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Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303



Dear Mr. Bearzi:

SUBJECT: TRANSMITTAL OF HUMAN-HEALTH AND ECOLOGICAL SCREENING ASSESSMENT FOR THE TECHNICAL AREA 16 BURN GROUND, REVISION 1

The purpose of this letter is to transmit the revised screening assessment for the Technical Area (TA) 16 open burning treatment units included within the draft Los Alamos National Laboratory Hazardous Waste Facility Permit. This revision includes additional data and figures as requested by the New Mexico Environment Department- Hazardous Waste Bureau (NMED-HWB) on January 7, 2010 by teleconference and email. This assessment concludes that no potential unacceptable risks to human and ecological receptors are present at the TA-16 Burn Ground.

The enclosed human-health and ecological screening assessment for the TA-16 Burn Ground includes figures illustrating all sample locations; toxicity equivalent concentrations for dioxin and furan data; and total concentration values for barium, cadmium and silver. The assessment revision also incorporates further spatial analysis and avian receptor data. This advanced assessment also makes mention of the following considerations.

- Small mammal studies conducted within the area indicate that populations within the area are healthy.
- Elevated concentrations could likely be due to historic operations at the site.
- Previous studies have found no effects to small mammal populations at similar dioxin/furan concentrations in the canyons.

The following are additional factors that contribute to reducing the risk to human and ecological receptors at the TA-16 Burn Ground.

- Historical operations at the TA-16 Burn Ground included other open burning operations that were previously closed under the Resource Conservation and Recovery Act or are scheduled for clean-up under the corrective action program.



- The current and proposed future annual volumes of waste to be treated at the TA-16 Burn Ground are significantly decreased from past operations and are therefore unlikely to adversely impact the concentration of contaminants in the soil surrounding the units.
 - Decreases to the total volume of waste treated at the TA-16 Burn Ground has been detailed in previous submittals to the NMED-HWB and is due to strong efforts in total waste minimization, careful waste segregation, and the substitution of nonhazardous materials for high explosive research and processing operations.
- Types of waste streams treated and waste treatment methods used in the past were more likely to have impacts to soil than waste streams that are currently treated or slated for treatment within the future.
 - Past waste streams included more material such as wooden pallets, plastics, metal pieces, paper, and solvents. Waste treatment, prior to the installation of the propane burners at TA-16-388, included the addition of wood and a petroleum fuel such as kerosene. Current operations do not require fuel other than propane at TA-16-388 and only a small amount of a petroleum based fuel at TA-16-399. Waste streams have been eliminated through waste minimization efforts mentioned above, as well as increased waste generator education on minimizing the potential for high explosives contamination.

A compact disc is also included with this submittal that includes an electronic copy of the assessment discussed above.

Please contact Jack Ellvinger at (505) 667-0633 of the Water Quality and RCRA Group (ENV-RCRA) if you have questions.

Sincerely,



Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group (ENV-RCRA)

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1.0 HUMAN-HEALTH SCREENING ASSESSMENT

A human-health risk screening assessment for Technical Area 16 (TA-16) Burn Ground is presented in the following sections.

1.1 Conceptual Site Model

Only authorized Laboratory workers currently have access to the area around the TA-16 Burn Ground so the predominant land use is industrial. Therefore, Laboratory workers are the primary receptors and the industrial scenario is the defining scenario for the human health risk screening assessment (i.e., the scenario on which decisions are based). Because the site is located within the boundaries of an operational facility (TA-16), the reasonably foreseeable future land use will continue to be industrial. Residential exposure is also assessed and provided for comparison purposes.

Potential exposure pathways for a site worker (as well as a hypothetical resident) include incidental ingestion of soil, inhalation of fugitive dust or vapors, dermal contact with soil, and external irradiation by gamma-emitting radionuclides. Inhalation of gas-phase contaminants, such as tritium and/or organic chemicals emanating from the site into the atmosphere, is not a potential means of exposure. Other potential pathways from subsurface releases to potential receptors would be complete only if soil were to be excavated and brought to the surface. In such a case, the potential contaminant migration pathways and potential exposure pathways would be the same as those of a surface soil release.

The primary ecological exposure pathways include root uptake, ingestion of contaminated soil, and food-web transport.

1.2 Identification of Chemicals of Potential Concern

1.2.1 Sampling

Thirty-seven surface samples (0-1 ft) were collected from 37 locations across the TA-16 Burn Ground (Figure 1.2-1) and analyzed for Resource Conservation and Recovery Act (RCRA) metals and/or dioxin and furan congeners. One sample (09RCRA462) is a background sample and is therefore not included in the calculation of the risks from dioxin and furan congeners. The data used are summarized in the following paragraphs and are evaluated in the human health and ecological risk screening assessments.

1.2.2 Evaluation of Inorganic Chemicals

Thirty-one surface samples were collected from 31 locations and analyzed for RCRA metals. Table 1.2-1 presents the comparison of the inorganic chemicals to soil background values (BVs) (LANL 1998, 059730). Barium, cadmium, and silver were detected above BVs in at least one soil sample (Figures 1.2-2, 1.2-3, 1.2-4). These three inorganic chemicals are retained as chemicals of potential concern (COPCs).

1.2.3 Evaluation of Organic Chemicals

Thirty-six surface samples were collected from 36 locations and analyzed for dioxin/furan congeners (Figure 1.2-5). Dioxin/furan congeners were detected in each sample (Table 1.2-2). The number of congeners detected ranged from 3 to 17. All detected dioxin/furan congeners were retained as COPCs.

1.3 Screening Evaluation

The exposure point concentration (EPC) for the dioxin and furan congeners is the sum of the detected congeners weighted by the World Health Organization (WHO) 1995 Toxic Equivalent Factors (TEFs) (<http://www.epa.gov/ncea/pdfs/dioxin/part2/drich9.pdf>); the sum is expressed as the tetrachlorodibenzodioxin (TCDD) [2,3,7,8-] equivalent concentration. The TEFs used are presented in Table 1.3-1 and the TEF calculations are presented in Table 1.3-2.

The EPCs are the 95% upper confidence limit (UCL) of the arithmetic mean. All samples were collected from 0-1 ft and all of the data are used to calculate 95% UCLs for the industrial and residential risk screening assessments. The 95% UCL for dioxin and furan congeners was calculated using the TCDD[2,3,7,8-] equivalent concentration for each sample (Table 1.3-2).

The 95% UCLs for each COPC were calculated as described in U.S. Environmental Protection Agency (EPA) guidance (EPA 2002, 073593). Tests for distributions were performed using ProUCL 4.00.04 to determine the appropriate method for UCL calculations and the recommended UCLs were used (Figures 1.3-1, 1.3-2, 1.3-3, and 1.3-4). The 95% UCLs for each COPC are presented in Table 1.3-3. The following methods were used to calculate 95% UCL concentrations (depending on the type of distribution found for the data set):

- Student's t-statistic procedure – normal distributions
- Chebyshev (Mean, Sd) procedure – nonparametric distributions
- H-UCL procedure – lognormal distributions

The EPC for each COPC was compared with the industrial and residential soil screening levels (SSLs). The chemical SSLs used in the evaluations were obtained from New Mexico Environment Department (NMED) guidance (NMED 2009, 106420). The SSLs for carcinogens are equivalent to a 1×10^{-5} cancer risk and for noncarcinogens represent a hazard quotient (HQ) of 1.0. The comparisons with SSLs are conducted separately for carcinogens and noncarcinogens for industrial and residential receptors (Tables 1.3-4 through 1.3-7).

The EPCs for noncarcinogenic COPCs were less than their respective industrial and residential SSLs. The hazard indices (HIs) for the noncarcinogenic COPCs are approximately 0.004 and 0.06, respectively (Tables 1.3-4 and 1.3-5), which are less than NMED's target HI of 1.0 (NMED 2009, 106420).

The EPCs for carcinogenic COPCs were less than their respective industrial and residential SSLs. The total excess cancer risks from exposure to carcinogenic COPCs are approximately 3×10^{-7} and 2×10^{-6} , respectively (Tables 1.3-6 and 1.3-7), which are less than the NMED target risk level of 1×10^{-5} (NMED 2009, 106420).

1.3.1 Uncertainty Analysis

The analysis for human health is subject to uncertainties associated with data evaluation, exposure assessment, and toxicity values. Each or all of these uncertainties may affect the assessment results.

1.3.1.1 Data Evaluation

Data evaluation uncertainties may include errors in sampling, laboratory analysis, and data analysis. Although concentrations used in this risk assessment were less than estimated quantitation limits for some COPCs, data evaluation uncertainties are expected to have little effect on the assessment results.

The J (estimated) qualification of detected concentrations of some organic COPCs does not affect the assessment.

Another data evaluation uncertainty relates to the use of the 95% UCL as the EPC for each COPC. Use of the 95% UCL may result in an overestimation of risk for analytes that have elevated detection limits. Use of the maximum concentration also overestimates the exposure to contamination. Receptors are not exposed to these concentrations across the site.

1.3.1.2 Exposure Assessment

The receptors used in the assessment are subject to exposures in a different manner than the exposure assumptions used to derive the SSLs. Assumptions for the industrial SSLs are that the potentially exposed individual is a Laboratory worker who is outside for 8 h/d for 225 d/yr (NMED 2009, 106420) and spends the entire 8 h on-site within the contaminated area. Because it is unlikely that the worker is within the contaminated area for the entire work day, the screening assessment overestimates the exposure. As a result, risk, hazard, and dose may be overestimated.

Assumptions underlying the exposure parameters, routes of exposure, amount of contaminated media available for exposure, and intake rates for routes of exposure are consistent with NMED parameters and default values (NMED 2006, 106420). In the absence of site-specific data, several upper-bound values for the assumptions may be combined to estimate exposure for any one pathway, and the resulting risk estimate can exceed the 99th percentile. Therefore, uncertainties in the assumptions underlying the exposure pathways may contribute to risk assessments that exceed the reasonably expected range.

1.3.1.3 Toxicity Values

The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the risk-based screening values used in the screening evaluation (NMED 2009, 106420). Uncertainties were identified in four areas with respect to the toxicity values: (1) extrapolation from other animals to humans, (2) interindividual variability in the human population, (3) the derivation of RfDs and SFs, and (4) the chemical form of the COPC.

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 between animals and humans in chemical absorption, metabolism, excretion, and toxic responses. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated in each of these steps, resulting in the overestimation of potential risk.

For noncarcinogenic effects, the degree of variability in human physical characteristics is important both in determining the risks that can be expected at low exposures and in defining the no-observed-adverse-effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a 10-fold factor to reflect individual variability within the human population that can contribute to uncertainty in the risk assessment. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

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 between other animals and humans in chemical absorption, metabolism, excretion, and toxic response. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address

these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.

COPCs may be bound to the environmental matrix and not available for absorption into the human body. However, the exposure scenarios default to the assumption that the COPCs are bioavailable. This assumption can lead to an overestimation of the total risk.

1.3.1.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally unknown and possible interactions could be synergistic or antagonistic, resulting in either an overestimation or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

1.3.2 Interpretation

Based on an industrial scenario, the HI (0.004) is less than NMED's target level of 1.0 and the cancer risk (3×10^{-7}) is less than the NMED target level of 1×10^{-5} . For the residential scenario, the HI (0.06) is less than NMED's target level of 1.0 and the cancer risk (2×10^{-6}) is less than the NMED target level of 1×10^{-5} . The screening assessments indicate that there is no potential unacceptable risk to human health at the TA-16 Burn Ground.

2.0 ECOLOGICAL SCREENING ASSESSMENT

An ecological risk screening assessment for the TA-16 Burn Ground is presented in the following sections.

2.1 Screening Evaluation

The ecological risk-screening evaluation identifies chemicals of potential ecological concern (COPECs) and is based on the comparison of EPCs to ecological screening levels (ESLs) in accordance with Laboratory guidance (LANL 2004, 087630). The EPCs used in the assessment are presented in Table 1.3-3 and the calculation is described in section 1.3. The ESLs obtained from ECORISK Database, Version 2.3 (LANL 2008, 103352) are presented in Table 2.1-1. In addition, the avian ESLs for TCDD[2,3,7,8-] from ECORISK Database, Version 2.0 (LANL 2003, 080117) are presented in Table 2.1-1. The ESLs are based on similar species and are derived from experimentally determined NOAELs, lowest-observed-adverse-effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and TRVs are presented in the ECORISK Database, Versions 2.0 and 2.3 (LANL 2003, 080117; LANL 2008, 103352).

The HQs calculated for each COPEC and screening receptor are the ratios of the EPC to the ESLs for each ecological receptor. The higher the contaminant levels relative to the ESLs, the higher the potential risk to receptors; conversely, the higher the ESLs relative to the contaminant levels, the lower the potential risk to receptors. The analysis begins with a comparison of the minimum ESL for each COPC to the EPC. HQs greater than 0.3 are used to identify COPECs requiring additional evaluation (LANL 2004, 087630). Individual HQs for a receptor are summed to derive an HI; an HI greater than 1.0 is an indication

that further assessment may be needed to be sure that exposure to multiple COPECs at a site will not lead to potential adverse impacts to a given receptor population. The HQ and HI analysis is a conservative indication of potential adverse effects and is designed to minimize the potential of overlooking possible COPECs at the site.

The HQs using the minimum ESLs exceeded 0.3 for barium, cadmium, silver, and TCDD[2,3,7,8-] (Table 2.1-2). All of the COPCs are retained as COPECs. An HQ for each COPEC/receptor combination was calculated and summed to obtain an HI for each receptor. The HI is the sum of HQs for chemicals with common toxicological endpoints for a given receptor. It is assumed for the purposes of ecological screening, that nonradionuclides have common toxicological effects and that HQs may be added. The calculations indicate that receptors, except the kestrel, robin (herbivore and omnivore), and cottontail, have HIs greater than 1.0 (Table 2.1-3). The results are discussed further in the uncertainty section.

2.2 Uncertainty Analysis

2.2.1 Chemical Form

The assumptions used in the ESL derivations are 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. These factors tend to result in conservative ESL estimates, 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 COPCs was not determined as part of the investigation. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not typically found in the environment. Inorganic, organic, and radionuclide COPECs are generally not 100% bioavailable to receptors in the natural environment because of interference from other natural processes, such as the adsorption of chemical constituents to matrix surfaces (e.g., soil) or 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 2004, 087630), and the values are biased toward overestimating the potential risk to receptors.

2.2.2 Exposure Assumptions

The EPCs used in the calculations of HQs are the 95% UCL concentrations. These EPCs are conservative estimates of exposure to each COPC. The sampling efforts focused on areas of known contamination, and receptors were assumed to ingest 100% of their food and spend 100% of their time at the site. These assumptions regarding the exposure for terrestrial receptors within the TA-16 Burn Ground are likely to result in an overestimation of potential ecological exposure and risk.

2.2.3 Toxicity Values

The HQs were calculated using ESLs, which are based on NOAELs as threshold effect levels; actual risk for a given COPEC/receptor combination occurs at a higher level, possibly somewhere between the NOAEL-based threshold and the threshold based on the LOAEL. The use of NOAELs leads to an overestimation of potential risk to ecological receptors. ESLs are based on laboratory studies requiring extrapolation to wildlife receptors. Laboratory studies are typically based on “artificial” and maintained populations with genetically similar individuals and are limited to single chemical exposures in isolated and controlled conditions using a single-exposure pathway. Wild species are concomitantly exposed to a

variety of chemical and environmental stressors, potentially rendering them more susceptible to chemical stress. On the other hand, wild populations are likely more genetically diverse than laboratory populations, making wild populations, as a whole, less sensitive to chemical exposure than laboratory populations. The uncertainties associated with the ESLs tend to lead to an overestimation of potential risk.

The avian ESLs for TCDD[2,3,7,8-] obtained from ECORISK Database, Version 2.0 (LANL 2003, 080117) are based on a toxicity value using intraperitoneal injections. This route of exposure does not occur naturally and assumes that 2,3,7,8-TCDD bioavailability and absorption from the gastrointestinal tract and the abdominal cavity are not significantly different. However, exposure by this route likely overestimates the potential absorption of TCDD[2,3,7,8-] by the receptor and thereby overestimates the potential effect on the receptor.

2.2.4 Comparison of EPCs to Background Concentrations

The ecological risk-screening assessments are based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs of some of the inorganic COPECs are similar to background concentrations, indicating that exposure of receptors to these inorganic chemicals is similar to background.

The EPC for cadmium is similar to background concentrations for soil, indicating that exposure is similar to background (Table 2.2-1). Cadmium is not retained as a COPEC because the EPC is similar to background. Barium and silver are retained as COPECs for further evaluation.

2.2.5 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUFs) are used to account for the amount of time that a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUF for an individual organism is calculated by dividing the size of the site by the HR for that receptor. Because threatened and endangered species must be assessed on an individual basis (EPA 1999, 070086), the AUF is applicable for the Mexican spotted owl. The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl. Because the unadjusted HI for the kestrel (top carnivore) is 0.5 (Table 2.2-2) an AUF for the Mexican spotted owl is not warranted. There is no potential adverse impact to the Mexican spotted owl because the kestrel (top carnivore) HI is less than 1.0.

2.2.6 Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of threatened and endangered species (EPA 1999, 070086). One approach to addressing the potential effects on populations is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for each receptor is based on the individual receptor home range and its dispersal distance (Bowman et al. 2002, 073475). Bowman et al. (2002, 073475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the HR (i.e., the square root of the HR area). If only the dispersal distances for the mammals with HRs within the range of the screening receptors are used, the median dispersal distance becomes 3.6 times the square root of the HR ($R^2 = 0.91$) (Bowman et al. 2002, 073475). If it is assumed that the receptors can disperse over 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 for each receptor can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately $40HR$.

The population area use factor (PAUF) is calculated by dividing the site area (approximately 2.6 hectares [ha] for the TA-16 Burn Ground) by the population area of the receptor (Table 2.2-2). The HQs and HIs are recalculated minus the COPEC (cadmium) eliminated based on similarity to background (section 2.2.4) and adjusted by multiplying by the PAUFs. The HQs and HIs for the earthworm and plant are not adjusted by a PAUF because these receptors do not have HRs.

The adjusted HIs are less than 1.0 for the kestrel, robin, cottontail, and red fox (Table 2.2-3). The adjusted HI for the shrew (4) is above 1.0, but less than 10, and is approximately 10 for the deer mouse (Table 2.2-3). The elevated HIs for the deer mouse and shrew are due to TCDD[2,3,7,8-] equivalent concentrations.

The TCDD[2,3,7,8-] equivalent concentrations are relatively consistent across the site, except for the two highest concentrations. Based on the spatial distribution of the data, the TCDD[2,3,7,8-] equivalent concentrations in one area east of 16-0399 are higher than the rest of the area sampled. The outlier test in ProUCL 4.00.04 indicates that the maximum TCDD[2,3,7,8-] equivalent concentration is an outlier for this data set. This may indicate, at least in part, that the dioxins and furans in this area are from other sources, e.g., the SWMUs/AOCs to the east of the burn ground area. The concentrations also bias the EPC and overestimate the potential risk to the receptor populations. The area east of 16-0399 is approximately 0.1 ha. Comparing the maximum TCDD[2,3,7,8-] equivalent concentration in this area ($3.71\text{E-}05$ mg/kg) to the ESLs results in HQs of 64 and 128 for the deer mouse and shrew, respectively (Table 2.2-4). Adjusting the HQs with the PAUFs in Table 2.2-5 results in HQs of 1.9 and 0.8 (Table 2.2-6), respectively, for this area.

The rest of the area around 16-0388 and 16-0399 is approximately 2.5 ha. Recalculating the TCDD[2,3,7,8-] equivalent EPC without the two highest concentrations in the area east of 16-0399 results in a 95% UCL of approximately $1.2\text{E-}06$ mg/kg (Figure 2.2-1). Comparing the revised 95% UCL to the ESLs results in HQs of 2 and 4 for the deer mouse and shrew, respectively (Table 2.2-4). Adjusting the HQs by the PAUFs in Table 2.2-5 results in HQs of 1.7 and 0.6 (Table 2.2-6), respectively, for the larger area.

Given the conservative nature of the ESLs as described above, the HQs for the deer mouse and shrew are overestimated. In addition, Dourson and Stara (1983, 073474) 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 do not adversely affect ecological receptors. Therefore, the adjusted HIs for the shrew and deer mouse do not indicate potential risks to these receptors across the site. As indicated below previous studies by the Laboratory have found no effects to small mammal populations at similar dioxin and furan congener concentrations in the canyons.

Biota investigations have been conducted in canyon reaches in Los Alamos/Pueblo Canyon (LANL 2004, 087390), Mortandad Canyon (LANL 2006, 094161; LANL 2007, 098279), and Pajarito Canyon (LANL 2008, 104909). Field and laboratory studies included collection and analysis of soil, sediment, and water samples; cavity-nesting bird monitoring and analysis of eggs; small mammal trapping and analysis of whole organisms; earthworm bioaccumulation tests—measures of growth and survival, and analysis of whole organisms; and seedling germination tests. The studies found no effects from exposure to TCDD in any of the canyon reaches.

The TCDD equivalent concentrations reported in Kraig et al. (2002, 085536, Table 5 and Table A-6) ranged from 4.7×10^{-7} mg/kg to 3.5×10^{-6} mg/kg in samples from lower Los Alamos Canyon. These levels are similar to the TCDD concentrations in Los Alamos and Pueblo Canyons (LANL 2005, 091818); the range of concentrations is 1.71×10^{-10} mg/kg to 4.96×10^{-6} mg/kg. Dioxins and furans, therefore, appear

to be present throughout the Los Alamos and Pueblo Canyons watershed at levels exceeding the screening levels for small mammals. The field studies conducted in the Los Alamos and Pueblo Canyons watershed included four locations where small-mammal populations were evaluated, and two small-mammal study areas were in the Pueblo Canyon watershed (reaches AC-3 and P-3W). No difference in population density, sex ratio, or reproductive classes was noted between these small-mammal study areas (LANL 2004, 087390). Because adverse ecological effects to mammals were not identified by the ecological risk assessment, the assessment implicitly demonstrated that there are no adverse ecological effects from dioxins and furans. In addition, TCDD concentrations ranged from 3.14×10^{-7} mg/kg to 3.09×10^{-6} mg/kg in Pajarito Canyon (dioxins and furans were not analyzed for in Mortandad Canyon) as part of the canyon investigation and no adverse effects were reported (LANL 2008, 104909).

The 95% UCL for TCDD[2,3,7,8-] equivalent across the site is 6.65×10^{-6} mg/kg, which is similar to the concentrations detected in Los Alamos, Pueblo, and Pajarito Canyons. Because no adverse ecological effects to mammals were identified following small mammal trapping and analysis of whole organisms in these canyons at similar concentrations, no adverse ecological effects are present within the TA-16 Burn Ground.

The HIs are above 1.0 for the earthworm (2) and the plant (6). Barium is the primary COPEC for the earthworm and plant. The barium ESLs for the earthworm (330 mg/kg) and plant (110 mg/kg) are similar to or less than the soil BV (295 mg/kg) and the maximum background concentration (410 mg/kg). A comparison of the barium EPC (704 mg/kg) to the maximum background concentration (410 mg/kg) results in a ratio of 1.7. Therefore, the EPC is less than twice background and not likely to impact the earthworm and plant. Furthermore, as noted above, the Dourson and Stara (1983, 073474) study indicated that HIs up to 10 may not adversely affect ecological receptors.

The plant community was observed to be typical of the surrounding area and appears healthy; no evidence was found that there are any adverse impacts of contamination to the plant community. No marked differences in vegetation were observed between this area and areas with similar topography that did not have elevated HIs. In addition, substantially higher concentrations of barium were reported in Cañon de Valle below the 260 Outfall as part of the Resource Conservation and Recovery Act facility investigations conducted from 1998-2002 (LANL 2003, 077965). Despite the substantially elevated barium concentrations (maximum concentration of 37300 mg/kg) in the canyon sediment, the plant community was observed to be typical of the surrounding area and is luxuriant and healthy; no evidence was found that there are any adverse impacts of any contamination in Cañon de Valle to the plant community. These observations support the conclusions that barium is not impacting the earthworm and plant at the TA-16 Burn Ground and the Dourson and Stara (1983, 073474) study. Because the plant community is not affected by the COPECs, the earthworm population is also likely not affected. Therefore, no COPECs are retained at this site.

3.0 CONCLUSIONS

The human-health screening assessment found that risks were below the NMED target levels for the industrial and residential scenarios. The ecological risk screening assessment found that no COPECs are retained for this area. The HIs calculated based on literature derived ESLs are conservative and overestimate the potential risk to receptors. Field observations and published studies indicate that the slightly elevated HIs do not reflect actual adverse ecological impacts to receptors at the site. Therefore, no potential unacceptable risks to human and ecological receptors are present.

4.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Bowman, J., J.A.G. Jaeger, and L. Fahrig, 2002. "Dispersal Distance of Mammals is Proportional to Home Range Size," *Ecology*, Vol. 83, No. 7, pp. 2049-2055. (Bowman et al. 2002, 073475)

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**Table 1.2-1
Background Comparisons for Inorganic Chemicals at the TA-16 Burn Ground**

Sample ID	Depth (ft)	Media	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Soil Background Value (mg/kg)			8.17	295	0.4	19.3	22.3	0.1	1.52	1
09RCRA696	0-1	Soil	1.94	1180	0.33	7.85	11	0.0154	1.01(U)	0.574
09RCRA698	0-1	Soil	2.23	470	0.493	6.25	11.5	0.0163	1.07(U)	0.634
09RCRA700	0-1	Soil	0.773(J)	242	0.326	3.05	6.03	0.00568(J)	1.05(U)	0.398(J)
09RCRA702	0-1	Soil	3.39	196	0.487	11.1	13	0.0196	1.11(U)	0.452(J)
09RCRA704	0-1	Soil	2.42	229	0.555	8.8	19.7	0.0122(J)	1.05(U)	0.537
09RCRA706	0-1	Soil	1.94	298	0.562	5.2	11.5	0.0103(J)	1.03(U)	0.39(J)
09RCRA708	0-1	Soil	0.944(J)	970	0.319	4.59	9.16	0.0061(J)	1.01(U)	0.692
09RCRA710	0-1	Soil	0.767(J)	1780	0.453	5.24	13.5	0.04	1.05(U)	7.95
09RCRA712	0-1	Soil	0.981(J)	1730	0.425	5.16	9.48	0.0203	1.17(U)	1.59
09RCRA714	0-1	Soil	1.53	105	0.325	5.72	8.74	0.0123	1.04(U)	0.373(J)
09RCRA716	0-1	Soil	2.15	434	0.579	7.83	15.3	0.0152	1.03(U)	0.446(J)
09RCRA718	0-1	Soil	1.8	1260	0.68	8.89	17.4	0.0209	1.13(U)	0.876
09RCRA720	0-1	Soil	2.5	199	0.313	13.1	10.9	0.00946(J)	1.10(U)	0.439(J)
09RCRA722	0-1	Soil	1.8	243	0.46	8.24	11.1	0.00976(J)	1.04(U)	0.375(J)
09RCRA724	0-1	Soil	1.96	356	0.362	6.77	12.5	0.0116	1.02(U)	0.622
09RCRA726	0-1	Soil	1.76	98.8	0.358	6.06	11.9	0.00683(J)	1.05(U)	0.352(J)
09RCRA728	0-1	Soil	1.34	314	0.389	6.01	11.1	0.00848(J)	1.02(U)	0.413(J)
09RCRA730	0-1	Soil	1.46	230	0.366	4.79	7.11	0.00794(J)	1.05(U)	0.331(J)
09RCRA732	0-1	Soil	1.84	267	0.414	6.85	11.8	0.0118	1.03(U)	0.297(J)
09RCRA734	0-1	Soil	1.79	345	0.381	7.24	13.3	0.00854(J)	1.05(U)	0.471(J)
09RCRA736	0-1	Soil	1.45	275	0.385	6.03	15.9	0.00817(J)	1.02(U)	0.449(J)
09RCRA738	0-1	Soil	1.24	141	0.219	11.6	10	0.00888(J)	1.05(U)	0.164(J)
09RCRA740	0-1	Soil	1.85	612	0.439	9.55	10.4	0.0184	1.03(U)	1.12
09RCRA742	0-1	Soil	1.17	488	0.408	7.41	9.64	0.0115(J)	1.06(U)	0.923
09RCRA744	0-1	Soil	2.26	948	0.621	9.74	11.4	0.0412	1.09(U)	1.17
09RCRA746	0-1	Soil	1.47	270	0.317	8.47	10.5	0.00913(J)	1.04(U)	0.509(J)
09RCRA748	0-1	Soil	1.54	417	0.487	8.05	11.2	0.0112(J)	1.05(U)	0.771
09RCRA750	0-1	Soil	1.21	414	0.32	6.3	10.7	0.008(J)	1.06(U)	0.821
09RCRA752	0-1	Soil	2.1	486	0.306	7.13	11.9	0.0135	1.05(U)	0.64
09RCRA754	0-1	Soil	1.48	401	0.373	6.52	12.9	0.0115(J)	1.07(U)	0.552
09RCRA756	0-1	Soil	1.77	915	0.438	9.12	13.4	0.0229	1.11(U)	1.7

Note: Source of BVs is LANL (1998, 059730). Bolded values are above the soil BV.

**Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground**

Congener	09RCRA460 (mg/kg)	09RCRA461 (mg/kg)	09RCRA463 (mg/kg)	09RCRA464 (mg/kg)	09RCRA465 (mg/kg)	09RCRA695 (mg/kg)	09RCRA697 (mg/kg)	09RCRA699 (mg/kg)	09RCRA701 (mg/kg)	09RCRA703 (mg/kg)
2,3,7,8-TCDD	Not detected	1.03E-07	1.33E-07	Not detected	6.18E-07					
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	1.92E-06	Not detected				
1,2,3,4,7,8-HxCDD	4.19E-07	Not detected	Not detected	Not detected	5.38E-06	Not detected	Not detected	Not detected	Not detected	7.33E-07
1,2,3,6,7,8-HxCDD	7.15E-07	Not detected	Not detected	Not detected	1.06E-05	Not detected	4.67E-07	5.61E-07	Not detected	1.58E-06
1,2,3,7,8,9-HxCDD	7.26E-07	Not detected	Not detected	Not detected	1.14E-05	Not detected	5.18E-07	5.20E-07	Not detected	1.65E-06
1,2,3,4,6,7,8-HpCDD	2.08E-05	4.22E-06	4.41E-06	1.08E-05	2.92E-04	4.50E-06	8.35E-06	1.31E-05	8.37E-06	3.67E-05
OCDD	1.41E-04	2.07E-05	2.70E-05	3.22E-05	1.55E-03	3.41E-05	8.61E-05	1.02E-04	5.06E-05	2.09E-04
2,3,7,8-TCDF	1.83E-07	Not detected	Not detected	Not detected	2.01E-07	3.14E-06	6.59E-07	5.72E-07	1.14E-06	Not detected
1,2,3,7,8-PeCDF	Not detected	1.59E-06	4.83E-07	8.30E-07	Not detected	Not detected				
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	6.33E-07	7.15E-07	Not detected	5.13E-07	Not detected	Not detected	4.66E-07
1,2,3,4,7,8-HxCDF	4.95E-07	Not detected	Not detected	7.30E-07	3.21E-06	6.73E-07	5.88E-07	5.83E-07	Not detected	9.55E-07
1,2,3,6,7,8-HxCDF	5.39E-07	Not detected	Not detected	1.02E-06	3.96E-06	Not detected	4.53E-07	4.82E-07	Not detected	8.90E-07
2,3,4,6,7,8-HxCDF	7.23E-07	Not detected	Not detected	1.09E-06	5.33E-06	Not detected	6.30E-07	5.67E-07	Not detected	1.13E-06
1,2,3,7,8,9-HxCDF	Not detected									
1,2,3,4,6,7,8-HpCDF	1.04E-05	1.63E-06	1.20E-06	5.09E-06	8.44E-05	2.33E-06	3.50E-06	4.30E-06	3.05E-06	1.27E-05
1,2,3,4,7,8,9-HpCDF	5.35E-07	Not detected	Not detected	1.38E-06	5.95E-06	Not detected	Not detected	Not detected	Not detected	1.02E-06
OCDF	1.77E-05	2.54E-06	2.83E-06	1.07E-05	1.87E-04	3.98E-06	1.25E-05	1.27E-05	5.82E-06	2.93E-05

**Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground (continued)**

Congener	09RCRA705 (mg/kg)	09RCRA707 (mg/kg)	09RCRA709 (mg/kg)	09RCRA711 (mg/kg)	09RCRA713 (mg/kg)	09RCRA715 (mg/kg)	09RCRA717 (mg/kg)	09RCRA719 (mg/kg)	09RCRA721 (mg/kg)	09RCRA723 (mg/kg)
2,3,7,8-TCDD	Not detected	1.69E-07	5.49E-07	1.34E-06	1.38E-07	2.52E-07	1.50E-07	Not detected	1.28E-07	2.22E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	5.13E-07	6.99E-06	6.73E-07	5.39E-07	6.33E-07	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	7.41E-07	Not detected	7.71E-07	1.79E-05	1.47E-06	1.21E-06	5.53E-07	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDD	1.40E-06	7.53E-07	1.28E-06	3.33E-05	2.80E-06	2.45E-06	1.01E-06	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDD	1.49E-06	8.03E-07	1.40E-06	4.07E-05	3.42E-06	3.06E-06	1.01E-06	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDD	3.66E-05	2.01E-05	3.23E-05	9.00E-04	5.81E-05	6.85E-05	2.02E-05	6.22E-07	4.64E-06	1.95E-05
OCDD	2.08E-04	1.29E-04	1.85E-04	4.80E-03	2.38E-04	3.69E-04	1.01E-04	2.92E-06	2.68E-05	1.06E-04
2,3,7,8-TCDF	5.45E-07	9.19E-07	5.95E-07	1.51E-06	3.84E-07	3.38E-07	1.65E-06	1.46E-07	3.25E-07	3.23E-07
1,2,3,7,8-PeCDF	Not detected	5.72E-07	4.76E-07	1.65E-06	Not detected	Not detected	1.87E-06	Not detected	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	6.77E-07	4.97E-07	1.97E-06	Not detected	Not detected	1.82E-06	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	7.64E-07	7.87E-07	7.66E-07	1.21E-05	9.65E-07	1.01E-06	2.02E-06	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDF	7.60E-07	7.41E-07	7.37E-07	1.44E-05	1.52E-06	1.28E-06	1.50E-06	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	9.33E-07	9.19E-07	8.63E-07	1.78E-05	1.69E-06	1.56E-06	1.82E-06	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	2.02E-06	Not detected	Not detected	4.86E-07	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	1.13E-05	7.27E-06	8.71E-06	2.88E-04	2.34E-05	2.38E-05	1.01E-05	Not detected	1.49E-06	3.03E-06
1,2,3,4,7,8,9-HpCDF	9.20E-07	7.30E-07	7.41E-07	1.92E-05	8.20E-07	1.29E-06	7.29E-07	Not detected	Not detected	Not detected
OCDF	2.79E-05	1.95E-05	2.19E-05	6.57E-04	2.33E-05	4.71E-05	1.62E-05	Not detected	3.42E-06	6.36E-06

**Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground (continued)**

Congener	09RCRA725 (mg/kg)	09RCRA727 (mg/kg)	09RCRA729 (mg/kg)	09RCRA731 (mg/kg)	09RCRA733 (mg/kg)	09RCRA735 (mg/kg)	09RCRA737 (mg/kg)	09RCRA739 (mg/kg)	09RCRA741 (mg/kg)	09RCRA743 (mg/kg)
2,3,7,8-TCDD	Not detected	2.76E-07	9.45E-08	4.61E-07	1.73E-07	Not detected	Not detected	Not detected	2.41E-07	1.33E-07
1,2,3,7,8-PeCDD	Not detected									
1,2,3,4,7,8-HxCDD	Not detected	5.22E-07	Not detected							
1,2,3,6,7,8-HxCDD	Not detected	9.35E-07	5.88E-07	Not detected						
1,2,3,7,8,9-HxCDD	Not detected	1.12E-06	7.07E-07	Not detected						
1,2,3,4,6,7,8-HpCDD	6.76E-07	2.26E-05	1.36E-05	5.93E-06	2.00E-06	3.55E-06	8.76E-07	3.76E-06	3.17E-06	4.19E-06
OCDD	4.00E-06	1.36E-04	7.97E-05	3.18E-05	1.10E-05	2.29E-05	3.57E-06	1.91E-05	1.38E-05	1.65E-05
2,3,7,8-TCDF	2.22E-07	3.17E-07	4.13E-07	2.45E-07	2.00E-07	3.19E-07	2.65E-07	2.86E-07	3.83E-07	3.42E-07
1,2,3,7,8-PeCDF	Not detected	Not detected	6.28E-07	Not detected						
2,3,4,7,8-PeCDF	Not detected									
1,2,3,4,7,8-HxCDF	Not detected	5.51E-07	5.90E-07	Not detected						
1,2,3,6,7,8-HxCDF	Not detected	5.39E-07	4.38E-07	Not detected						
2,3,4,6,7,8-HxCDF	Not detected	6.73E-07	5.17E-06	Not detected						
1,2,3,7,8,9-HxCDF	Not detected									
1,2,3,4,6,7,8-HpCDF	Not detected	8.01E-06	5.17E-06	2.02E-06	7.45E-07	1.68E-06	Not detected	7.53E-07	6.40E-07	6.87E-07
1,2,3,4,7,8,9-HpCDF	Not detected	5.06E-07	Not detected							
OCDF	Not detected	1.55E-05	8.65E-06	3.64E-06	1.19E-06	3.59E-06	Not detected	1.91E-06	1.51E-06	1.34E-06

**Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground (continued)**

Congener	09RCRA745 (mg/kg)	09RCRA747 (mg/kg)	09RCRA749 (mg/kg)	09RCRA751 (mg/kg)	09RCRA753 (mg/kg)	09RCRA755 (mg/kg)
2,3,7,8-TCDD	Not detected	1.82E-07	1.76E-07	1.33E-07	Not detected	Not detected
1,2,3,7,8-PeCDD	Not detected					
1,2,3,4,7,8-HxCDD	Not detected	6.08E-07				
1,2,3,6,7,8-HxCDD	Not detected	8.00E-07				
1,2,3,7,8,9-HxCDD	Not detected	8.24E-07				
1,2,3,4,6,7,8-HpCDD	1.54E-06	7.12E-06	6.39E-06	4.88E-06	4.89E-06	1.20E-05
OCDD	8.98E-06	4.47E-05	3.34E-05	2.83E-05	2.89E-05	3.76E-05
2,3,7,8-TCDF	3.25E-07	3.83E-07	4.38E-07	4.23E-07	3.77E-07	4.11E-07
1,2,3,7,8-PeCDF	Not detected	Not detected	Not detected	7.18E-07	5.05E-07	Not detected
2,3,4,7,8-PeCDF	Not detected					
1,2,3,4,7,8-HxCDF	Not detected	Not detected	Not detected	4.88E-07	Not detected	Not detected
1,2,3,6,7,8-HxCDF	Not detected					
2,3,4,6,7,8-HxCDF	Not detected					
1,2,3,7,8,9-HxCDF	Not detected					
1,2,3,4,6,7,8-HpCDF	Not detected	1.61E-06	1.38E-06	8.28E-07	1.12E-06	1.38E-06
1,2,3,4,7,8,9-HpCDF	Not detected					
OCDF	Not detected	5.33E-06	3.29E-06	2.57E-06	3.11E-06	4.04E-06

Addendum to Figure 1.2-1

	Dioxin-Furan Analysis	Metals Analysis
Sample Location on Figure	Sample ID	Sample ID
06/08/09 Location 1	09RCRA460	Not Applicable
06/08/09 Location 2	09RCRA461	Not Applicable
06/08/09 Location 3	09RCRA462	Not Applicable
06/08/09 Location 4	09RCRA463	Not Applicable
06/08/09 Location 5	09RCRA464	Not Applicable
06/08/09 Location 6	09RCRA465	Not Applicable
08/26/09 Location 1	09RCRA695	09RCRA696
08/26/09 Location 2	09RCRA697	09RCRA698
08/26/09 Location 3	09RCRA699	09RCRA700
08/26/09 Location 4	09RCRA701	09RCRA702
08/26/09 Location 5	09RCRA703	09RCRA704
08/26/09 Location 6	09RCRA705	09RCRA706
08/26/09 Location 7	09RCRA707	09RCRA708
08/26/09 Location 9	09RCRA709	09RCRA710
08/26/09 Location 8	09RCRA711	09RCRA712
08/26/09 Location 28	09RCRA713	09RCRA714
08/26/09 Location 29	09RCRA715	09RCRA716
08/26/09 Location 25	09RCRA717	09RCRA718
08/26/09 Location 30	09RCRA719	09RCRA720
08/26/09 Location 24	09RCRA721	09RCRA722
08/26/09 Location 26	09RCRA723	09RCRA724
08/26/09 Location 31	09RCRA725	09RCRA726
08/26/09 Location 27	09RCRA727	09RCRA728
08/26/09 Location 11	09RCRA729	09RCRA730
08/26/09 Location 10	09RCRA731	09RCRA732
08/26/09 Location 14	09RCRA733	09RCRA734
08/26/09 Location 12	09RCRA735	09RCRA736
08/26/09 Location 13	09RCRA737	09RCRA738
08/26/09 Location 22	09RCRA739	09RCRA740
08/26/09 Location 23	09RCRA741	09RCRA742
08/26/09 Location 16	09RCRA743	09RCRA744
08/26/09 Location 21	09RCRA745	09RCRA746
08/26/09 Location 20	09RCRA747	09RCRA748
08/26/09 Location 19	09RCRA749	09RCRA750
08/26/09 Location 18	09RCRA751	09RCRA752
08/26/09 Location 17	09RCRA753	09RCRA754
08/26/09 Location 15	09RCRA755	09RCRA756

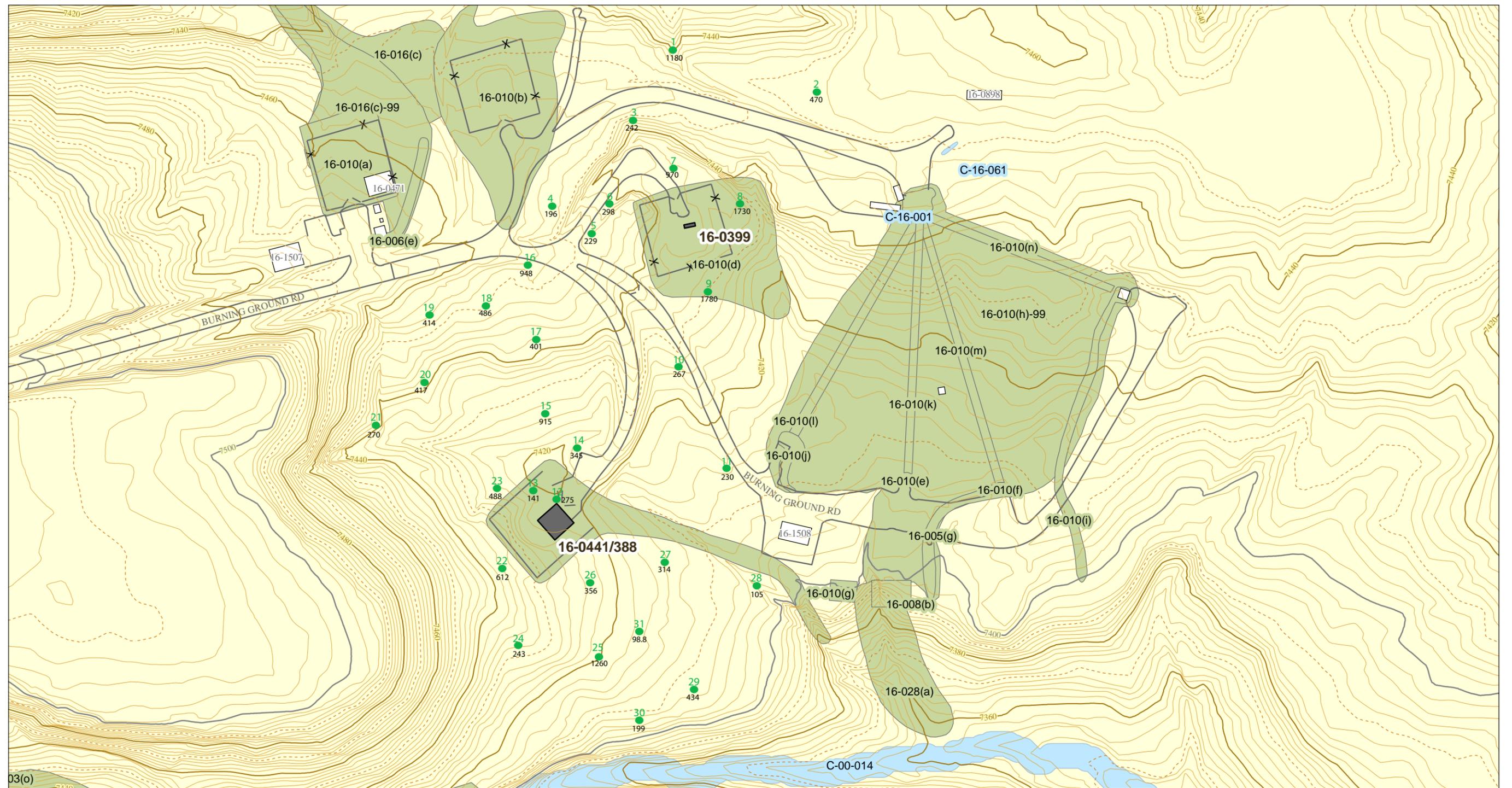


Figure 1.2-2: Technical Area 16 Burn Ground Barium Soil Concentrations

Map Created By: Kathryn Bennett, WES-EDA-GIS GIS Team, July 15, 2009, Map Reference #09-0030-12-TA16BurnGround

—x— Fences	RCRA waste management units
— Roads, Paved	■ RWMU Structure
PRC and Areas of Concern	□ Other Structures
■ AOC	● 08/26/09 Soil Sample Location
■ SWMU	

100-ft Contour
20-ft Contour
10-ft Contour
2-ft Contour

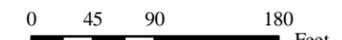


* Concentrations values in black for each sample location are barium concentrations in milligrams per kilogram (mg/Kg).

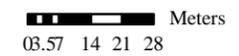
DISCLAIMER:

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1:1,600



1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)



DATA SOURCES:

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V:\er\FWO_fences\KSL_fences_arc20081015	Fences	2009-04-16	15-Oct-08
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.FWO_roads\erdg\1v.ER.KSL_centerline	centerline_arc	2009-04-16	2005-12-15
X:\Projects\04-Projects\04-0005\data\LANL_street_clip	Roads, Paved	2009-04-16	15-Oct-08
V:\er\SWRC_hazardouswaste\SWRC_trca_rwmu_ply	RCRA waste management units	2009-04-16	06-Apr-05
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.FWO_structures\erdg\1v.ER.KSL_struct	Structures	2009-04-16	01-Jul-05
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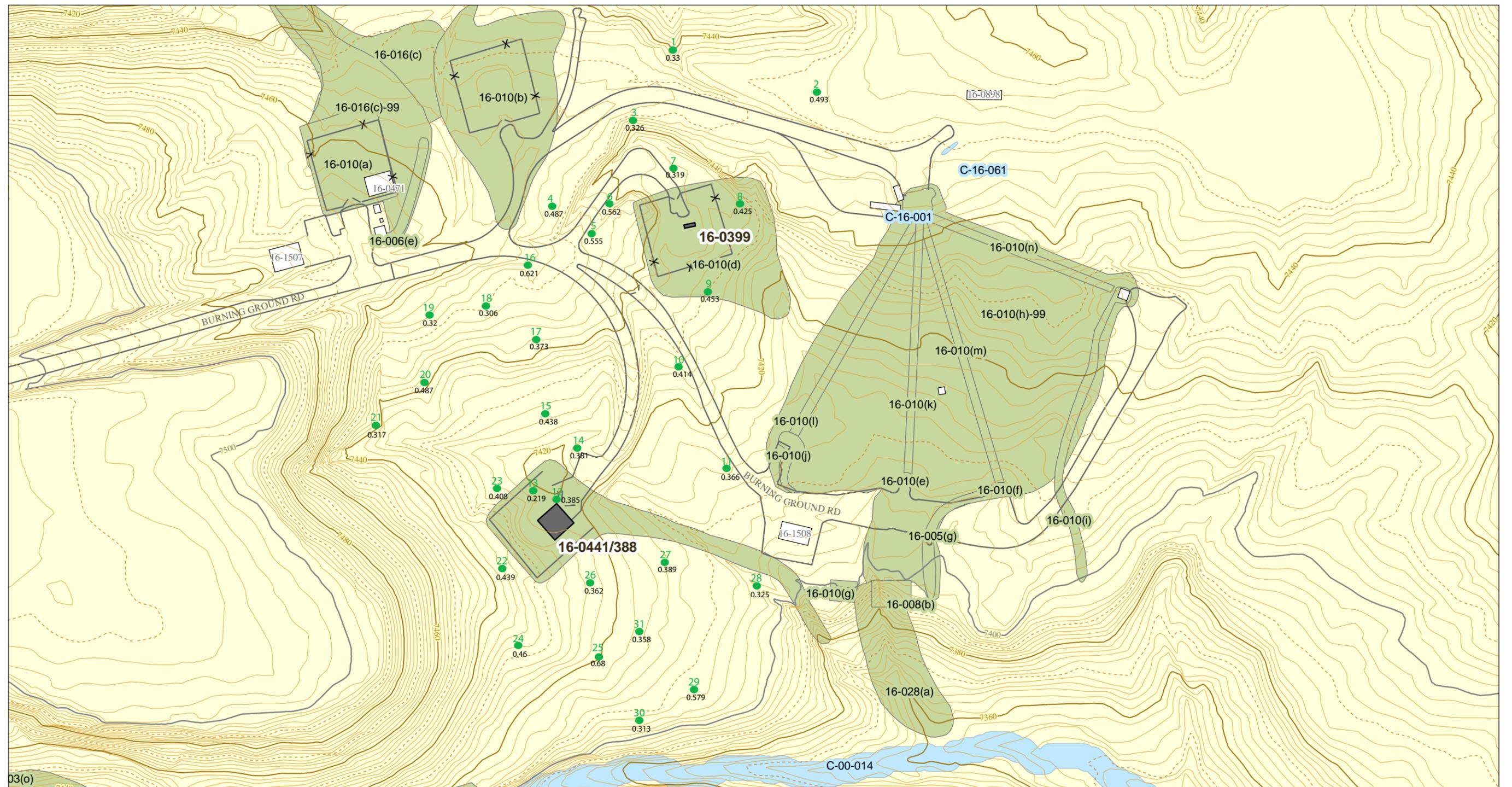
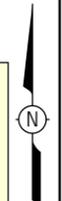


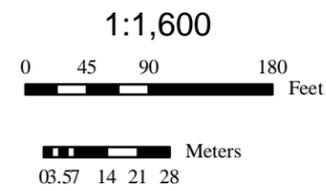
Figure 1.2-3: Technical Area 16 Burn Ground Cadmium Soil Concentrations

Map Created By: Kathryn Bennett, WES-EDA-GIS GIS Team, July 15, 2009, Map Reference #09-0030-12-TA16BurnGround

	100-ft Contour		Fences		RWMU Structure
	20-ft Contour		Roads, Paved		Other Structures
	10-ft Contour		PRS and Areas of Concern		08/26/09 Soil Sample Location
	2-ft Contour		AOC		SWMU



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1983 North American Datum
 State Plane Coordinate System
 New Mexico, Central Zone (US Feet)

DATA SOURCES:

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C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.LANL_hypsography\erdg\1v.ER.LANL_cd\20-ft Contour	20-ft Contour	2009-04-16	1991
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V:\er\FWO_fences\KSL_fences_arc20081015	Fences	2009-04-16	15-Oct-08
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.FWO_roads\erdg\1v.ER.KSL_centerline	centerline_arc	2009-04-16	2005-12-15
X:\Projects\04-Projects\04-0005\data\LANL_street_clip	Roads, Paved	2009-04-16	15-Oct-08
V:\er\SWRC_hazardouswaste\SWRC_trca_rwmu_ply	RCRA waste management units	2009-04-16	06-Apr-05
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.FWO_structures\erdg\1v.ER.KSL_struct	Structures	2009-04-16	01-Jul-05
X:\users\benett\arcms\PRSPrs_all_req.shp (downloaded from SDE server gis-sde-p.erdg\1v.ER.ER_prs)	PRS and Areas of Concern	2009-07-15	2009-03-13

* Concentrations values in black for each sample location are cadmium concentrations in milligrams per kilogram (mg/Kg).



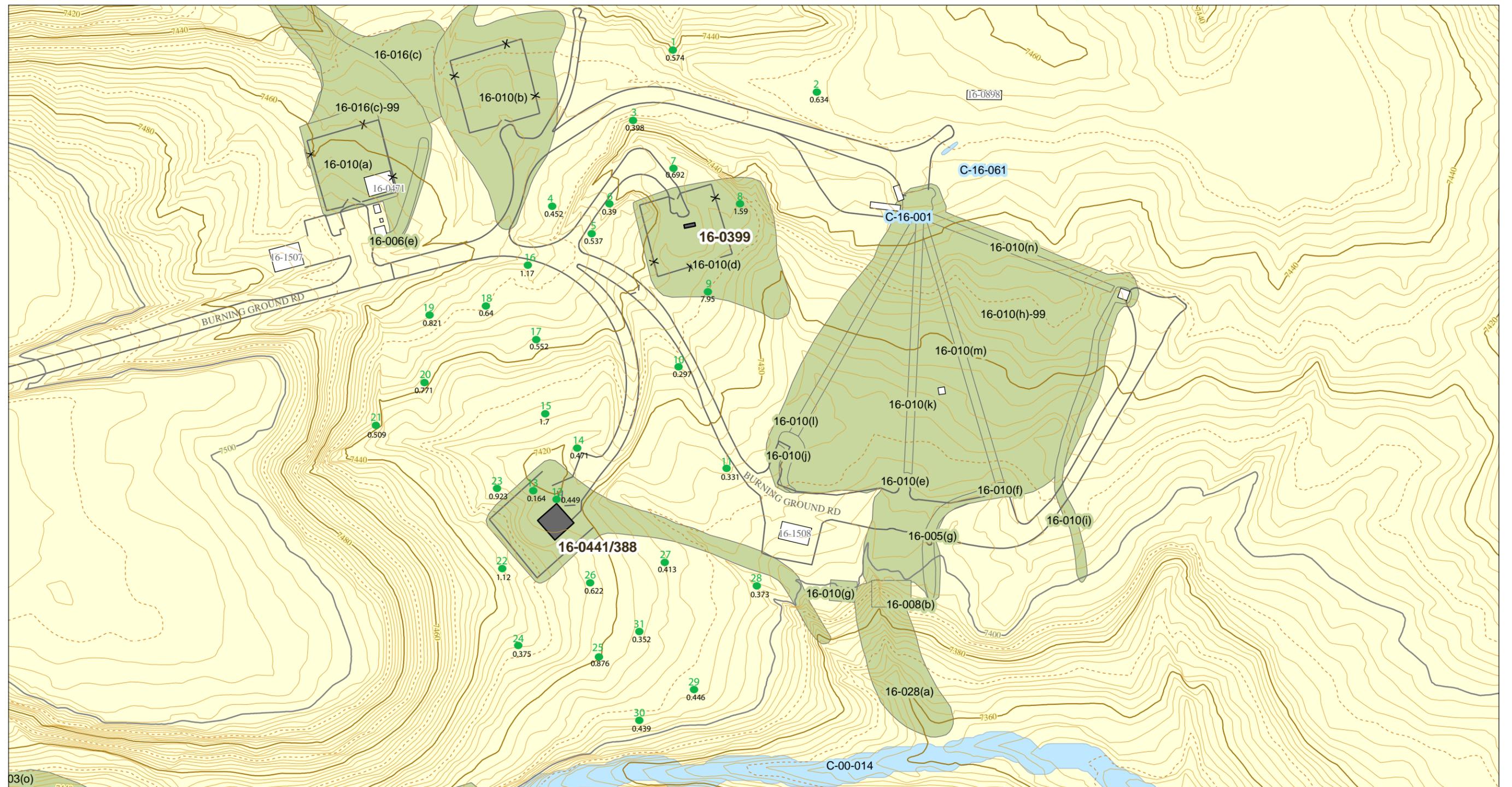
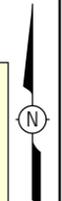


Figure 1.2-4: Technical Area 16 Burn Ground Silver Soil Concentrations

Map Created By: Kathryn Bennett, WES-EDA-GIS GIS Team, July 15, 2009, Map Reference #09-0030-12-TA16BurnGround

	100-ft Contour		Fences		RWMU Structure
	20-ft Contour		Roads, Paved		Other Structures
	10-ft Contour		PRS and Areas of Concern		08/26/09 Soil Sample Location
	2-ft Contour		AOC		
			SWMU		

* Concentrations values in black for each sample location are silver concentrations in milligrams per kilogram (mg/Kg).



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1:1,600

0 45 90 180 Feet

0 3.57 14 21 28 Meters

DATA SOURCES:

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V:\er\FWO_fences\KSL_fences_arc20081015	Fences	2009-04-16	15-Oct-08
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.FWO_roads\erdg\1v.ER.KSL_centerline	centerline_arc	2009-04-16	2005-12-15
X:\Projects\04-Projects\04-0005\data\LANL_street_clip	Roads, Paved	2009-04-16	15-Oct-08
V:\er\SWRC_hazardouswaste\SWRC_trca_rwmu_ply	RCRA waste management units	2009-04-16	06-Apr-05
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdg\1v.ER.FWO_structures\erdg\1v.ER.KSL_struct	Structures	2009-04-16	01-Jul-05
X:\users\bennett\arcms\PRSP\prs_all_req.shp (downloaded from SDE server gis-sde-p.erdg\1v.ER.ER_prs)	PRS and Areas of Concern	2009-07-15	2009-03-13

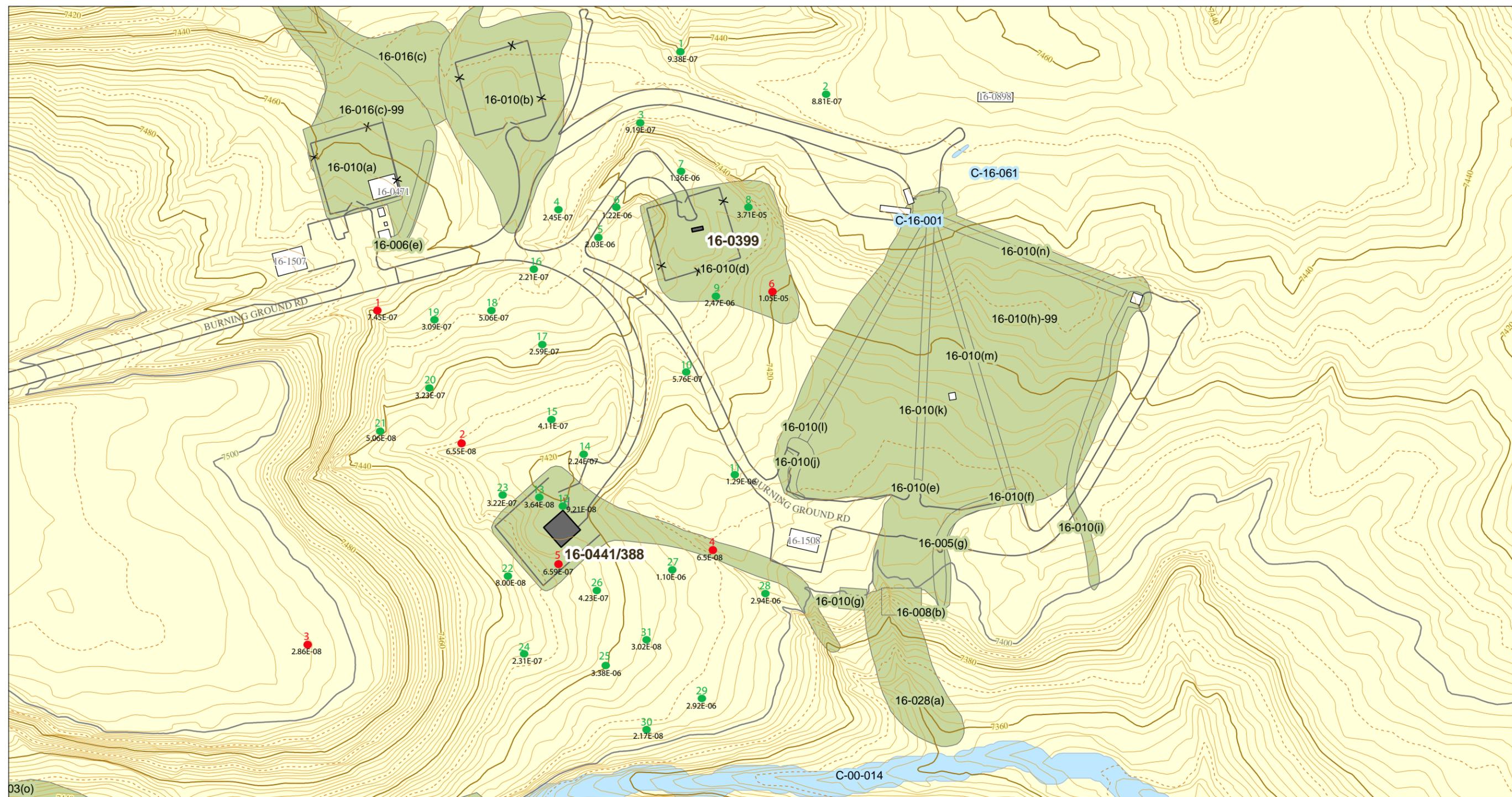
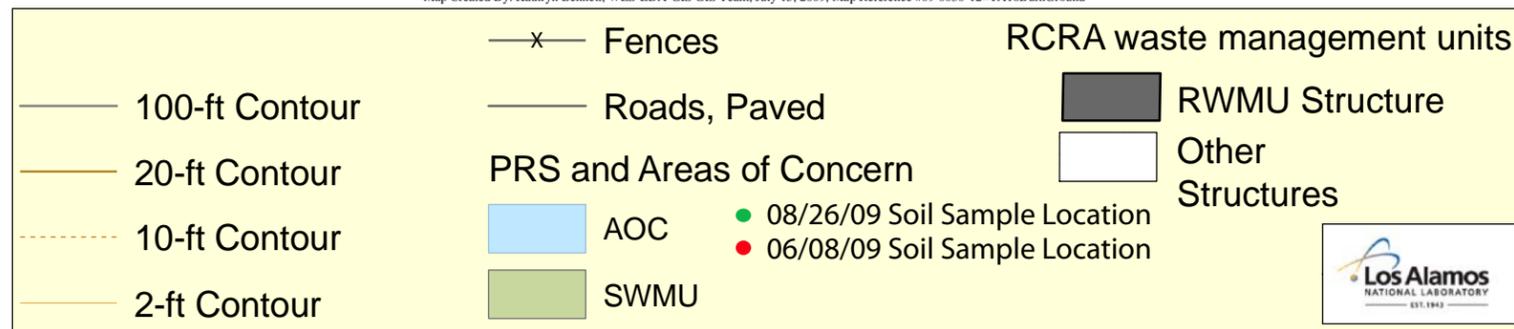


Figure 1.2-5: Technical Area 16 Burn Ground Dioxin/Furan Soil Concentrations

Map Created By: Kathryn Bennett, WES-EDA-GIS GIS Team, July 15, 2009, Map Reference #09-0030-12-TA16BurnGround



* Concentrations values in black for each sample location are TCDD toxicity equivalent concentrations in milligrams per kilogram (mg/Kg).



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1:1,600

0 45 90 180 Feet

03.57 14 21 28 Meters

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES:

PATH	NAME	DATE ACCESSED	DATE PUBLISHED
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V:\er\FWO_fences\KSL_fences_arc20081015	Fences	2009-04-16	15-Oct-08
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdgi1v.ER.FWO_roads\erdgi1v.ER.KSL_centerline	centerline_arc	2009-04-16	2005-12-15
X:\Projects\04-Projects\04-0005\data\lanl_street_clip	Roads, Paved	2009-04-16	15-Oct-08
V:\er\SWRC_hazardouswaste\SWRC_rra_rwmu_ply	RCRA waste management units	2009-04-16	06-Apr-05
C:\Documents and Settings\106087\Application Data\ESRI\ArcCatalog\Connection to GIS-SDE-P.sde\erdgi1v.ER.FWO_structures\erdgi1v.ER.KSL_struct	Structures	2009-04-16	01-Jul-05
X:\users\bennett\arcms\PRS\prs_all_req.shp (downloaded from SDE server gis-sde-p.erdgi1v.ER.ER.PRS)	PRS and Areas of Concern	2009-07-15	2009-03-13

**Table 1.3-1
Toxic Equivalency Factors (TEFs) Used for Calculating TCDD Equivalent Concentrations**

Dioxin and Furan Congeners	WHO 1995* TEF
Tetrachlorodibenzodioxin[2,3,7,8-]	1
Pentachlorodibenzodioxin[1,2,3,7,8-]	1
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	0.1
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	0.1
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	0.1
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	0.01
Octachlorodibenzodioxin	0.0003
Tetrachlorodibenzofuran[2,3,7,8-]	0.1
Pentachlorodibenzofuran[1,2,3,7,8-]	0.03
Pentachlorodibenzofuran[2,3,4,7,8-]	0.3
Hexachlorodibenzofuran[1,2,3,4,7,8-]	0.1
Hexachlorodibenzofuran[1,2,3,6,7,8-]	0.1
Hexachlorodibenzofuran[1,2,3,7,8,9-]	0.1
Hexachlorodibenzofuran[2,3,4,6,7,8-]	0.1
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	0.01
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	0.01
Octachlorodibenzofuran	0.0003

*<http://www.epa.gov/ncea/pdfs/dioxin/part2/drich9.pdf>.

**Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors**

Congener	09RCRA460 (mg/kg)	09RCRA461 (mg/kg)	09RCRA463 (mg/kg)	09RCRA464 (mg/kg)	09RCRA465 (mg/kg)	09RCRA695 (mg/kg)	09RCRA697 (mg/kg)	09RCRA699 (mg/kg)	09RCRA701 (mg/kg)	09RCRA703 (mg/kg)
2,3,7,8-TCDD	Not detected	1.03E-07	1.33E-07	Not detected	6.18E-07					
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	1.92E-06	Not detected				
1,2,3,4,7,8-HxCDD	4.19E-08	Not detected	Not detected	Not detected	5.38E-07	Not detected	Not detected	Not detected	Not detected	7.33E-08
1,2,3,6,7,8-HxCDD	7.15E-08	Not detected	Not detected	Not detected	1.06E-06	Not detected	4.67E-08	5.61E-08	Not detected	1.58E-07
1,2,3,7,8,9-HxCDD	7.26E-08	Not detected	Not detected	Not detected	1.14E-06	Not detected	5.18E-08	5.20E-08	Not detected	1.65E-07
1,2,3,4,6,7,8,-HpCDD	2.08E-07	4.22E-08	4.41E-08	1.08E-07	2.92E-06	4.50E-08	8.35E-08	1.31E-07	8.37E-08	3.67E-07
OCDD	4.23E-08	6.21E-09	8.10E-09	9.66E-09	4.65E-07	1.02E-08	2.58E-08	3.06E-08	1.52E-08	6.27E-08
2,3,7,8-TCDF	1.83E-08	Not detected	Not detected	Not detected	2.01E-08	3.14E-07	6.59E-08	5.72E-08	1.14E-07	Not detected
1,2,3,7,8-PeCDF	Not detected	4.77E-07	1.45E-07	2.49E-07	Not detected	Not detected				
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	1.90E-07	2.15E-07	Not detected	1.54E-07	Not detected	Not detected	1.40E-07
1,2,3,4,7,8-HxCDF	4.95E-08	Not detected	Not detected	7.30E-08	3.21E-07	6.73E-08	5.88E-08	5.83E-08	Not detected	9.55E-08
1,2,3,6,7,8-HxCDF	5.39E-08	Not detected	Not detected	1.02E-07	3.96E-07	Not detected	4.53E-08	4.82E-08	Not detected	8.90E-08
2,3,4,6,7,8-HxCDF	7.23E-08	Not detected	Not detected	1.09E-07	5.33E-07	Not detected	6.30E-08	5.67E-08	Not detected	1.13E-07
1,2,3,7,8,9-HxCDF	Not detected									
1,2,3,4,6,7,8-HpCDF	1.04E-07	1.63E-08	1.20E-08	5.09E-08	8.44E-07	2.33E-08	3.50E-08	4.30E-08	3.05E-08	1.27E-07
1,2,3,4,7,8,9-HpCDF	5.35E-09	Not detected	Not detected	1.38E-08	5.95E-08	Not detected	Not detected	Not detected	Not detected	1.02E-08
OCDF	5.31E-09	7.62E-10	8.49E-10	3.21E-09	5.61E-08	1.19E-09	3.75E-09	3.81E-09	1.75E-09	8.79E-09
TCDD[2,3,7,8-] equivalent concentration	7.45E-07	6.55E-08	6.50E-08	6.59E-07	1.05E-05	9.38E-07	8.81E-07	9.19E-07	2.45E-07	2.03E-06

**Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors (continued)**

Congener	09RCRA705 (mg/kg)	09RCRA707 (mg/kg)	09RCRA709 (mg/kg)	09RCRA711 (mg/kg)	09RCRA713 (mg/kg)	09RCRA715 (mg/kg)	09RCRA717 (mg/kg)	09RCRA719 (mg/kg)	09RCRA721 (mg/kg)	09RCRA723 (mg/kg)
2,3,7,8-TCDD	Not detected	1.69E-07	5.49E-07	1.34E-06	1.38E-07	2.52E-07	1.50E-07	Not detected	1.28E-07	2.22E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	5.13E-07	6.99E-06	6.73E-07	5.39E-07	6.33E-07	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	7.41E-08	Not detected	7.71E-08	1.79E-06	1.47E-07	1.21E-07	5.53E-08	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDD	1.40E-07	7.53E-08	1.28E-07	3.33E-06	2.80E-07	2.45E-07	1.01E-07	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDD	1.49E-07	8.03E-08	1.40E-07	4.07E-06	3.42E-07	3.06E-07	1.01E-07	Not detected	Not detected	Not detected
1,2,3,4,6,7,8,-HpCDD	3.66E-07	2.01E-07	3.23E-07	9.00E-06	5.81E-07	6.85E-07	2.02E-07	6.22E-09	4.64E-08	1.05E-07
OCDD	6.24E-08	3.87E-08	5.55E-08	1.44E-06	7.14E-08	1.11E-07	3.03E-08	8.76E-10	8.04E-09	3.18E-08
2,3,7,8-TCDF	5.45E-08	9.19E-08	5.95E-08	1.51E-07	3.84E-08	3.38E-08	1.65E-07	1.46E-08	3.25E-08	3.23E-08
1,2,3,7,8-PeCDF	Not detected	1.72E-07	1.43E-07	4.95E-07	Not detected	Not detected	5.61E-07	Not detected	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	2.03E-07	1.49E-07	5.91E-07	Not detected	Not detected	5.46E-07	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	7.64E-08	7.87E-08	7.66E-08	1.21E-06	9.65E-08	1.01E-07	2.02E-07	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDF	7.60E-08	7.41E-08	7.37E-08	1.44E-06	1.52E-07	1.28E-07	1.50E-07	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	9.33E-08	9.19E-08	8.63E-08	1.78E-06	1.69E-07	1.56E-07	1.82E-07	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	2.02E-07	Not detected	Not detected	4.86E-08	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	1.13E-07	7.27E-08	8.71E-08	2.88E-06	2.34E-07	2.38E-07	1.01E-07	Not detected	1.49E-08	3.03E-08
1,2,3,4,7,8,9-HpCDF	9.20E-09	7.30E-09	7.41E-09	1.92E-05	8.20E-09	1.29E-08	7.29E-09	Not detected	Not detected	Not detected
OCDF	8.37E-09	5.85E-09	6.57E-09	1.97E-07	6.99E-09	1.41E-08	4.86E-09	Not detected	1.03E-09	1.91E-09
TCDD[2,3,7,8-] equivalent concentration	1.22E-06	1.36E-06	2.47E-06	3.71E-05	2.94E-06	2.92E-06	3.38E-06	2.17E-08	2.31E-07	4.23E-07

**Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors (continued)**

Congener	09RCRA725 (mg/kg)	09RCRA727 (mg/kg)	09RCRA729 (mg/kg)	09RCRA731 (mg/kg)	09RCRA733 (mg/kg)	09RCRA735 (mg/kg)	09RCRA737 (mg/kg)	09RCRA739 (mg/kg)	09RCRA741 (mg/kg)	09RCRA743 (mg/kg)
2,3,7,8-TCDD	Not detected	2.76E-07	9.45E-08	4.61E-07	1.73E-07	Not detected	Not detected	Not detected	2.41E-07	1.33E-07
1,2,3,7,8-PeCDD	Not detected									
1,2,3,4,7,8-HxCDD	Not detected	5.22E-08	Not detected							
1,2,3,6,7,8-HxCDD	Not detected	9.35E-08	5.88E-08	Not detected						
1,2,3,7,8,9-HxCDD	Not detected	1.12E-07	7.07E-08	Not detected						
1,2,3,4,6,7,8,-HpCDD	6.76E-09	2.26E-07	1.36E-07	5.93E-08	2.00E-08	3.55E-08	8.76E-09	3.76E-08	3.17E-08	4.19E-08
OCDD	1.20E-09	4.08E-08	2.39E-08	9.54E-09	3.30E-09	6.87E-09	1.07E-09	5.73E-09	4.14E-09	4.95E-09
2,3,7,8-TCDF	2.22E-08	3.17E-08	4.13E-08	2.45E-08	2.00E-08	3.19E-08	2.65E-08	2.86E-08	3.83E-08	3.42E-08
1,2,3,7,8-PeCDF	Not detected	Not detected	1.88E-07	Not detected						
2,3,4,7,8-PeCDF	Not detected									
1,2,3,4,7,8-HxCDF	Not detected	5.51E-08	5.90E-08	Not detected						
1,2,3,6,7,8-HxCDF	Not detected	5.39E-08	4.38E-08	Not detected						
2,3,4,6,7,8-HxCDF	Not detected	6.73E-08	5.17E-07	Not detected						
1,2,3,7,8,9-HxCDF	Not detected									
1,2,3,4,6,7,8-HpCDF	Not detected	8.01E-08	5.17E-08	2.02E-08	7.45E-09	1.68E-08	Not detected	7.53E-09	6.40E-09	6.87E-09
1,2,3,4,7,8,9-HpCDF	Not detected	5.06E-09	Not detected							
OCDF	Not detected	4.65E-09	2.60E-09	1.09E-09	3.57E-10	1.08E-09	Not detected	5.83E-10	4.53E-10	4.02E-10
TCDD[2,3,7,8-] equivalent concentration	3.02E-08	1.10E-06	1.29E-06	5.76E-07	2.24E-07	9.21E-08	3.64E-08	8.00E-08	3.22E-07	2.21E-07

**Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors (continued)**

Congener	09RCRA745 (mg/kg)	09RCRA747 (mg/kg)	09RCRA749 (mg/kg)	09RCRA751 (mg/kg)	09RCRA753 (mg/kg)	09RCRA755 (mg/kg)
2,3,7,8-TCDD	Not detected	1.82E-07	1.76E-07	1.33E-07	Not detected	Not detected
1,2,3,7,8-PeCDD	Not detected					
1,2,3,4,7,8-HxCDD	Not detected	6.08E-08				
1,2,3,6,7,8-HxCDD	Not detected	8.00E-08				
1,2,3,7,8,9-HxCDD	Not detected	8.24E-08				
1,2,3,4,6,7,8-HpCDD	1.54E-08	7.12E-08	6.39E-08	4.88E-08	4.89E-08	1.20E-07
OCDD	2.69E-09	1.34E-08	1.00E-08	8.49E-09	8.67E-09	1.13E-08
2,3,7,8-TCDF	3.25E-08	3.83E-08	4.38E-08	4.23E-08	3.77E-08	4.11E-08
1,2,3,7,8-PeCDF	Not detected	Not detected	Not detected	2.15E-07	1.52E-07	Not detected
2,3,4,7,8-PeCDF	Not detected					
1,2,3,4,7,8-HxCDF	Not detected	Not detected	Not detected	4.88E-08	Not detected	Not detected
1,2,3,6,7,8-HxCDF	Not detected					
2,3,4,6,7,8-HxCDF	Not detected					
1,2,3,7,8,9-HxCDF	Not detected					
1,2,3,4,6,7,8-HpCDF	Not detected	1.61E-08	1.38E-08	8.28E-09	1.12E-08	1.38E-08
1,2,3,4,7,8,9-HpCDF	Not detected					
OCDF	Not detected	1.60E-09	9.87E-10	7.71E-10	9.33E-10	1.21E-09
TCDD[2,3,7,8-] equivalent concentration	5.06E-08	3.23E-07	3.09E-07	5.06E-07	2.59E-07	4.11E-07

**Table 1.3-3
Exposure Point Concentrations for the Industrial and Residential Scenarios and Ecological Receptors**

COPC	Number of Analyses	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Mean Concentration (mg/kg)	Distribution	EPC (mg/kg)	EPC Method
Barium	31	98.8	1780	526.3	Lognormal	704.4	95% H-UCL
Cadmium	31	0.219	0.68	0.416	Normal	0.448	95% Student's-t UCL
Silver	31	0.164	7.95	0.872	Nonparametric	1.94	95% Chebyshev (Mean, Sd) UCL
TCDD[2,3,7,8-] equivalent	36	0.000000217	0.0000371	0.00000212	Nonparametric	0.00000665	95% Chebyshev (Mean, Sd) UCL

**Table 1.3-4
Industrial Screening Evaluation of Noncarcinogenic COPCs**

COPC	EPC (mg/kg) ^a	Industrial SSL (mg/kg) ^b	Hazard Quotient
Barium	704.4	224000	0.003
Cadmium	0.448	1120	0.0004
Silver	1.94	5680	0.0003
HI			0.004

^a The EPC is the 95% UCL.

^b SSLs are from NMED (2009, 106420).

**Table 1.3-5
Industrial Screening Evaluation of Carcinogenic COPCs**

COPC	EPC (mg/kg) ^a	Industrial SSL (mg/kg) ^b	Cancer Risk
TCDD[2,3,7,8-] equivalent	0.00000665	0.000204	3×10^{-7}
Total Excess Cancer Risk			3×10^{-7}

^a The EPC is the 95% UCL.

^b SSL is from NMED (2009, 106420).

**Table 1.3-6
Residential Screening Evaluation of Noncarcinogenic COPCs**

COPC	EPC (mg/kg) ^a	Residential SSL (mg/kg) ^b	Hazard Quotient
Barium	704.4	15600	0.05
Cadmium	0.448	77.9	0.006
Silver	1.94	391	0.005
HI			0.06

^a The EPC is the 95% UCL.

^b SSLs are from NMED (2009, 106420).

**Table 1.3-7
Residential Screening Evaluation of Carcinogenic COPCs**

COPC	EPC (mg/kg) ^a	Residential SSL (mg/kg) ^b	Cancer Risk
TCDD[2,3,7,8-] equivalent	0.00000665	0.0000414	2×10^{-6}
Total Excess Cancer Risk			2×10^{-6}

^a The EPC is the 95% UCL.

^b SSL is from NMED (2009, 106420).

Dioxin/Furan

General Statistics

Number of Valid Observations 36

Number of Distinct Observations 36

Raw Statistics

Minimum 2.17E-08
 Maximum 0.0000371
 Mean 2.082E-06
 Median 4.645E-07
 SD 6.281E-06
 Coefficient of Variation N/A
 Skewness 5.299

Log-transformed Statistics

Minimum of Log Data -17.65
 Maximum of Log Data -10.2
 Mean of log Data -14.56
 SD of log Data 1.645

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.329
 Shapiro Wilk Critical Value 0.935

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.978
 Shapiro Wilk Critical Value 0.935

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 3.85E-06

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 4.791E-06
 95% Modified-t UCL 4.005E-06

Assuming Lognormal Distribution

95% H-UCL 4.476E-06

95% Chebyshev (MVUE) UCL 4.366E-06

97.5% Chebyshev (MVUE) UCL 5.523E-06

99% Chebyshev (MVUE) UCL 7.795E-06

Gamma Distribution Test

k star (bias corrected) 0.421
 Theta Star 4.951E-06
 MLE of Mean 2.082E-06
 MLE of Standard Deviation 3.21E-06
 nu star 30.28

Approximate Chi Square Value (.05) 18.71
 Adjusted Level of Significance 0.0428
 Adjusted Chi Square Value 18.3

Anderson-Darling Test Statistic 2.058
 Anderson-Darling 5% Critical Value 0.826
 Kolmogorov-Smirnov Test Statistic 0.206
 Kolmogorov-Smirnov 5% Critical Value 0.156

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 3.369E-06
 95% Adjusted Gamma UCL 3.445E-06

Potential UCL to Use

Figure 1.3-1. ProUCL printout of dioxin/furan UCL calculations for the TA-16 Burn Ground.

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 3.804E-06
 95% Jackknife UCL 3.85E-06
 95% Standard Bootstrap UCL 3.756E-06
 95% Bootstrap-t UCL 1.202E-05
 95% Hall's Bootstrap UCL 1.052E-05
 95% Percentile Bootstrap UCL 4.079E-06
 95% BCA Bootstrap UCL 5.553E-06

95% Chebyshev(Mean, Sd) UCL 6.645E-06

97.5% Chebyshev(Mean, Sd) UCL 8.619E-06

99% Chebyshev(Mean, Sd) UCL 1.25E-05

Use 95% Chebyshev (Mean, Sd) UCL 6.645E-06

Barium

General Statistics

Number of Valid Observations 31

Raw Statistics

Minimum 98.8
Maximum 1780
Mean 526.3
Median 356
SD 446.9
Coefficient of Variation 0.849
Skewness 1.654

Number of Distinct Observations 31

Log-transformed Statistics

Minimum of Log Data 4.593
Maximum of Log Data 7.484
Mean of log Data 5.979
SD of log Data 0.752

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.777
Shapiro Wilk Critical Value 0.929

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.958
Shapiro Wilk Critical Value 0.929

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 662.5

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 683.8
95% Modified-t UCL 666.5

Assuming Lognormal Distribution

95% H-UCL 704.4

95% Chebyshev (MVUE) UCL 851.8
97.5% Chebyshev (MVUE) UCL 996.1
99% Chebyshev (MVUE) UCL 1280

Gamma Distribution Test

k star (bias corrected) 1.734
Theta Star 303.5
MLE of Mean 526.3
MLE of Standard Deviation 399.6
nu star 107.5
Approximate Chi Square Value (.05) 84.58
Adjusted Level of Significance 0.0413
Adjusted Chi Square Value 83.45

Anderson-Darling Test Statistic 1.001
Anderson-Darling 5% Critical Value 0.76
Kolmogorov-Smirnov Test Statistic 0.185
Kolmogorov-Smirnov 5% Critical Value 0.16

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 668.9
95% Adjusted Gamma UCL 678

Potential UCL to Use

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 658.3
95% Jackknife UCL 662.5
95% Standard Bootstrap UCL 657.1
95% Bootstrap-t UCL 694.7
95% Hall's Bootstrap UCL 687.1
95% Percentile Bootstrap UCL 661.1
95% BCA Bootstrap UCL 689.7
95% Chebyshev(Mean, Sd) UCL 876.1
97.5% Chebyshev(Mean, Sd) UCL 1028
99% Chebyshev(Mean, Sd) UCL 1325

Use 95% H-UCL 704.4

Figure 1.3-2. ProUCL printout of barium UCL calculations for the TA-16 Burn Ground.

Cadmium

General Statistics

Number of Valid Observations 31

Number of Distinct Observations 30

Raw Statistics

Minimum 0.219
Maximum 0.68
Mean 0.416
Median 0.389
SD 0.104
Coefficient of Variation 0.251
Skewness 0.723

Log-transformed Statistics

Minimum of Log Data -1.519
Maximum of Log Data -0.386
Mean of log Data -0.907
SD of log Data 0.246

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.948
Shapiro Wilk Critical Value 0.929

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.975
Shapiro Wilk Critical Value 0.929

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 0.448

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 0.449
95% Modified-t UCL 0.448

Assuming Lognormal Distribution

95% H-UCL 0.451
95% Chebyshev (MVUE) UCL 0.497
97.5% Chebyshev (MVUE) UCL 0.532
99% Chebyshev (MVUE) UCL 0.601

Gamma Distribution Test

k star (bias corrected) 15.48
Theta Star 0.0269
MLE of Mean 0.416
MLE of Standard Deviation 0.106
nu star 959.8
Approximate Chi Square Value (.05) 888.9
Adjusted Level of Significance 0.0413
Adjusted Chi Square Value 885.1

Anderson-Darling Test Statistic 0.387
Anderson-Darling 5% Critical Value 0.745
Kolmogorov-Smirnov Test Statistic 0.0982
Kolmogorov-Smirnov 5% Critical Value 0.158

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 0.449
95% Adjusted Gamma UCL 0.451

Potential UCL to Use

Figure 1.3-3. ProUCL printout of cadmium UCL calculations for the TA-16 Burn Ground.

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 0.447
95% Jackknife UCL 0.448
95% Standard Bootstrap UCL 0.446
95% Bootstrap-t UCL 0.449
95% Hall's Bootstrap UCL 0.45
95% Percentile Bootstrap UCL 0.448
95% BCA Bootstrap UCL 0.449
95% Chebyshev(Mean, Sd) UCL 0.498
97.5% Chebyshev(Mean, Sd) UCL 0.533
99% Chebyshev(Mean, Sd) UCL 0.602

Use 95% Student's-t UCL 0.448

Silver

General Statistics

Number of Valid Observations 31

Number of Distinct Observations 31

Raw Statistics

Minimum 0.164
 Maximum 7.95
 Mean 0.872
 Median 0.537
 SD 1.361
 Coefficient of Variation 1.561
 Skewness 5.001

Log-transformed Statistics

Minimum of Log Data -1.808
 Maximum of Log Data 2.073
 Mean of log Data -0.496
 SD of log Data 0.69

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.386
 Shapiro Wilk Critical Value 0.929

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.872
 Shapiro Wilk Critical Value 0.929

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 1.287

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 1.509
 95% Modified-t UCL 1.323

Assuming Lognormal Distribution

95% H-UCL 1.005

95% Chebyshev (MVUE) UCL 1.211
 97.5% Chebyshev (MVUE) UCL 1.404
 99% Chebyshev (MVUE) UCL 1.784

Gamma Distribution Test

k star (bias corrected) 1.41
 Theta Star 0.619
 MLE of Mean 0.872
 MLE of Standard Deviation 0.734
 nu star 87.39

Approximate Chi Square Value (.05) 66.84

Adjusted Level of Significance 0.0413

Adjusted Chi Square Value 65.84

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Anderson-Darling Test Statistic 2.718

Anderson-Darling 5% Critical Value 0.763

Kolmogorov-Smirnov Test Statistic 0.212

Kolmogorov-Smirnov 5% Critical Value 0.161

Data not Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 1.274

95% Jackknife UCL 1.287

95% Standard Bootstrap UCL 1.268

95% Bootstrap-t UCL 2.337

95% Hall's Bootstrap UCL 2.699

95% Percentile Bootstrap UCL 1.322

95% BCA Bootstrap UCL 1.626

95% Chebyshev(Mean, Sd) UCL 1.937

97.5% Chebyshev(Mean, Sd) UCL 2.398

99% Chebyshev(Mean, Sd) UCL 3.304

Assuming Gamma Distribution

95% Approximate Gamma UCL 1.14

95% Adjusted Gamma UCL 1.157

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 1.937

Figure 1.3-4. ProUCL printout of silver UCL calculations for the TA-16 Burn Ground.

**Table 2.1-1
Ecological Screening Levels for Terrestrial Receptors**

Chemical	Kestrel (Avian insectivore)	Kestrel (carnivore)	Robin (herbivore)	Robin (insectivore)	Robin (omnivore)	Deer mouse	Desert cottontail	Earthworm	Plant	Montane shrew	Red fox
Barium	11000	37000	820	1000	930	1800	3300	330	110	1300	41000
Cadmium	2	580	4.4	0.29	0.54	0.51	9.9	140	32	0.27	510
Silver	19	840	11	2.6	4.3	24	150	na ^a	560	14	4100
TCDD[2,3,7,8-] equivalent	0.000014 ^b	0.000014 ^b	0.00024 ^b	0.0000041 ^b	0.0000081 ^b	0.00000058	0.000048	5	na	0.00000029	0.0000012

Note: ESLs from ECORISK Database, Version 2.3 (LANL 2008, 103352) unless otherwise noted.

^a na = Not available.

^b Avian ESLs for TCDD taken from ECORISK Database, Version 2.0 (LANL 2000, 080117).

**Table 2.1-2
Comparison of EPCs with the Minimum ESLs**

COPC	EPC ^a (mg/kg)	Minimum ESL ^b (mg/kg)	Receptor	Hazard Quotient
Barium	704.4	110	Plant	6.4
Cadmium	0.448	0.27	Montane shrew	1.7
Silver	1.94	2.6	Robin (insectivore)	0.7
TCDD[2,3,7,8-] equivalent	0.00000665	0.00000029	Montane shrew	22.9

^a The EPC the 95% UCL.

^b ESLs from ECORISK Database, Version 2.3 (LANL 2008, 103352).

**Table 2.1-3
Hazard Quotient Analysis**

COPECs	EPC (mg/kg)	Kestrel (Avian insectivore)	Kestrel (carnivore)	Robin (herbivore)	Robin (insectivore)	Robin (omnivore)	Deer mouse	Desert cottontail	Earthworm	Plant	Montane shrew	Red fox
Barium	704.4	0.06	0.02	0.9	0.7	0.08	0.4	0.2	2.1	6.4	0.5	0.02
Cadmium	0.448	0.2	0.0008	0.1	1.5	0.8	0.9	0.05	0.003	0.01	1.7	0.0009
Silver	1.94	0.1	0.002	0.2	0.7	0.5	0.08	0.01	na*	0.003	0.1	0.0005
TCDD[2,3,7,8-] equivalent	6.65E-06	0.5	0.5	0.03	1.6	0.8	11.5	0.1	0.000001	na	22.9	5.5
HI		0.9	0.5	1	5	2	13	0.4	2	6	25	6

Note: Bolded values indicate HQs greater than 0.3 or HIs greater than 1.0.

* na = Not available.

**Table 2.2-1
Comparison of EPCs to Background Concentrations in Soil**

COPEC	EPC (mg/kg)	Soil Background Concentrations (mg/kg)
Barium	704.4	21-410
Cadmium	0.448	0.2–2.6
Silver	1.94	1

**Table 2.2-2
Population Area Use Factors for Ecological Receptors**

Receptor	Home Range ^a (ha)	Population Area ^b (ha)	PAUF ^c
Kestrel	106	4240	0.0006
Robin	0.42	16.8	0.15
Deer mouse	0.077	3.0	0.87
Desert cottontail	3.1	124	0.02
Montane shrew	0.39	15.6	0.17
Red fox	1038	41,520	0.00006

^a Values from EPA 1993, 059384.

^b Derived by 40HR.

^c PAUF is calculated as the area of the site (2.6 ha) divided by the population area.

**Table 2.2-3
Adjusted Hazard Quotient Analysis**

COPECs	EPC (mg/kg)	Kestrel (Avian insectivore)	Kestrel (carnivore)	Robin (herbivore)	Robin (insectivore)	Robin (omnivore)	Deer mouse	Desert cottontail	Earthworm	Plant	Montane shrew	Red fox
Barium	704.4	0.00004	0.00001	0.1	0.1	0.01	0.3	0.004	2.1	6.4	0.09	0.000001
Silver	1.94	0.00006	0.000001	0.03	0.1	0.08	0.07	0.0002	na*	0.003	0.02	0.00000003
TCDD[2,3,7,8-] equivalent	6.65E-06	0.0003	0.0003	0.005	0.2	0.1	10	0.002	0.000001	na	4	0.0003
Adjusted HI		0.0004	0.0003	0.1	0.4	0.2	10	0.0006	2	6	4	0.0003

Note: Bolded values indicate HQs greater than 0.3 or HIs greater than 1.0.

* na = Not available.

**Table 2.2-4
Area Adjusted Hazard Quotient Analyses for TCDD[2,3,7,8-] equivalent**

COPECs	EPC (mg/kg)	Deer mouse	Montane shrew
TCDD[2,3,7,8-] equivalent for area east of 16-0399	3.71E-05	64	128
TCDD[2,3,7,8-] equivalent for rest of area around 16-388 and 16-0399	1.2E-06	2	4

**Table 2.2-5
Population Area Use Factors for Ecological Receptors**

Receptor	Home Range ^a (ha)	Population Area ^b (ha)	PAUF for Area East of 16-0399 ^c	PAUF for Rest of Area Around 16-0388 and 16- 0399 ^d
Deer mouse	0.077	3.0	0.03	0.83
Montane shrew	0.39	15.6	0.006	0.16

^a Values from EPA 1993, 059384.

^b Derived by 40HR.

^c PAUF calculated as the area of the site (0.1 ha) divided by the population area.

^d PAUF calculated as the area of the site (2.5 ha) divided by the population area.

**Table 2.2-6
Area and PAUF Adjusted Hazard Quotient Analyses for TCDD[2,3,7,8-] equivalent**

COPECs	EPC (mg/kg)	Deer mouse	Montane shrew
TCDD[2,3,7,8-] equivalent for area east of 16-0399	3.71E-05	1.9	0.8
TCDD[2,3,7,8-] equivalent for rest of area around 16-0388 and 16-0399	1.2E-06	1.7	0.6

Dioxin/Furan data w/o highs

General Statistics

Number of Valid Observations 34

Number of Distinct Observations 34

Raw Statistics

Minimum 2.17E-08
 Maximum 3.38E-06
 Mean 8.042E-07
 Median 4.17E-07
 SD 9.224E-07
 Coefficient of Variation N/A
 Skewness 1.574

Log-transformed Statistics

Minimum of Log Data -17.65
 Maximum of Log Data -12.6
 Mean of log Data -14.78
 SD of log Data 1.398

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.778
 Shapiro Wilk Critical Value 0.933

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.954
 Shapiro Wilk Critical Value 0.933

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 1.072E-06

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 1.11E-06
 95% Modified-t UCL 1.079E-06

Assuming Lognormal Distribution

95% H-UCL 2.086E-06

95% Chebyshev (MVUE) UCL 2.22E-06
 97.5% Chebyshev (MVUE) UCL 2.765E-06
 99% Chebyshev (MVUE) UCL 3.836E-06

Gamma Distribution Test

k star (bias corrected) 0.745
 Theta Star 1.08E-06
 MLE of Mean 8.042E-07
 MLE of Standard Deviation 9.319E-07
 nu star 50.64
 Approximate Chi Square Value (.05) 35.3
 Adjusted Level of Significance 0.0422
 Adjusted Chi Square Value 34.67
 Anderson-Darling Test Statistic 0.335
 Anderson-Darling 5% Critical Value 0.786
 Kolmogorov-Smirnov Test Statistic 0.0924
 Kolmogorov-Smirnov 5% Critical Value 0.157

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 1.064E-06
 95% Jackknife UCL 1.072E-06
 95% Standard Bootstrap UCL 1.06E-06
 95% Bootstrap-t UCL 1.133E-06
 95% Hall's Bootstrap UCL 1.107E-06
 95% Percentile Bootstrap UCL 1.056E-06
 95% BCA Bootstrap UCL 1.116E-06
 95% Chebyshev(Mean, Sd) UCL 1.494E-06
 97.5% Chebyshev(Mean, Sd) UCL 1.792E-06
 99% Chebyshev(Mean, Sd) UCL 2.378E-06

Assuming Gamma Distribution

95% Approximate Gamma UCL 1.154E-06
 95% Adjusted Gamma UCL 1.175E-06

Potential UCL to Use

Use 95% Approximate Gamma UCL 1.154E-06

Figure 2.2-1. ProUCL printout of dioxin/furan UCL calculations without the highest values for the TA-16 Burn Ground.

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