. The excavated soil, totaling 55 cubic yards, was transported to Keers Solid Waste Management Facility located in Mountainair, New Mexico, for hydrocarbon soil farming. See *Enclosure Two* for copies of the disposal manifests.

During removal, an underground power line, was encountered above the UST and was temporarily rerouted during construction activities. An underground electric line also runs east-west about 15 feet north of the UST location at a depth of approximately 4 feet. Also, a north-south running sewer line is located about 6 feet west of the UST excavation at a depth of approximately five feet. A concrete encased utility corridor runs north-south immediately west of the UST excavation. No other utilities lines are located near the UST site. Utility corridor investigations revealed that they were not impacted by the TPH soil contamination.

3.0 EXCAVATION SAMPLING

Following removal of the UST, the contaminated fill material was removed and the tuff below the tank was removed to a depth of approximately 11 feet. Four samples of tuff from below the tank were then collected and submitted to LANL's mobile chemical analytical laboratory (MCAL) for TPH analysis using EPA SW-846, Method 418.1. Table 1 provides information regarding the sample IDs, depths, and analytical results.

TABLE 1
Excavation Bottom TPH Results

Sample ID	Sample Location/Depth	Analytical Data
0100-95-0736	West end / 11 feet	5,163 ppm
0100-95-0737	Southeast Corner / 11 feet	2,989 ppm
0100-95-0738	Northeast Corner / 11 feet	8,215 ppm
0100-95-0739	Southwest Corner / 11 feet	10,822 ppm

All samples were field screened for radioactivity and none was detected.

4.0 ON-SITE INVESTIGATION HORIZONTAL AND VERTICAL EXTENT OF CONTAMINATION

On December 4 through 13, 1995, five boreholes were advanced to a total depth of 40 feet to determine the extent of vertical and horizontal TPH contamination. Chain of custody forms and analytical data sheets are enclosed for all five soil borings as discussed in Tables 2-6 of this report *(See Enclosure Three)*. *Enclosure Four* contains a map showing the location of each borehole and *Enclosure Five* contains each corehole sample log.

Borehole 01

Borehole #01 was completed on December 4 and 5, 1995, near the center of the UST excavation. The fill material used to backfill the excavation was encountered from 0 to 10 feet. Gray and brown tuff was encountered from 10 to 40 feet. From 10 to 30 feet, the recovered core samples had a fuel oil odor and varied in moisture content. The core was particularly moist with water, although not exhibiting saturated conditions, within the zone from 30 to 35 feet. Samples were collected at approximately five-foot intervals and submitted for analysis of TPH using EPA SW-846, Method 418.1. This analytical method was used for evaluating all subsequent corehole samples. Analytical results showed elevated TPH concentrations from 11 feet to between 30 and 35 feet, with concentrations ranging from 148 to 5818 ppm (Table 2). Samples collected at 35 and 40 feet showed no detectable TPH concentrations.

TABLE 2
Borehole #01 TPH Results

Sample ID	Sample Depth (ft)	PID Value (ppm)	Analytical Data
0100-95-0916	11.0	0	4,237 ppm
0100-95-0917	16.0	89	4,541 ppm
0100-95-0918	20.0	24	1,119 ppm

0100-95-0919	25.0	49	5,818 ppm
0100-95-0920	30.0	0	148 ppm
0100-95-0921	35.0	0	ND
0100-95-0922	40.0	0	ND

Borehole 02

Borehole #02 was completed on December 11, 1995, approximately 15 feet east of the UST excavation. Reddish brown to gray, moderately welded tuff was encountered from near the surface to a depth of 40 feet. Occasional brown stains, believed to be iron oxide, were noticed on the recovered core. However, based on the analytical results these stains proved not to be related to TPH contamination. The recovered core did not have a fuel oil odor and moisture contents were low. Samples were collected at approximately five-foot intervals and where stains or other possible signs of TPH contamination were observed. Sample results showed no detectable TPH concentrations (Table 3).

TABLE 3
Borehole #02 TPH Results

Sample ID	Sample Depth (ft)	PID Value (ppm)	Analytical Data
0100-95-0923	3.0	0	ND
0100-95-0924	8.0	0	ND
0100-95-0925	12.0	0	ND
0100-95-0926	13.0	0	ND
0100-95-0927	17.0	0	ND
0100-95-0928	19.0	0	ND
0100-95-0929	23.5	0	ND
0100-95-0930	28.0	0	ND
0100-95-0931	33.0	0	ND
0100-95-0932	36.0	0	ND
0100-95-0933	38.5	0	ND

Borehole 03

Borehole #03 was completed on December 12, 1995, approximately 20 feet west of the UST excavation. Reddish brown to gray, moderately welded tuff with occasional brown clay lined fractures were encountered from near the surface to a depth of 40 feet. The recovered core had no fuel oil odor and moisture contents were low. Samples were collected at approximately every five-foot interval and where stains or other possible signs of contamination were observed. Sample results showed no detectable TPH concentrations (Table 4).

TABLE 4

Borehole #03 TPH Results

Sample ID	Sample Depth (ft)	PID Value (ppm)	Analytical Data
0100-95-0934	3.0	0	ND
0100-95-0935	8.0	0	ND
0100-95-0936	14.0	0	ND
0100-95-0937	19.0	0	ND
0100-95-0938	24.0	0	ND
0100-95-0939	29.0	0	ND
0100-95-0940	34.5	0	ND
0100-95-0941	39.0	0	ND

Borehole 04

Borehole #04 was completed on December 12, 1995, approximately 10 feet north of the UST excavation. Reddish brown to gray and dusky red, moderately welded tuff was encountered from near the surface to a depth of 40 feet. Reddish clay lined fractures were occasionally noted. Recovered core did not have a fuel oil odor and moisture contents were low. Samples were collected at approximately five-foot intervals and where stains or other possible signs of contamination were observed. Sample results showed no detectable TPH concentrations (Table 5).

TABLE 5

Borehole #04 TPH Results

Sample ID	Sample Depth (ft)	PID Value (ppm)	Analytical Data
0100-95-0942	8.0	0	ND
0100-95-0943	12.0	0	ND
0100-95-0944	14.0	0	ND
0100-95-0945	19.0	0	ND
0100-95-0946	23.5	0	ND
0100-95-0947	27.0	0	ND
0100-95-0948	28.5	0	ND
0100-95-0949	31.5	0	ND
0100-95-0950	38.0	0	ND

Borehole 05

Borehole #05 was completed on December 13, 1995, approximately 70 feet south of the UST excavation. Since 6th Street Warehouses #3 and #4 are adjacent to the south side of the UST excavation, it was necessary to locate borehole #05 on the south side of the building. Dark and light gray, moderately welded tuff was encountered from near the surface to a depth of 40 feet during drilling. Again samples were collected at approximately five-foot intervals. Recovered core had no fuel oil odor and moisture contents were low. Sample results showed no detectable TPH concentrations (Table 6).

TABLE 6

Borehole #05 TPH Results

Sample ID	Sample Depth (ft)	PID Value (ppm)	Analytical Data
0100-95-0951	4.0	0	ND
0100-95-0952	8.5	0	ND
0100-95-0953	14.5	0	ND
0100-95-0954	19.0	0	ND

0100-95-0955	23.0	0	ND
0100-95-0956	27.0	0	ND
0100-95-0959	34.0	0	ND
0100-95-0960	37.0	0	ND

4.1 Corehole Investigation Summary

Based on the analytical data, both the horizontal and vertical extent of TPH affected tuff have been defined, and at depth, the TPH concentrations do not exceed 5,818 ppm. Borehole #01 provides evidence that the TPH plume extends vertically to no deeper than 30 to 35 feet. The four surrounding boreholes indicate that there has been little if any horizontal movement of the TPH plume. There appears to be three primary reasons for this apparent lack of significant migration of the fuel oil: first, the moderately welded tuff lacks sufficient permeability for significant migration, second, the observed fractures in the tuff were mostly clay filled, thus inhibiting migration, and third, the moisture zone at a depth of 30 to 35 feet in borehole #01 has acted as a barrier to vertical migration.

5.0 UST REQUIRED INFORMATION

Depth to groundwater beneath TA-0 is approximately 1,000 feet. There are no private water supply wells within a 1000 foot radius or municipal water wells within an one mile radius of this UST removal site. Additionally, there are no surface water courses within 500 feet of this UST removal site. LANL has determined that the surrounding utility corridors were not impacted by the petroleum soil contamination. No potentially explosive fuel oil or harmful vapors have been detected in these corridors or in the vicinity of the release. This report also contains information that is required in Part XII, §1206 B., of the USTR *(See Enclosures 6 and 7).*

6.0 CONCLUSIONS

LANL has determined that there is no threat to human health and the environment from the fuel oil soil contamination. The extent of the contamination has now been defined. No highly contaminated soil was encountered during this investigation. Because the UST was abandoned in the late 1960's, LANL has no tank tightness or repair data on this UST. If you should require any additional information, please contact me at 665-2505.

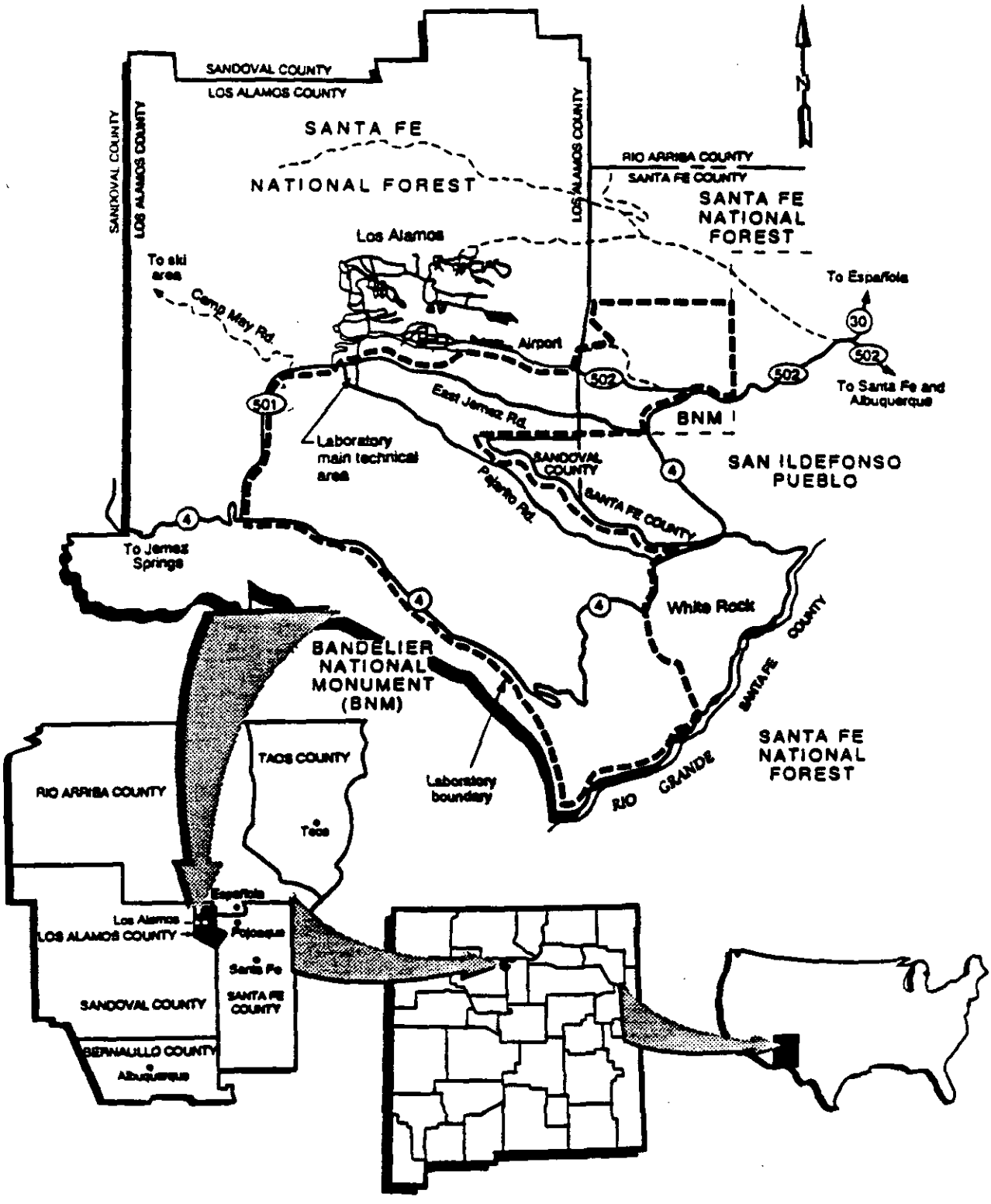
Enclosures:

1. Maps of LANL's Property Boundary, Technical Areas, and of the UST Site
2. Disposal Manifests
3. Chain of Custody and Corehole Sample Analytical Data Sheets
4. Corehole Locations
5. Corehole Sample Logs
6. LANL General Geology and Hydrology Information
7. Groundwater Wells and Other Penetrations and Drawings

ENCLOSURE ONE

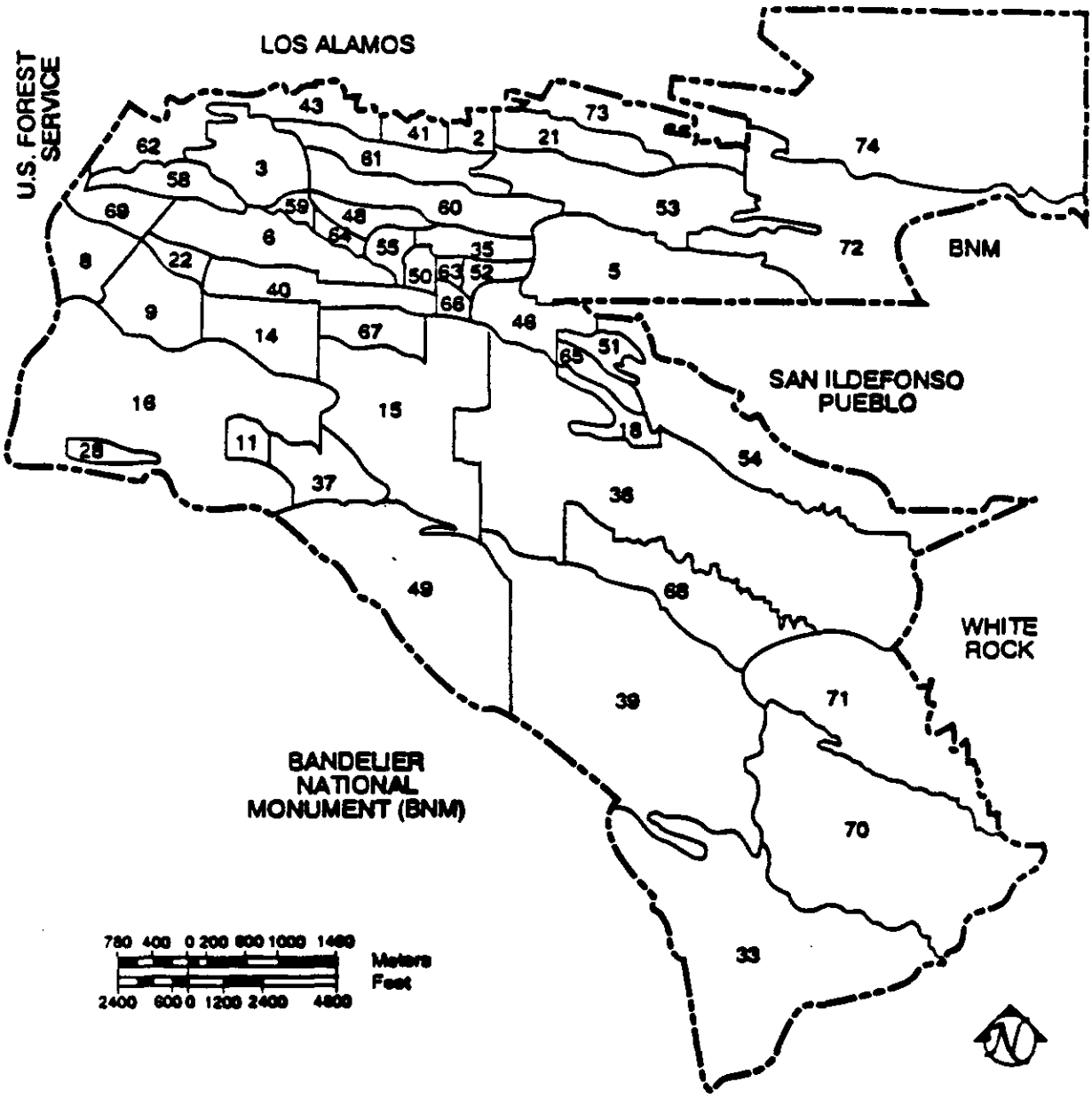
MAPS OF LANL'S PROPERTY BOUNDARY, TECHNICAL AREAS, AND UST SITE

Note: No surface impoundments or pit areas reside in the vicinity of this former UST.

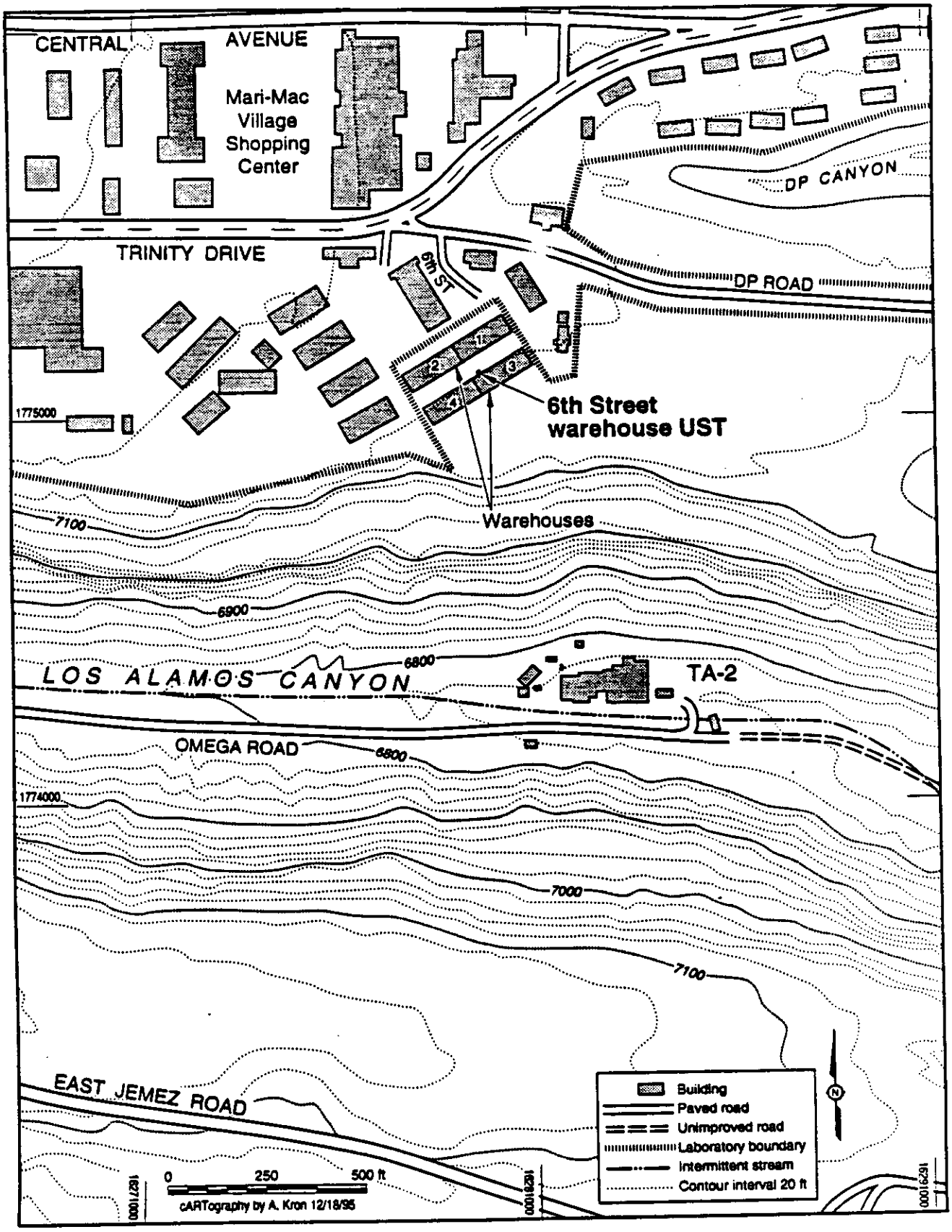


Regional location of Los Alamos National Laboratory.

TA-0 Is Located In The Town Site.



Technical areas (TAs) of Los Alamos National Laboratory in relation to surrounding landholdings.



Location of the 6th Street warehouse area (SWMU Group 0-1) in Los Alamos.

ENCLOSURE TWO

DISPOSAL MANIFESTS

KEERS ENVIRONMENTAL

NMED GROUND WATER DISCHARGE PERMIT

5904 FLORENCE AVE. NE
'QUERQUE, NM 87113
) 823-9006
1-800-327-2766
FAX (505) 823-2766

KEERS HYDROCARBON SOIL LAND FARM
14 MILES SOUTH ON HWY 55 FROM
MOUNTAINAIR, NEW MEXICO

GROUND WATER DISCHARGE PERMIT
MANIFEST 00218

HYDROCARBON CONTAMINATED SOIL MANIFEST

PART I

GENERATOR NAME Los Alamos National Laboratory

GENERATOR ADDRESS P.O. Box 1663 MSJ593

CITY/STATE/ZIP Los Alamos / NM / 87545

TELEPHONE 505-667-7579 FAX

TECHNICAL FIRM Keers

TECHNICAL CONTACT Dan Gray

TELEPHONE 823-9006 FAX 823-2766

KEERS HYDROCARBON CONTAMINATED SOIL PROFILE SHEET NUMBER 00168

QUANTITY 20 CUBIC YARDS X DRUMS _____ OTHER Bulk

GENERATORS CERTIFICATION: I HEREBY CERTIFY THAT THE ABOVE DESCRIBED MATERIAL IS NOT A HAZARDOUS WASTE AS DEFINED BY US EPA AND/OR STATE AND LOCAL REGULATIONS, DOES NOT CONTAIN REGULATED RADIOACTIVE MATERIALS OR REGULATED CONCENTIONS OF PCB'S (POLYCHLORINATED BIPHENYLS), AND THIS MATERIAL DOES NOT CONTAIN FREE LIQUIDS. I ALSO CERTIFY THAT ...E MATERIAL BEING REPRESENTED IN THIS MANIFEST CORRESPONDS WITH AND IS THE SAME AS THE MATERIAL REFERENCED IN THE HYDROCARBON CONTAMINATED SOIL PROFILE SHEET SHOWN ABOVE.

NAME OF GENERATOR OR AUTHORIZED AGENT (PRINT) Henry Paul Nunes

SIGNATURE OF GENERATOR OR AUTHORIZED AGENT Henry Paul Nunes

RECEIPT DATE 11-22-95

PART II

TRANSPORTER CERTIFICATION: I HEREBY CERTIFY THAT NO OTHER MATERIAL HAS BEEN PLACED IN THIS TRUCK SINCE ACCEPTANCE OF THE MATERIAL AS DESCRIBED IN PART I OF THIS DOCUMENT.

NAME OF TRANSPORTER (PRINT) _____

SIGNATURE OF TRANSPORTER _____

RECEIPT DATE _____

PART III

THIS IS TO CERTIFY THAT KEERS HYDROCARBON CONTAMINATED SOIL LAND FARM, OPERATING UNDER N.M.E.D GROUND WATER DISCHARGE PERMIT #DP-1012 HAS ACCEPTED THE ABOVE MATERIAL.

...ME OF AUTHORIZED AGENT (PRINT) _____

...NATURE OF AUTHORIZED AGENT _____

RECEIPT DATE _____

MATERIAL DEPOSITED IN CELL # _____ LOCATION _____

KEERS ENVIRONMENTAL

NMED GROUND WATER DISCHARGE PERMIT

5904 FLORENCE AVE. NE
UQUERQUE, NM 87113
) 823-9006
1-800-327-2766
FAX (505) 823-2766

KEERS HYDROCARBON SOIL LAND FARM
14 MILES SOUTH ON HWY 55 FROM
MOUNTAINAIR, NEW MEXICO

GROUND WATER DISCHARGE PERMIT
MANIFEST 00222

HYDROCARBON CONTAMINATED SOIL MANIFEST

PART I

GENERATOR NAME Los Alamos National Laboratory
GENERATOR ADDRESS P.O. Box 1663 MS J593
CITY/STATE/ZIP Los Alamos / NM / 87545
TELEPHONE 505-667-7577 FAX
TECHNICAL FIRM Keers
TECHNICAL CONTACT Dan Gay
TELEPHONE 823-9006 FAX 823-2766
KEERS HYDROCARBON CONTAMINATED SOIL PROFILE SHEET NUMBER 00168

QUANTITY 35 CUBIC YARDS _____ DRUMS _____ OTHER Bulk

GENERATORS CERTIFICATION: I HEREBY CERTIFY THAT THE ABOVE DESCRIBED MATERIAL IS NOT A HAZARDOUS WASTE AS DEFINED BY US EPA AND/OR STATE AND LOCAL REGULATIONS, DOES NOT CONTAIN REGULATED RADIOACTIVE MATERIALS OR REGULATED CONCENTIONS OF PCB'S (POLYCHLORINATED BIPHENYLS), AND THIS MATERIAL DOES NOT CONTAIN FREE LIQUIDS. I ALSO CERTIFY THAT MATERIAL BEING REPRESENTED IN THIS MANIFEST CORRESPONDS WITH AND IS THE SAME AS THE MATERIAL REFERENCED IN THE HYDROCARBON CONTAMINATED SOIL PROFILE SHEET SHOWN ABOVE.

NAME OF GENERATOR OR AUTHORIZED AGENT (PRINT) Henry Paul Nunes
SIGNATURE OF GENERATOR OR AUTHORIZED AGENT Henry Paul Nunes
RECEIPT DATE 11-14-95

PART II

TRANSPORTER CERTIFICATION: I HEREBY CERTIFY THAT NO OTHER MATERIAL HAS BEEN PLACED IN THIS TRUCK SINCE ACCEPTANCE OF THE MATERIAL AS DESCRIBED IN PART I OF THIS DOCUMENT.

NAME OF TRANSPORTER (PRINT) C. Paul M Chavez Chavez Soil Trucking
SIGNATURE OF TRANSPORTER Paul M Chavez Keers
RECEIPT DATE 11/21/95

PART III

THIS IS TO CERTIFY THAT KEERS HYDROCARBON CONTAMINATED SOIL LAND FARM, OPERATING UNDER N.M.E.D GROUND WATER DISCHARGE PERMIT #DP-1012 HAS ACCEPTED THE ABOVE MATERIAL.

NAME OF AUTHORIZED AGENT (PRINT) J Shannon Kayser
SIGNATURE OF AUTHORIZED AGENT
RECEIPT DATE 11-21-95
MATERIAL DEPOSITED IN CELL # 5 LOCATION Middle - South side

Eidson
STEEL PRODUCTS, INC.
8301 BROADWAY, S.E., ALBUQUERQUE, NM 87105
TELEPHONE (505) 873-0160 FAX (505) 873-0167

T A N K D I S P O S A L

DATE: 11/14/95

TO WHOM IT MAY CONCERN:

PLEASE BE ADVISED THAT THE FOLLOWING TANK(S) WILL BE PROPERLY DISPOSED OF AND/OR RECYCLED BY EIDSON STEEL PRODUCTS, INC. IN ACCORDANCE WITH APPLICABLE RULES AND REGULATIONS:

TANK SIZE: GALLONS 3500 DIMENSIONS 8 X 25 LABEL # UNKNOWN

PREVIOUS LOCATION OF TANK(S) 6TH STREET WAREHOUSE, LOS ALAMOS, NM

OWNER KEERS ENVIRONMENTAL

DISPOSAL REQUESTED BY KEERS ENVIRONMENTAL

RESPECTFULLY,

EIDSON STEEL PRODUCTS, INC.

MESA ENVIRONMENTAL

A DIVISION OF MESA OIL, INC.

RECYCLING MANIFEST / RECEIPT

Service Order # 085265

82

Mailing Address
Keers Environmental Inc
5904 Florence Ave NE
Accts Payable - Emily Sanchez
Albq NM 87113

(505) 823-9006 Ext. 0000

Service Address
Keers Environmental Inc
600 6th St
Robbi
Los Alamos NM 87544

(505) 288-0079 Ext. 0000
Contact: Sterling Johnson

Account Number	P.O. Number	Order Date	Terms
KEERS01		11/08/95	Net 30 days

Description	Ordered	Unit	Price
Used Oil Removal	1	Gal-Tank	0.2000
Oily Water Removal	1	Gal-Tank	0.7200

Meet Robbi Across The Street From The Hilltop In In Los Alamos At 7:30 Am

Quantity	Total
2,500	2,500

APPROVAL:

JOB #:

CAT:

CLASS:

SPECIAL INSTRUCTIONS

SALES TAX

TOTAL DUE MESA OIL $

Ship to Mesa Oil Belen

FORM OF PAYMENT

CASH:

CHECK:

CREDIT APP.#

APPROVED BY

VENDOR

MC / VISA

P.O.#

GENERATORS CERTIFICATION: This material is described to the best of my ability. This material has not been mixed with PCB's or hazardous waste listed in 40 C.F.R. part 262. I acknowledge the accuracy of the total due on this receipt. If to be charged on account I understand that an invoice will follow with terms of NET 30 DAYS.

Printed / Typed Name | Signature | Date

12/7/95

TRANSPORTER, STORER AND RECYCLER

MESA OIL, INC. - PLANT
Belen, NM
EPA# NMD 0000096024
TEXAS TWC ID# 40849

MESA OIL, INC. - PLANT
Golden, CO
EPA# COD 983772955

Mailing Address:
Mesa Oil, Inc.
7239 Bradburn Blvd.
Westminster, CO 80030
(303) 426-4777

MESA01

IN CASE OF SPILL CONTACT: MESA OIL, INC. 1-800-USED-OIL

D.O.T. REQUIREMENT - MAXIMUM LOAD 7000 GALLONS
OIL N.O.S. COMBUSTIBLE LIQUID

TRANSPORTER ACKNOWLEDGMENT OF RECEIPT OF MATERIALS:
I certify materials have been tested and are below 1,000 PPM halogens.

Bob Williams | Bob Williams | 11-9-95

Printed / Typed Name | Signature | Date

TREATMENT FACILITY OPERATOR:
The described materials were handled by me, the treatment facility named above, and were accepted.

Printed / Typed Name | Signature | Date

White - Return to Generator Green - Records Pink - Office Goldenrod - Generator Copy

ENCLOSURE THREE

CHAIN OF CUSTODY AND COREHOLE SAMPLE ANALYTICAL DATA SHEETS

Los Alamos National Laboratory Environmental Restoration (Los Alamos, NM 87545)

CHAIN OF CUSTODY/REQUEST FOR ANALYSIS

Technical Area	00	**Send Lab Report to**	Janet Brewer	**Field Unit Leader**	Garry Allen
Operable Unit	1071		E525		(505)667-3394
Date	12/05/95	**LANL Destination**	Chem Van	**Turnaround**	45 days
OU Contact	Rebecca C. Eaton	**LANL Contact**	John Miglio	**Lab Report Required**	01/19/96
Contact Phone No	(505) 662-1358	**LANL Mail Stop**		**Charge Code**	MA1CB0400000

Relinquished by: ~~Dave Frank~~ ALEX MORA **(Signature):** **Affiliation:** ERM/Golder	**Date:** 12 04 95	**Relinquished by:** CST-1.2 **(Signature):** Laura Kelly **Affiliation:**	**Date:** 12/4/95	**Relinquished by:** **(Signature):** **Affiliation:**	**Date:**
Received by: CST-1.2 **(Signature):** Laura Kelly **Affiliation:**	**Time:** 1145 TO 1515	**Received by:** ALEX MORA **(Signature):** **Affiliation:** ERM	**Time:** 1530	**Received by:** **(Signature):** **Affiliation:**	**Time:**

POSSIBLE HAZARD IDENTIFICATION: (please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances): Radiological___ Highly Toxic___ Flammable___ Skin Irritant___ Non-Hazard X Other___

SCREENING METHOD: Rad Van/Chem Van

SAMPLE DISPOSAL: Return to Client

Comments: BH 01

Field Unique Sample #/ID	Cont ID	Date & Time Collected	Sample Container Volume/Material	Matrix	Preserv	ANALYSIS REQUESTED: (SMO Order Codes)	REMARKS (Conditions of receipt, etc.)
0100-95-0916	01	12/04/95 1145	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0917	01	12/04/95 1320	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0918	01	12/04/95 1520	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0919	01	12/05/95 1040	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0920	01	12/05/95 1150	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0921	01	12/05/95 1420	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0922	01	12/05/95 1515	125 ml Septum Amber G	Soil	Ice	CVTPH	

tal Petroleum Hydrocarbons in Soil.

CST-12 Mobile Analytical Laboratory

Analytical Results

Analyst: LAK

Date: 12/4/95

Sample #	Weight(g)	Dilution	ABS	Soil oncentration (mg/kg)
Daily Std.	10	1	0.268	58
0100-95-0916	10.2	100	0.201	4237
0100-95-0917	10.7	100	0.226	4541
0100-95-0918	9.8	100	0.051	1119

ily Std. Recovery: 105%

Total Petroleum Hydrocarbons in Soil.

CST-12 Mobile Analytical Laboratory

Analytical Results

Analyst: LAK

Date: 12/5/95

Sample #	Weight(g)	Dilution	ABS	Soil Concentration (mg/kg)
Daily Std.	10	1	0.045	10
0100-95-0919	10.2	100	0.276	5818
0100-95-0920	10.4	1	0.714	148
0100-95-0921	10.8	1	-0.008	<1
0100-95-0922	10.6	1	-0.001	<1

Daily Std. Recovery: 88%

Los Alamos National Laboratory Environmental Restoration (Los Alamos, NM 87545)

CHAIN OF CUSTODY/REQUEST FOR ANALYSIS

Technical Area 00	**Send Lab Report to** Janet Brewer		**Field Unit Leader** Garry Allen
Operable Unit 1071	E525		(505)667-3394
Date 12/11/95	**LANL Destination** Chem Van		**Turnaround** 45 days
OU Contact Rebecca C. Eaton	**LANL Contact** John Miglio		**Lab Report Required** 01/25/96
Contact Phone No (505) 662-1358	**LANL Mail Stop**		**Charge Code** MA1CB0400000

Relinquished by: ~~Dave Frank~~ ALEX MORA **(Signature):** **Affiliation:** ERM/Golder	**Date:** 12-11-95	**Relinquished by:** CST-12 Laura Kelly **(Signature):** **Affiliation:**	**Date:** 12/11/95	**Relinquished by:** **(Signature):** **Affiliation:**	**Date:**	
Received by: CST-12 Laura Kelly **(Signature):** **Affiliation:**	**Time:** 1630 To 1445.	**Received by:** ALEX MORA **(Signature):** **Affiliation:** ERM	**Time:** 1500	**Received by:** **(Signature):** **Affiliation:**	**Time:**	

POSSIBLE HAZARD IDENTIFICATION: (please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances): Radiological___ Highly Toxic___ Flammable___ Skin Irritant___ Non-Hazard X Other___

SCREENING METHOD: Rad Van/Chem Van

SAMPLE DISPOSAL: Return to Client

Comments: B1102

Field Unique Sample #/ID	Cont ID	Date & Time Collected	Sample Container Volume/Material	Matrix	Preserv	ANALYSIS REQUESTED: (SMO Order Codes)	REMARKS (Conditions of receipt, etc.)
0100-95-0923	01	12/11/95 1030	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0924	01	12/11/95 1100	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0925	01	12/11/95 1120	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0926	01	12/11/95 1305	125 ml Septum Amber G.	Soil	Ice	CVTPH	
0100-95-0927	01	12/11/95 1315	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0928	01	12/11/95 1340	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0929	01	12/11/95 1350	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0930	01	12/11/95 1415	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0931	01	12/11/95 1430	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0932	01	12/11/95 1440	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0933	01	12/11/95 1445	125 ml Septum Amber G	Soil	Ice	CVTPH	

Total Petroleum Hydrocarbons in Soil.

CST-12 Mobile Analytical Laboratory

Analytical Results

Analyst: LAK

Date: 12/11/95

Sample #	Weight(g)	Dilution	ABS	Soil Concentration (mg/kg)
Daily Std.	10	1	0.053	11
0100-95-0923	10.4	1	-0.01	<1
0100-95-0924	9.7	1	-0.004	<1
0100-95-0925	10	1	-0.007	<1
0100-95-0926	9.9	1	-0.006	<1
0100-95-0927	10.4	1	0.001	<1
0100-95-0928	10.3	1	-0.002	<1
0100-95-0929	10.3	1	-0.03	<1
0100-95-0930	10	1	-0.008	<1
0100-95-0931	10.6	1	-0.009	<1
0100-95-0932	10.7	1	-0.007	<1
0100-95-0933	10.5	1	-0.011	<1

Daily Std. Recovery: 104%

Los Alamos National Laboratory Environmental Restoration (Los Alamos, NM 87545)

CHAIN OF CUSTODY/REQUEST FOR ANALYSIS

Technical Area 00	**Send Lab Report to** Janet Brewer		**Field Unit Leader** Garry Allen
Operable Unit 1071	E525		(505)667-3394
Date 12/12/95	**LANL Destination** Chem Van		**Turnaround** 45 days
OU Contact Rebecca C. Eaton	**LANL Contact** John Miglio		**Lab Report Required** 01/26/96
Contact Phone No (505) 662-1358	**LANL Mail Stop**		**Charge Code** MA1CB0400000

Relinquished by: ~~Dave Frank~~ ~~ALEX MORA~~ **(Signature):** **Affiliation:** ERM/Golder	**Date:** 12-12-95	**Relinquished by:** CST-12 **(Signature):** Laura Kelly **Affiliation:**	**Date:** 12/12/95	**Relinquished by:** **(Signature):** **Affiliation:**	**Date:**
Received by: CST-12 **(Signature):** Laura Kelly **Affiliation:**	**Time:** 0900 TO 1130.	**Received by:** ALEX MORA **(Signature):** **Affiliation:** ERM	**Time:** 1130	**Received by:** **(Signature):** **Affiliation:**	**Time:**

POSSIBLE HAZARD IDENTIFICATION: (please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances): **Radiological**___ **Highly Toxic**___ **Flammable**___ **Skin Irritant**___ **Non-Hazard** X **Other**___

SCREENING METHOD: Rad Van/Chem Van

SAMPLE DISPOSAL: Return to Client

Comments: BH03

Field Unique Sample #/ID	Cont ID	Date & Time Collected	Sample Container Volume/Material	Matrix	Preserv	ANALYSIS REQUESTED: (SMO Order Codes)	REMARKS (Conditions of receipt, etc.)
0100-95-0934	01	12/12/95 0900	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0935	01	12/12/95 0915	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0936	01	12/12/95 0930	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0937	01	12/12/95 1007	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0938	01	12/12/95 1018	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0939	01	12/12/95 1100	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0940	01	12/12/95 1116	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0941	01	12/12/95 1130	125 ml Septum Amber G	Soil	Ice	CVTPH	

Los Alamos National Laboratory Environmental Restoration (Los Alamos, NM 87545)

CHAIN OF CUSTODY/REQUEST FOR ANALYSIS

Technical Area	00	**Send Lab Report to**	Janet Brewer	**Field Unit Leader**	Garry Allen
Operable Unit	1071		E525		(505)667-3394
Date	12/12/95	**LANL Destination**	Chem Van	**Turnaround**	45 days
OU Contact	Rebecca C. Eaton	**LANL Contact**	John Miglio	**Lab Report Required**	01/26/96
Contact Phone No	(505) 662-1358	**LANL Mail Stop**		**Charge Code**	MA1CB0400000

Relinquished by: ~~Dave Frank~~ ~~ALEX MORA~~ **(Signature):** **Affiliation:** ERM/Golder	**Date:** 12-12-95	**Relinquished by:** CST-12 **(Signature):** Laura Kelly **Affiliation:**	**Date:** 12/12/95	**Relinquished by:** **(Signature):** **Affiliation:**	**Date:**
Received by: CST-12 **(Signature):** Laura Kelly **Affiliation:**	**Time:** 1400 TC	**Received by:** ALEX MORA **(Signature):** **Affiliation:** ERM	**Time:** 1500	**Received by:** **(Signature):** **Affiliation:**	**Time:**

POSSIBLE HAZARD IDENTIFICATION: (please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances): Radiological___ Highly Toxic___ Flammable___ Skin Irritant___ Non-Hazard X Other___

SCREENING METHOD: Rad Van/Chem Van

SAMPLE DISPOSAL: Return to Client

Comments: Bin 04

Field Unique Sample #/ID	Cont ID	Date & Time Collected	Sample Container Volume/Material	Matrix	Preserv	ANALYSIS REQUESTED: (SMO Order Codes)	REMARKS (Conditions of receipt, etc.)
0100-95-0942	01	12/12/95 1400	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0943	01	12/12/95 1420	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0944	01	12/12/95 1420	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0945	01	12/12/95 0000	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0946	01	12/12/95 1500	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0947	01	12/12/95 1520	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0948	01	12/12/95 1520	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0949	01	12/12/95 0000 1546	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0950	01	12/12/95 0000 1550	125 ml Septum Amber G	Soil	Ice	CVTPH	

Original - LANL Destination Yellow - RPF Pink - FTL Copy

Los Alamos National Laboratory Environmental Restoration (Los Alamos, NM 87545)

CHAIN OF CUSTODY/REQUEST FOR ANALYSIS

Technical Area 00	Send Lab Report to Janet Brewer		Field Unit Leader Garry Allen
Operable Unit 1071	E525		(505)667-3394
Date 12/13/95	LANL Destination Chem Van		Turnaround 45 days
OU Contact Rebecca C. Eaton	LANL Contact John Miglio		Lab Report Required 01/27/96
Contact Phone No (505) 662-1358	LANL Mail Stop		Charge Code MA1CB0400000

Relinquished by: ~~Dave Frank~~ ALEX MORA (Signature): Affiliation: ERM/Golder	Date: 12-13-95	Relinquished by: CST-12 (Signature): Laura Kelly Affiliation:	Date: 12-13-95	Relinquished by: (Signature): Affiliation:	Date:
Received by: CST-12 (Signature): Laura Kelly Affiliation:	Time: 1000 to 1145	Received by: ALEX MORA (Signature): Affiliation: ERM	Time: 1145	Received by: (Signature): Affiliation:	Time:

POSSIBLE HAZARD IDENTIFICATION: (please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances): Radiological___ Highly Toxic___ Flammable___ Skin Irritant___ Non-Hazard X Other___

SCREENING METHOD: Rad Van/Chem Van

SAMPLE DISPOSAL: Return to Client

Comments: BH 05

Field Unique Sample #/ID	Cont ID	Date & Time Collected	Sample Container Volume/Material	Matrix	Preserv	ANALYSIS REQUESTED: (SMO Order Codes)	REMARKS (Conditions of receipt, etc.)
0100-95-0951	01	12/13/95 1000	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0952	01	12/13/95 1015	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0953	01	12/13/95 1033	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0954	01	12/13/95 1100	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0955	01	12/13/95 1100	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0956	01	12/13/95 1120	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0959	01	12/13/95 1140	125 ml Septum Amber G	Soil	Ice	CVTPH	
0100-95-0960	01	12/13/95 1145	125 ml Septum Amber G	Soil	Ice	CVTPH	

Total Petroleum Hydrocarbons in Soil.

CST-12 Mobile Analytical Laboratory

Analytical Results

Analyst: LAK

Date: 12/12/95

Sample #	Weight(g)	Dilution	ABS	Soil Concentration (mg/kg)
Daily Std.	10	1	0.052	11
0100-95-0934	10.2	1	-0.002	<1
0100-95-0935	10	1	-0.008	<1
0100-95-0936	9.7	1	-0.005	<1
0100-95-0937	10.2	1	-0.007	<1
0100-95-0938	9.8	1	-0.005	<1
0100-95-0939	10.4	1	0	<1
0100-95-0940	10.3	1	-0.003	<1
0100-95-0941	10.2	1	-0.002	<1
0100-95-0942	10.4	1	0.002	<1
0100-95-0943	10.2	1	-0.002	<1
0100-95-0944	10.5	1	0.003	<1
0100-95-0945	10.2	1	0	<1
0100-95-0946	9.5	1	0.003	<1
0100-95-0947	10.6	1	-0.001	<1
0100-95-0948	10.6	1	-0.002	<1
0100-95-0949	9.6	1	-0.003	<1
0100-95-0950	10.2	1	0	<1

Daily Std. Recovery: 102%

Total Petroleum Hydrocarbons in Soil.

CST-12 Mobile Analytical Laboratory

Analytical Results

Analyst: jbr

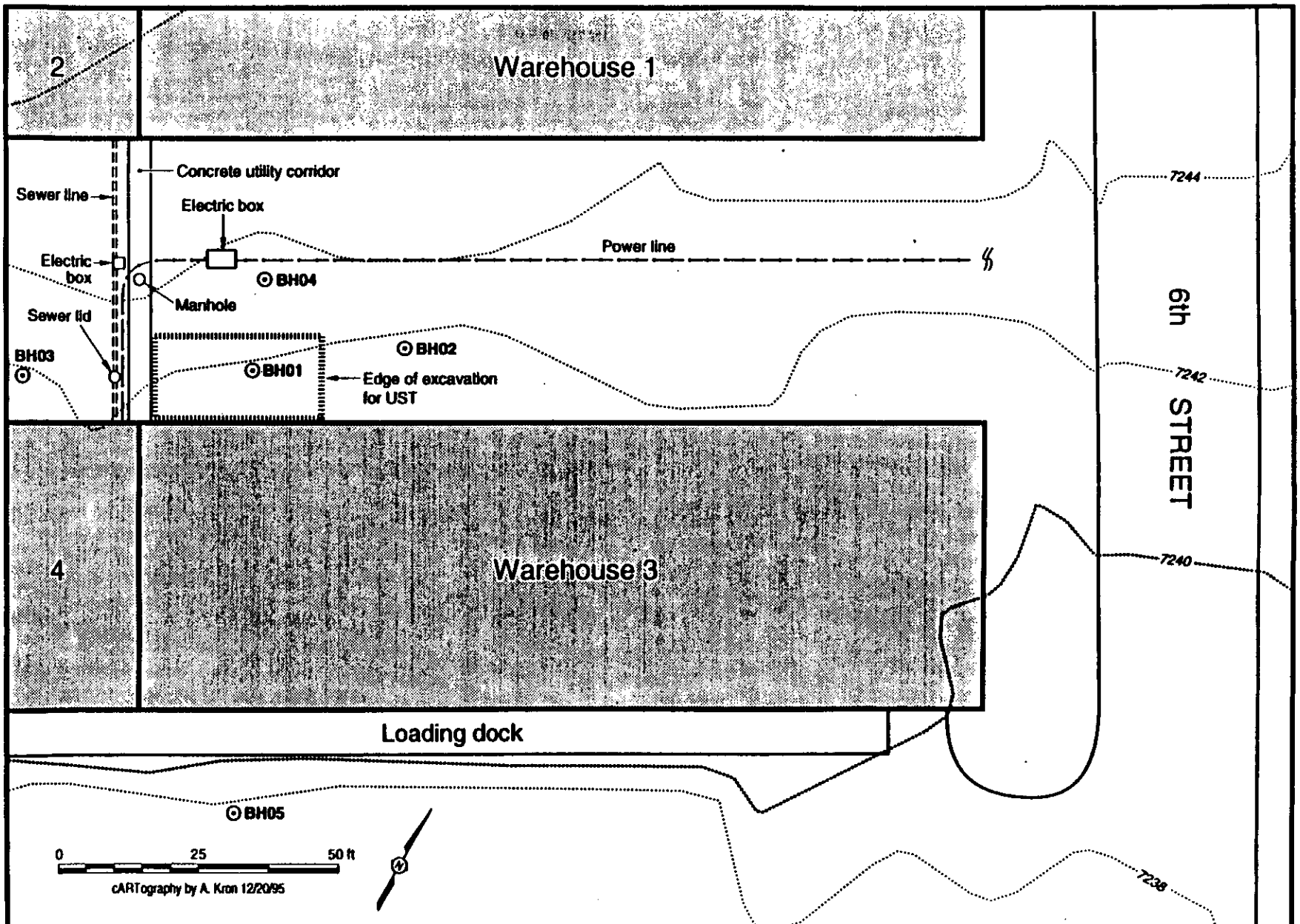
Date: 12/13/95

Sample #	Weight(g)	Dilution	ABS	Soil Concentration (mg/kg)
Daily Std.	10	1	0.052	11
0100-95-0951	10.3	1	0.013	3
0100-95-0952	10.6	1	-0.001	<1
0100-95-0953	10.2	1	-0.002	<1
0100-95-0954	10.1	1	-0.003	<1
0100-95-0955	10.2	1	-0.001	<1
0100-95-0956	10.4	1	-0.002	<1
0100-95-0959	10	1	-0.001	<1
0100-95-0960	10.1	1	-0.001	<1

Daily Std. Recovery: 102%

ENCLOSURE FOUR

COREHOLE LOCATIONS



Locations of boreholes at the underground storage tank, 6th Street warehouse.

ENCLOSURE FIVE

COREHOLE SAMPLE LOGS

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID [illegible] TA/OU [illegible] Drill Depth From [illegible] To 35 Page [illegible] of 2

Driller [illegible] Box #(s) NA Start Date/Time [illegible] End Date/Time 1430 / 12-4-95

Drilling Equip./Method [illegible] Sampling Equip./Method [illegible]

All samples field screened using [illegible]

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
10					FILL MATERIAL FROM 3-033 TRENCH EXCAVATION. THIS MATERIAL WAS NOT SAMPLED			
	2.0 / 2.1 100%	3100-95-3916	VM=0.0 %=ND B/V=ND	NA	RUN #1, 10.3'-11.2', 11 45, SAMPLE TAKEN FROM 11.0 FT. LOOSE TO CONSOLIDATED, VERY LT. GRAY TO WHITE TUFF. STRONG ODOR, WET TO DRY, POWDERY APPEARANCE.			SAMPLE FOR TPH ONLY VIA CHEM VAN METHOD 418.1
12	2.0 / 2.1 100%	3100-95-3917	VM=5.1 %=NDA B/V=	NA	RUN #2, 14.7-16.7, 13 20, SAMPLE COLLECTED FROM THE 15 FT MARK. CORE IS LOOSE TO CONSOLIDATED, LOOSE GRADING TO CONSOLIDATED LIGHT GRAY TO DARK GRAY TUFF, NO PUMICE VISIBLE. FRESH CUT CORE IS WET GRADING TO DRY.			TPH VIA CHEM VAN.
15	2.3 / 2.1 100%	3100-95-3918	VM=2.4 %=NDA B/V=NDA	NA	RUN #3, 18.3-20.4, 1520. SAMPLE COLLECTED FROM THE 20 FT. MARK, SAME LITHOLOGY AS THE PAST TWO SAMPLES. S. [illegible] 15.2 12 4 95			
20	2.3 / 2.0 100%	3100-95-3919	VM=4.9 %=NDA B/V=NDA	NA	RUN #4, 23.3'-25.3', 1040, SAMPLE WAS COLLECTED AT THE 25 FT. MARK. COHESIVE CONSOLIDATED, DARK GREY TO LIGHT GRAY PUMICE POOR ASH FLOW TUFF, HYDROCARBON ODOR, DAMP.			WEATHER FOR 12/5 IS CLOUDY, 65°F, SLIGHT BREEZE, SOME HIGH CLOUDS, NO PRECIPITATION.
25	2.3 / 2.1 100%	3100-95-3920	VM=1.4 %=ND B/V=ND	NA	RUN #5, 29-31 FT. 1150 SAMPLED FROM THE 30 FT. INTERVAL. CORE IS CONSOLIDATED COHESIVE PUMICE POOR ASHFLOW TUFF GRAY TO LIGHT BROWN WET. FERRICRYSTS TO 2MM SLIGHT HYDROCARBON ODOR.			BREAK FOR LUNCH 12 00
30	2.0 / 2.1 100%	3100-95-3921	VM=ND %=ND B/V=ND	NA	RUN #6, 34.25'-36.25', 1420. SAMPLE FROM THE 35 FT. INTERVAL. COHESIVE, CONSOLIDATED, BROWN CLAYEY TUFF, PLATY STRUCTURE, LITTLE VISIBLE PUMICE, NO FREE ODOR, WET.			[illegible] FOR THE DAY
35								

WEATHER: SUNNY, SOME HIGH CLOUDS, NO PRECIP, 68°F (NOON)

BORING WILL PROBABLY CONTINUE ON THE MONDAY WHEN THE JUNK CREW IS IN

Prepared by [illegible] Date 12 4 95 Checked By ALEX MOIR Date 12-7-95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY | **CORE SAMPLE LOG**

Borehole ID [illegible] TA/OU [illegible] Drill Depth From [illegible] To [illegible] Page [illegible] of [illegible]

Driller M HENKE Box #(s) 1-A Start Date/Time [illegible] End Date/Time [illegible]

Drilling Equip./Method [illegible] Sampling Equip./Method [illegible]

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
35	2.0/2.5 100%	0133 - 0135 0422	VOA ND g = ND B/N ND	NA	REAM F/ 38-40, 1550, SAMPLED AT 40' CONSOLIDATED COHESIVE LT BROWN TO LT GRAY TUFF. SOMEWHAT PLATY STRUCTURE NO VISIBLE CLASTS OR PUMICE, MOIST.			
40					FINISH DRILLING FOR THE DAY			
45								
50								

Prepared by D. FRANK Date 12-4-95 Checked By [illegible] Date [illegible]

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 02 TA/OU O, FU-1 Drill Depth From 0 To 10 Page 1 of 4

Driller STEWART BROSS Box #(s) NA Start Date/Time 12-11-95/1000 End Date/Time 12-11-95/1100

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CASINGED CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology·Petrology · Soil	Graphic Log	Lithologic Unit	Notes
0	3.5/5.0 RUN 1	0100-95 0023 @ 3'	PID: 0	NA	0-6" TOPSOIL / ROOT ZONE. 6"-1.8' COARSE TUFF BROWISH YELLOW (7.5YR 7/6) 1.8-2.0' STRONG BROWN (7.5YR 5/6) CLAY. DRY. LOW PLASTICITY. 2.0-2.4' LIGHT BROWN (7.5YR 6/4) WEATHERED CLAYEY TUFF. DRY. 2.4-3.5 GRAY (5Y) TUFF GROWED SLIGHT / MOIST. 3.5-5.0' NO RECOVERY FLUSHED WITH CLAY.			1000
5	5.0/5.0 RUN 2	0100-95 0024 @ 9'	PID: 0		5.0 - 10.0 MODERATELY WELDED TO WELDED TUFF WITH VITRIC AND DEVITRIFIED PUMICE, AND MODERATE TO RICH IN PHENOCRYSTS SLIGHTLY TO WELL INDURATED. - 20% PUMICE LAPILLI: VITRIFIED AND DEVITRIFIED, BROWN (5/3, 7.5YR), RANGES FROM 0.3 MM TO 2.5 CM. AVERAGES 2.0 CM. - 20% PHENOCRYST: SANIDINE (90%), PLAGIOCLASE (5%), SPHENE (2%), OTHERS (3%). QTZ IS ANGULAR, CLEAR, RANGING FROM 0.1 TO 0.3 MM, AND AVERAGING 0.2 MM IN SIZE. - MATRIX IS NOT OBSERVED. - MATRIX IS LIGHT REDDISH BROWN (5YR6/3) ASH, MODERATELY CONSOLIDATED.			1010
10								

Prepared by ALEX MORA Date 12-18-95 Checked By [signature] Date 12/21/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY | CORE SAMPLE LOG

Borehole ID 02 TA/OU O. FU-1 Drill Depth From 10 To 20 Page 2 of 4

Driller S-BART BLOSS Box #(s) NA Start Date/Time 12-11-95/1150 End Date/Time 12-11-95/1630

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
10	5.0/5.0	0945 at 12'	PID: 0	NA	10-15 MODERATELY WELDED IGNIMBRITE WITH PINK DEVITRIFIED PUMICE, AND RICH IN PHENOCRYST. WELL INDURATED. - 5% MAFIC MINERAL (BIOTITE) FINE GRAINED LIGHT GREY (7/N) RANGING FROM 0.03 cm AND MEASURING 3cm IN SIZE. - 35% FELDSPARS (QUARTZ (20%) SANIDINE CLEAR, 1 TO 3 mm AND 2mm AVERAGE IN SIZE. OTHER NOT IDENTIFIED MINERALS (10%) - LITHICS NOT OBSERVED - MATRIX SOFT (5YR) FIRM SLIGHTLY TO MODERATELY COHESIVE.			1100
11	RUN 3	0946 at 13'						
12		0						
13		0						
14								
15	5.0/5.0	0947 at 17'	PID: 0	NA	15-20 SLIGHTLY WELDED IGNIMBRITE WITH LESS PUMICE AND MODERATELY RICH IN PHENOCRYSTS THAN ABOVE. - 10% MAFIC MINERAL (BIOTITE) RANGING FROM 4 TO 1 cm AND AVERAGING 3cm IN SIZE. - 15% PHENOCRYSTS QUARTZ (20%) CLEAR FELDSPARS 1 mm IN SIZE. SANIDINE CLEAR, AUGERING 2 mm IN SIZE. OTHER UNIDENTIFIED (15%) - LITHICS NOT OBSERVED - MATRIX WEAK RED (2.5 YR 5/3) FIRM. MODERATELY COHESIVE.			1300
16	RUN 4	0948 at 19'						
17		0						
18								
19								
20								

Prepared by ALEX MORA Date 12-18-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY | **CORE SAMPLE LOG**

Borehole ID 02 TA/OU O. FOX 1 Drill Depth From 20 To 30' Page 3 of 4

Driller STEWART BROS Box #(s) UA Start Date/Time 12-11-95/1400 End Date/Time 12-11-95/1430

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology - Petrology - Soil	Graphic Log	Lithologic Unit	Notes
20	50/5.0	0103-95 0929	PID:0		20-25 SILTY CLAY. SWELLS. MOIST, NO STRUCTURE.			1400
21	RUN 5	@ 23.5'						
22								
23								
24	0	0						
25								
26	60/50	0103-95 0930 @ 28'	PID:0		25-30 SLIGHTLY TO MODERATELY WELDED IGNIMBRITE WITH VITRIFIED MATRIX AND MODERATE PHENOCRYST CONTENT. WELL INDURATED. - 10% SUB-ROUNDED, VITRIFIED, BROWN (7.5YR 5/2) PUMICE FROM 1/64 CM AND AVERAGING 3 MM IN SIZE. - 20% PHENOCRYSTS, QUARTZ (30%) CLEAR, 1/64 MM and AVERAGING 2MM IN SIZE - LITHICS NOT OBSERVED. - MATRIX IS REDDISH GRAY (5YR, 5/2), ASH, MODERATELY WELDED.			1420 28' REFUSAL AT 45° SLOPED BEDROCK.
27	RUN 6							
28								
29								
30								

Prepared by ALEX MOZA Date 12-18-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 02 TA/OU 0, FU-1 Drill Depth From 30' To 40' Page 4 of 4

Driller [illegible] Box #(s) NA Start Date/Time 12-11-95/1430 End Date/Time 12-11-95/1440

Drilling Equip./Method 4" HOLLOW STEM AUGER Sampling Equip./Method CONTINOUS CORE BARREL.

Depth (feet)	Recovery (feet per feet / %)	Field Anayltical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
30–35	5.0/5.0 RUN 7	0100-95 0931 at 33'	PID = 0	NA	30-35 SAA.			1430
35–40	5.0/5.0 RUN 8	0100-95 0932 at 35 0100-95 0433 at 38.5'	PID = 0	NA	35-40 SLIGHTLY TO MODERATELY WELDED IGNIMBRITE WITH VITRIC AND [illegible] PUMICES AND [illegible] IN PRESSED [illegible] CONTENT, [illegible] [illegible]. - 5 to 8% [illegible] VITRIC AND [illegible] [illegible] RANGING FROM 1 TO 4 CM AND [illegible] 2CM IN SIZE. - 20% PHENOCRYSTS, QUARTZ (3%), [illegible] TRANSLUCENT 1 TO 3 MM AND [illegible] 2MM IN SIZE. - LITHICS NOT OBSERVED - MATRIX IS [illegible] GRAY (5/2, 5YR) [illegible] SLIGHTLY [illegible].			1440 35' to 37' [illegible]
40					BOTTOM OF BOREHOLE AT 40'			

Prepared by ALEX MORA Date 12-18-95 Checked By [signature] Date 12/21/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 03 TA/OU 0-FU-7 Drill Depth From 0 To 10 Page 1 of 4

Driller STEWART BROS Box #(s) NA Start Date/Time 12-12-95/0900 End Date/Time 12-12-95/0930

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
0	5'/5.0 RUN 1	0808-95 0930 at 3'	PID = 0	NA	0-3.0' REDDISH BROWN SILTY CLAY (SOIL) WITH GRAVEL INCREASING TO BOTTOM. 3.0-5.0 NR.			0900
5	5'/5.0 RUN 2	0808 95 0935 at 8'	PID = 0	NA	5.0-10.0 MODERATELY WELDED RHYOLITE WITH DEVITRIFIED PUMICE AND MODERATE TO RICH IN PHENOCRYSTS. SLIGHTLY INDURATED. - 5% PUMICE LAPILLI, DEVITRIFIED REDDISH BROWN (5YR 4/3) RANGING FROM 2 TO 5 CM. AND AVERAGING 3 CM IN SIZE. - 20% PHENOCRYSTS: QUARTZ (90%) FELDSPAR THROUGHOUT, 3 MM TO SIZE. - LITHICS NOT OBSERVED. - MATRIX IS REDDISH BROWN (5YR 4/3) ASH, SLIGHTLY TO MODERATELY COHESIVE.			0915
10								

Prepared by ALEX MOZ Date 12-18-95 Checked By [signature] Date 12/21/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 03 TA/OU O FU-1 Drill Depth From 10 To 20 Page 2 of 4

Driller STANDARD BROS Box #(s) NA Start Date/Time 12-12-95/0930 End Date/Time 12-12-95/1010

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Anaytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
10	50/60 RUN 3	0936 @ 14'	PID = 0	NA	10-15 T.A.A. EXCEPT MATRIX IS GRAY (5YR 5/1)			0930 14' FRACTURE, METAL FLOOR 4 FOUND. 12-14 FRACTURED STRONG.
15	50/60 RUN 4	0937 @ 19'	PID = 0	NA	15-20 SLIGHTLY WELDED TO UNWELDED DEVITRIFIED, MODERATE TO RICH PHENOCRYST CONTENT, MOSTLY TO WELL INDURATED. - 5% PUMICE (SAND), DEVITRIFIED, GRAY (5/N), 3 cm MAXIMUM = 25 - 20% FRACTURES, CLOSED (90°), ANGULAR 1 TO 4 mm IN SIZE. - NO VISIBLE LITHICS - MATRIX IS GRAY (5/N), SILT, SLIGHTLY COHESIVE.			1000
20								

Prepared by ALEX MORA Date 12-19-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 93 TA/OU O.U-1 Drill Depth From 20 To 30 Page 3 of 4

Driller STRAIGHT BROS Box #(s) NA. Start Date/Time 12-12-95/1010 End Date/Time 12-12-95/1100

Drilling Equip./Method 4" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
20	5C/5C RUN 5	0100-95 0939 at 24'	PID = 0	NA	20-25 S.A.A - PUMICE UP TO 5CM IN SIZE.			1010 B3 FRACTURE, METAL OXIDE STAINS 22.5 STRONG METAL OXIDE STAINS.
21								
22								
23								
24								
25	5C/5C RUN 6	0100-95 0939 at 29'	PID = 0	NA	25-30 S.A.A - SANIDINE PRESENT (5% OF TOTAL PHENOCRYST CONTENT).			1100
26								
27								
28								
29								
30								

Prepared by ALEX MORA Date 12-19-95 Checked By _____ Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 33 TA/OU [illegible] Drill Depth From 30 To 40 Page 4 of 4

Driller [illegible] Box #(s) NA Start Date/Time [illegible] End Date/Time [illegible]

Drilling Equip./Method [illegible] Sampling Equip./Method [illegible]

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
30	5.0/5.0 RUN 7	0150-[illegible] 0940 to 34.5	PID=0.0	NA	30-35 S.A.A.			1110 34.5' FRACTURE, 45° ESTIMATED DIP DIRECTION [illegible]
31								
32								
33								
34								
35	5.0/5.0 RUN 8	0100-95 0941.	PID=0.0		35'-40' S.A.A. - PLASTIC BROWN TO GREENISH BROWN 37.3' POORLY SORTED, SUBANGULAR			1130 38.1' FRACTURE, HORIZONTAL [illegible] 39' FRACTURE 45° STRIKE N-S, ESTIMATED DIP DIRECTION [illegible]
36								
37								
38								
39								
40					BOTTOM OF BOREHOLE.			

Prepared by ALEX MORA Date 12-18-95 Checked By [signature] Date 12/

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 04 TA/OU [illegible] Drill Depth From 0 To 10 Page [illegible] of 4

Driller [illegible] Box #(s) [illegible] Start Date/Time 12-12-95/1345 End Date/Time 12-12-95/1400

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Anaytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
0	2.5/5.0 RUN 1	NA	PID 0	NA	0-2.5 REDDISH BROWN SANDY SILT [illegible] ORGANIC MATTER. 2.5-5.0 NR.			1345
5	5.0/5.0 RUN 2	[illegible] 0942 at 9'	PID 0	NA	5.0 TO 6.5 REDDISH BROWN SANDY SILT. 6.5 TO 10 MODERATELY WELDED IGNIMBRITE WITH DEVITRIFIED PUMICE AND MODERATE PHENOCRYST CONTENT. MODERATELY INDURATED. - 5% PUMICE [illegible] GRAY RED (2.5YR, 4/2). RANGING FROM 1 TO 3 CM IN SIZE AND AVERAGING 1 CM. - 20% PHENOCRYSTS, QUARTZ (90%) [illegible] TRANSPARENT. 1 TO 4 MM IN SIZE AND AVERAGING 2 MM. - LITHICS NOT OBSERVED - MATRIX IS DARK [illegible] (5YR, 4/6) SLIGHTLY [illegible].			1400
10								

Prepared by ALEX MORA Date 12-?-95 Checked By [illegible] Date 12/21/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 04 TA/OU 0 FD-1 Drill Depth From 10 To 20 Page 2 of 4

Driller STEWART GROSS Box #(s) NA Start Date/Time 12-13/1400 End Date/Time 12-13/1445

Drilling Equip./Method [illegible] Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
10–15	5.0/5.0 RUN 3	0100-95-0943 at 12'; 0100-95-0944 at 11'	PID =0	NA	10-15 S.A.A. EXCEPT [illegible] 3 CM. [illegible]; AT [illegible]			1400; 11-12 FRACTURED, 45° FILLED WITH [illegible] BROWN CLAY; CLAY [illegible] AND MOIST; 12-13 FRACTURED 45° S.A.A. FRACTURE.
15–20	5.0/5.0 RUN 4	0100-95-0945 at 17'	PID =0	NA	15-20 S.A.A.			1445

Prepared by ALEX MOZA Date 12-13-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY | **CORE SAMPLE LOG**

Borehole ID 04 TA/OU O-50-1 Drill Depth From 20 To 30 Page 3 of 4

Driller STEWART BROS Box #(s) NA Start Date/Time [illegible] End Date/Time [illegible]

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
20	5.0/5.0 RUN 5	0950-25-0946 at 23.5'	PID=0	NA	20-25 UNA MATRIX DARK GRAYISH GRAY (5YR 4/2).			1500
25	5.0/5.0 RUN 6	0000-25-0947 at 27.0 0.00 95-0948 at 28.5'	PID=0	NA	25-27 MODERATELY WELDED IGNIMBRITE WITH DEVITRIFIED PUMICE AND MODERATE IN MINERALOGIES TOWARD TO MODERATELY INDURATED. - 8% PUMICE LAPILLI, SCATTERED DARK MEDIUM GRAY (10YR 5/1), RANGING FROM 1 TO 3 CM, AND MEASURING 2CM IN SIZE. - 10% CRYSTALS (QUARTZ (5%) FELDSPAR, CLEAR 1-2 MM IN SIZE AND BIOTITES 1 MM IN SIZE. - LITHICS NOT OBSERVED - MATRIX IS DUSKY RED (2.5YR 3/3) 27-30 UNA SLIGHT PUMICE DARKENED (5YR 4/4) AND MATRIX DARK RED (2.5YR 3/6).			1500
30								

Prepared by ALEX MORA Date 12/20/95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 34 TA/OU [illegible] Drill Depth From 30 To 40 Page 4 of 4

Driller STEWART BROS. Box #(s) NA Start Date/Time 12-13-95/1500 End Date/Time 12-13-95/1600

Drilling Equip./Method [illegible] Sampling Equip./Method SOUTHWEST CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
30	5.0/5.0 RUN 7	0100-95 0949	PID: 0	NA	30-35 SAA EXCEPT MATRIX IS DARK REDDISH GRAY (5YR 4/2).			1545
35	5.0/5.0 RUN 8	0100-95 0950	PID: 0	NA	35-40 SAA			1600
40					BOTTOM OF BOREHOLE AT 40'			

Prepared by ALEX MORA Date 12-19-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY | CORE SAMPLE LOG

Borehole ID 05 TA/OU 0-FU-1 Drill Depth From 0 To 10 Page 1 of 4

Driller STEWART BROS. Box #(s) NA Start Date/Time 12-13-95/1000 End Date/Time 12-13-95/1030

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
0	3.5/5.0 RUN 1	0100-95-0951 at 4'	PID=0	NA	0-1.5' ASPHALT 1.5-3.0 NR 3.0-5.0 BROWN CLAY WITH YELOWISH SAND. DRY LOW PLASTICITY.			1000
5	5.0/5.0 RUN 2	0100-95-0952. at 8.5'	PID=0	NA	5'-6' BROWN CLAY WITH YELOWISH SAND 6'-10 SLIGHTLY TO MODERATELY WELDED IGNIMBRITE WITH VITRIC PUMICE AND POOR TO MODERATE IN PHENOCRYSTS. SLIGHTLY INDURATED. – 5% PUMICE LAPILLI, VITRIC, LIGHT BLUISH GRAY (7/1), RANGING FROM 1 TO 3 CM, AND AVERAGING 1.5 CM IN SIZE. – 5% PHENOCRYST, QUARTZ (90%) SEMI-ANGULAR TRANSLUCID, RANGES FROM 1 TO 3 mm IN SIZE. OTHERS (10%). – LITHICS NOT OBSERVED. – MATRIX IS BLUISH GRAY (6/1), FSH. SLIGHTLY COHESIVE, AND BECOMING GRAY (5YR 6/1) TOWARD BOTTOM.			1015. FRACTURE AT 7', 30° CLAY LINNED. BROWN CLAY WITH WHITE CALICHE.

Prepared by ALEX MOSH Date 12-18-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 05 TA/OU 0.FU-1 Drill Depth From 10 To 20 Page 2 of 4

Driller STEWART BROS. Box #(s) NA Start Date/Time 12-13-95/1025 End Date/Time 12-13-95/1100

Drilling Equip./Method 6" HOLLOW STEM AUGER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
10	5.0/8.0 RUN 3	0160-95-0953. @ 14.5'	PID=0	NA	10-15' S.A.A EXCEPT: -MATRIX IS GRAY (7.5YR 6/1) AND - PHENOCRYSTS AVERAGE 4MM IN SIZE.			1025
11								
12								
13								
14								
15	5.0/5.0 RUN 4	0160-95-0954 @ 19'	PID=0	NA	15-20' S.A.A. EXCEPT: - PUMICE LAPILLI BROWN (7.5YR 4/2).			1030
16								
17								
18								
19								
20								
					NO ENTRIES - SEE NEXT PAGE			

Prepared by ALEX MORA Date 12-18-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY | **CORE SAMPLE LOG**

Borehole ID 05 TA/OU O PU-1 Drill Depth From 20 To 30 Page 3 of 4

Driller STEWART BROSS. Box #(s) NA Start Date/Time 12-13-95/1100 End Date/Time 12-13-95/1130

Drilling Equip./Method 6 HOLLOW STEM AUGER Sampling Equip./Method SOP OG.24 = CONTINUOUS 3 CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
20	5.0/5.0 RUN 5	0100-95-0955 at 23'	PID = 0	NA	20'-25' S.A.A. EXCEPT - MATRIX IS GRAY (5/N).			1100 FRACTURE. FROM 22' TO 23' 50°, SLIGHTLY STAINED BROWN.
21								
22								
23								
24								
25	5.0/5.0 RUN 6	0100-95 0956 at 27'	PID = 0	NA	25'-30' - SLIGHTLY WELDED IGNIMBRITE, WITH VITRIC AND DEVITRIFIED PUMICE, AND MODERATE IN PHENOCRYSTS. SLIGHTLY INDURATED. - 5% PUMICE (APILLI, VITRIC AND DEVITRIFIED, GRAY (5YR 6/1) RANGING FROM 1 TO 3 cm, AND AVERAGING 2 CM IN SIZE. ALSO DARK GRAY (5YR 4/1) PUMICES. - 10% PHENOCRYSTS, QUARTZ (70%), ANGULAR TO SEMI-ANGULAR, TRANSPARENT, AVERAGING 2 MM IN SIZE. - LITHICS NOT OBSERVED. - MATRIX IS GRAY (5YR 6/1) ASH, SLIGHTLY COHESIVE.			1120
26								
27								
28								
29								
30								

Prepared by ALEX MOZA Date 12-18-95 Checked By [signature] Date 12/20/95

LOS ALAMOS NATIONAL LABORATORY ENVIRONMENTAL RESTORATION PROGRAM

SAMPLE MANAGEMENT FACILITY

CORE SAMPLE LOG

Borehole ID 95 TA/OU O-50-1 Drill Depth From 30 To 40 Page 4 of 4

Driller STEWART BROS Box #(s) NA Start Date/Time 12-13-95/1130 End Date/Time 12-13-95/1200

Drilling Equip./Method CHICAGO BIT DIA PACKER Sampling Equip./Method CONTINUOUS CORE BARREL

Depth (feet)	Recovery (feet per feet / %)	Field Analytical Sample Number	Field Screening Results	Top/Bottom of Core in Box	Lithology-Petrology - Soil	Graphic Log	Lithologic Unit	Notes
30	50/60 RUN 7	0150-95 0959 at 34'	PID=0	NA	30-35 S.A.A 31.5-32.5 POORLY INDURATED			1130
35	30/50 RUN 8	0150-95 0960 at 37'	PID=0	NA	35-37' NR. 37-40 SAA. POORLY TO NON INDURATED GRAY (5Y) SAND-LIKE IGNIMBRITE			1140
40					BOTTOM OF BOREHOLE AT 40'.			1200

Prepared by ALEX MOZA Date 12-18-95 Checked By [signature] Date 12/20/95

LANL ENCLOSURE SIX

LANL GENERAL GEOLOGY AND HYDROLOGY INFORMATION

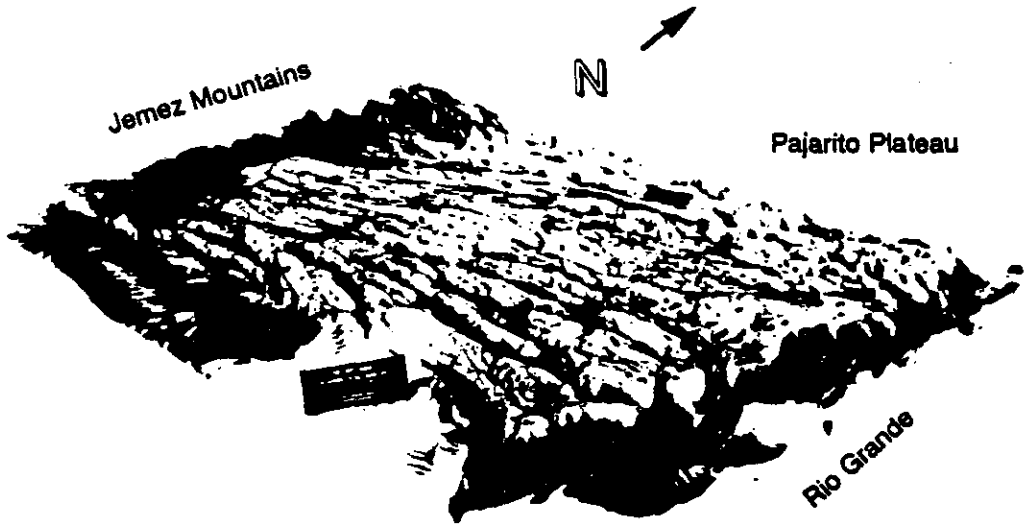


Figure II-3. Topography of the Los Alamos area.

The report provided environmental input for decisions regarding continuing activities at the Laboratory. It also provided more detailed information on the environment in and around Los Alamos. DOE is planning to prepare a new site-wide EIS for the Laboratory within the next several years.

C. Geology and Hydrology

Most of the finger-like mesas in the Los Alamos area are Bandelier Tuff, ash fall, ash fall pumice, and rhyolite tuff (Figure II-6). The tuff, ranging from nonwelded to welded, is over 300 m (1,000 ft) thick in the western part of the plateau and thins to about 80 m (260 ft) eastward above the Rio Grande. It was deposited as a result of a major eruption of a volcano in the Jemez Mountains about 1.1 to 1.4 million years ago.

The tuff overlaps onto the Tschicoma Formation, which consists of older volcanics that form the Jemez Mountains. The tuff is underlain by the conglomerate of the Puye Formation (Figure II-6) in the central and eastern edge along the Rio Grande. Chino Mesa basalts interfinger with the conglomerate along the river. These formations overlay the sediments of the Santa Fe Group, which extends across the Rio Grande Valley and is more than 1,000 m (3,300 ft) thick. The Laboratory is bordered on the east by the Rio Grande, within the Rio Grande Rift. Because the rift is slowly widening, the area experiences frequent but minor seismic disturbances.

Surface water in the Los Alamos area occurs primarily as ephemeral or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the Laboratory site before they are depleted by evaporation, transpiration, and infiltration. Run-off from heavy thunderstorms or heavy snowmelt reaches the Rio Grande several times a year in some drainages. Effluents from sanitary sewage, industrial waste treatment plants, and cooling-tower blowdown enter some canyons at rates sufficient to maintain surface flows for varying distances.

Groundwater in the Los Alamos area occurs in three modes: (1) water in shallow alluvium in canyons, (2) perched water (a body of groundwater above an impermeable layer that separates it from the underlying main body of groundwater), and (3) the main aquifer of the Los Alamos area.

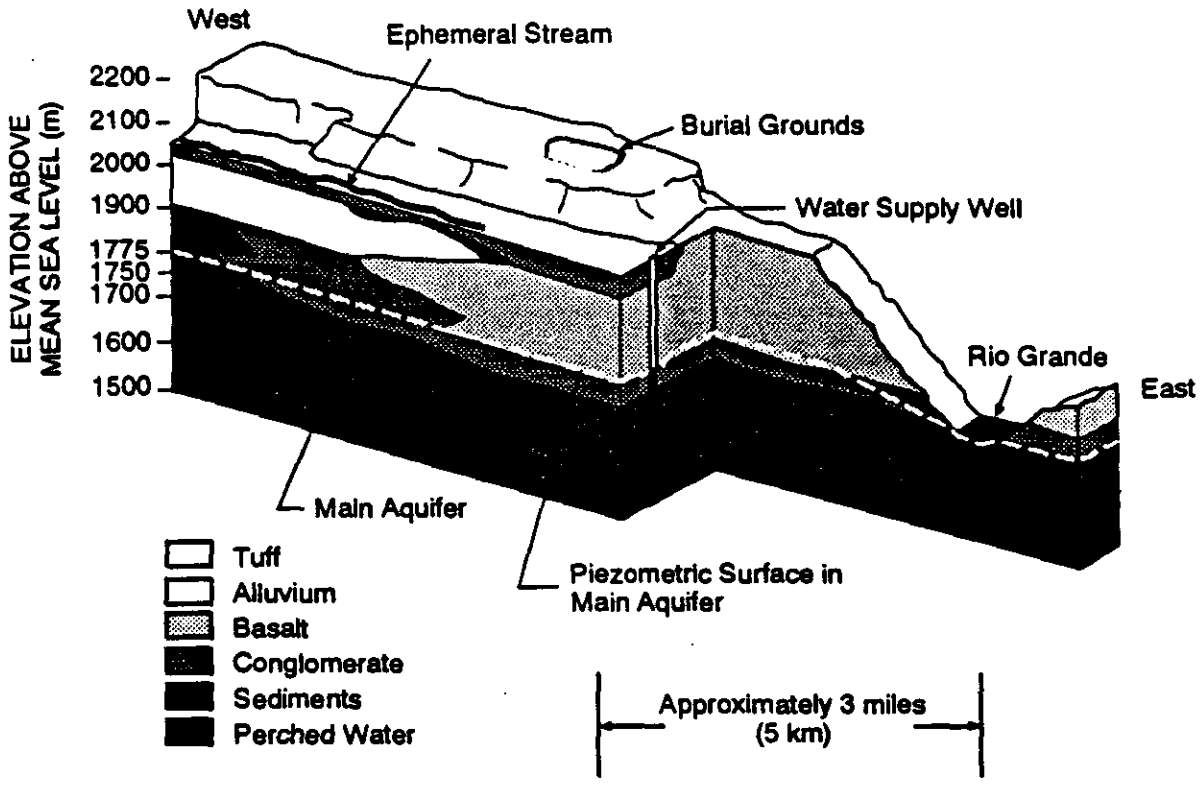


Figure II-6. Conceptual illustration of geologic and hydrologic relationship in Los Alamos area.

Ephemeral and interrupted streams have deposited alluvium that ranges from less than 1 m (3 ft) to as much as 30 m (100 ft) in thickness. Run-off in canyons infiltrates the alluvium until its downward movement is impeded by layers of weathered tuff and volcanic sediment that are less permeable than the alluvium. This creates shallow bodies of perched groundwater that move down gradient within the alluvium. As water in the alluvium moves down gradient, it is depleted by evapotranspiration and movement into underlying volcanics (Purtymun 1977). The perched alluvial groundwaters show the effects of discharges from the Laboratory.

Perched groundwater occurs at intermediate depths in conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia canyons. It has been found at depths of about 37 m (120 ft) in the midreach of Pueblo Canyon, about 45 to 60 m (150 to 200 ft) beneath the surface in lower Pueblo and Los Alamos canyons near their confluence in basalts in Los Alamos Canyon at 61 to 76 m (200 to 250 ft) (Figure II-6), and in Sandia Canyon near the eastern Laboratory boundary at a depth of about 137 m (450 ft). This intermediate depth perched water has one known discharge point at Basalt Spring in Los Alamos Canyon. The intermediate depth groundwaters communicate with the overlying perched alluvial groundwaters and show the effects of radioactive and inorganic contamination from Laboratory operations.

The main aquifer of the Los Alamos area is the only aquifer in the area capable of serving as a municipal water supply. The surface of the aquifer rises westward from the Rio Grande within the Tesuque Formation into the lower part of the Puye Formation beneath the central and western part of the plateau. Depth to the main aquifer is about 300 m (1,000 ft) beneath the mesa tops in the central part of the plateau. The main aquifer is separated from alluvial and perched waters by about 110 to 190 m (350 to 620 ft) of tuff and volcanic sediments with low (<10%) moisture content.

Water in the main aquifer is under artesian conditions in the eastern part and along the Rio Grande (Purtymun 1974b). Continuously recorded data on water levels collected in test wells since fall 1992 indicate that the main

aquifer exhibits confined aquifer response to barometric and earth tide effects throughout the Plateau. Major recharge to the main aquifer is probably from the west because the piezometric surface slopes downward to the east. The main aquifer discharges into the Rio Grande through springs in White Rock Canyon. The 18.5 km (11.5 mi) reach of the river in White Rock Canyon between Otowi Bridge and the mouth of Rito de Frijoles receives an estimated 5.3 to 6.8 × 10^6 m^3 (4,300 to 5,500 ac-ft) annually from the aquifer.

D. Climatology

Climatological averages for atmospheric state variables (temperature, pressure, and moisture) and precipitation are based on observations made at the official Los Alamos weather station from 1961 to 1991. Extremes are based on the 1911 to 1991 period. Although the location of the official weather station has changed over the years, all locations are within 30 m (100 ft) of each other in elevation and 5 km (3 mi) in distance. The meteorological conditions described here are representative of conditions on the Pajarito Plateau at an elevation of approximately 2,250 m (7,400 ft) above sea level.

Statistics on wind do not vary significantly from year to year; it may be helpful to refer to the wind roses for 1992 (Figures II-7 and II-8) along with the following text. In these diagrams, the length of each spoke is proportional to the amount of time that the wind blew from the indicated direction; circles of a probability of 6% and 12% are shown for reference. The spoke representing each wind direction sector is partitioned into segments, and the length of each segment is proportional to percentage of time the wind speed fell within the indicated range. Unless otherwise noted, the following discussion is based on winds observed at 11 m (36 ft) above the ground. The average time for wind gusts is approximately 1 s.

Los Alamos winds are generally light, averaging 2.8 m/s (6.3 mi/h). Strong winds are most frequent during the spring when sustained winds exceeding 11 m/s (25 mi/h) with peak gusts exceeding 22 m/s (50 mi/h) are common. The highest wind gust in the record is 34.4 m/s (77 mi/h).

Winds over the plateau show considerable spatial structure and temporal variability. The semiarid climate promotes strong surface heating by day and strong radiative cooling by night. Because the terrain is very complex, heating and cooling rates are uneven over the Los Alamos area, and this results in diurnal thermally generated local flows. However, it is often difficult to explain observed winds completely in terms of the simple conceptual models of slope and valley flows.

During sunny, light-wind days, an upslope flow often develops over the plateau in the morning hours. This flow is more pronounced along the western edge of the plateau, where it is 200 to 500 m (650 to 1650 ft) deep. By noon, southerly flow usually prevails over the entire plateau.

At measurement sites closer to the eastern edge of the plateau, wind roses show a weak secondary peak in the daytime wind direction in the northeast sector. These northeasterlies also show up in the wind roses for observations made at 92 m (300 ft) and 510 m (1,670 ft) above the ground. They are thought to result from cold air drainage down the Rio Grande Valley that persists into the early morning hours.

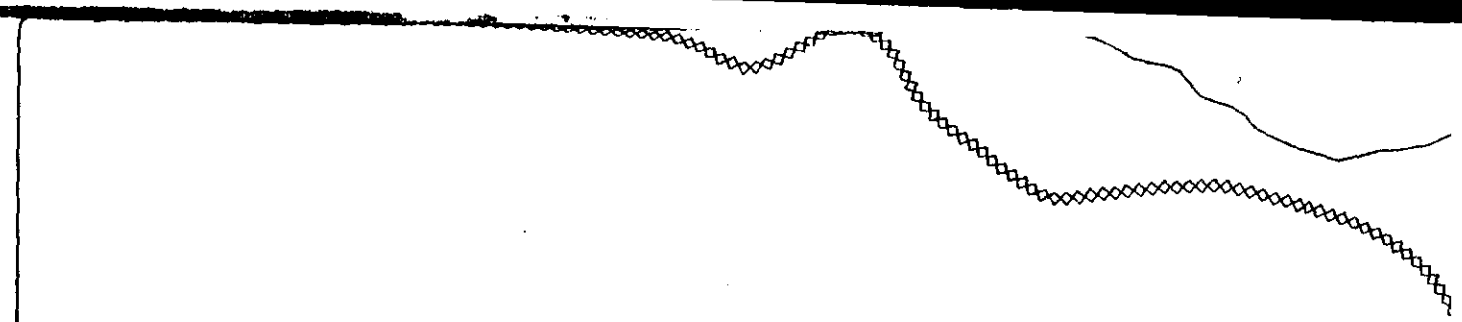
The prevailing nighttime flow along the western edge of the plateau is west-southwesterly to northwesterly. These nighttime westerlies result from cold air drainage off the Jemez Mountains and the Pajarito Plateau; the drainage layer is typically 50 m (165 ft) deep in the vicinity of TA-3. At sites farther from the mountains, the nighttime direction is more variable but usually has a relatively strong westerly component. Just above the drainage layer, the prevailing nighttime flow is southwesterly, with minor peaks in the distribution around northwest and northeast. At 510 m (1,673 ft) above the ground, the wind direction distribution exhibits a broad, flat peak covering the whole western half of the compass.

Atmospheric flow in the canyons is quite different than over the plateau. Data collected from Los Alamos Canyon suggest that at night a cold air drainage fills the lower portion of the canyon. The flow is steady and continues for about an hour after sunrise when it ceases abruptly and is followed by an unsteady up-canyon flow for a couple of hours. This up-canyon flow often gives way to the development of a rotor that fills the canyon when the wind over the plateau has a strong cross-canyon component. When the rotor occurs, southwesterly (or southeasterly) flow over the plateau results in northwesterly (or northeasterly) flow at the canyon bottom. Down-canyon flow begins again around sunset, but the onset time appears to be more variable than cessation time in the morning.

ENCLOSURE SEVEN

GROUNDWATER WELLS AND OTHER PENETRATIONS AND DRAWINGS

Note: The nearest public supply well is PM-5 which is approximately 8,800 feet southeast of former UST TA-0, 6th Street.



LEGEND

1748

PERCHED ALLUVIAL MONITORING WELLS
(Old wells are pre-1990; new wells installed since 1990 according to EPA guidelines)

- ○ New Dry Well
- ⊖ Old Dry Well
- ● New Saturated Well
- ◓ Old Saturated Well

Reviewer Signatures: (By signing, the reviewer indicates that he/she **reviewed** and **approves** the document.)

Reviewer (Print reviewer's name under title)	Signature	Date
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