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Title: Sampling and Analysis Plan for Assessment of LANL-Derived Residual Radionuclides in Soils within Tract A-16-e for Land Conveyance

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Sampling and Analysis Plan

for Assessment of LANL-Derived Residual Radionuclides in Soils within Tract A-16-e for Land Conveyance

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1.0 Overview

Public Law 105-119 directs the U.S. Department of Energy (DOE) to convey or transfer parcels of land to the Incorporated County of Los Alamos or their designees and to the Department of Interior, Bureau of Indian Affairs, in trust for the Pueblo de San Ildefonso. Los Alamos National Security is tasked to support DOE in conveyance and/or transfer of identified land parcels no later than September 2022. Under DOE Order 458.1, *Radiation Protection of the Public and the Environment* (O458.1, 2013), and Los Alamos National Laboratory (LANL or the Laboratory) implementing Policy 412 (P412, 2014a), real property with the potential to contain residual radioactive material must meet the criteria for clearance and release to the public.

This Sampling and Analysis Plan (SAP) investigates Tract A-16-e and proposes 50 project-specific soil samples for use in radiological clearance decisions consistent with LANL Procedure ENV-ES-TP-238 (2015a) and guidance in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM, 2000).

2.0 Background for A-16-e

2.1 Site location

A-16-e consists of the South-facing slope of Los Alamos canyon from the top of DP mesa (LANL Technical Area (TA)-21) to slightly above the drainage at the canyon bottom (see Figure 1). It is bordered on the West side by Tract A-16-a and on the East side by Tract A-16-d. A-16-e covers an area of approximately 54 acres (~216,200 m^2) including the access road which travels along the South side of DP mesa (this road defines the northern boundary of A-16-e for most of its extent) as well as undeveloped hill slope in Los Alamos Canyon.

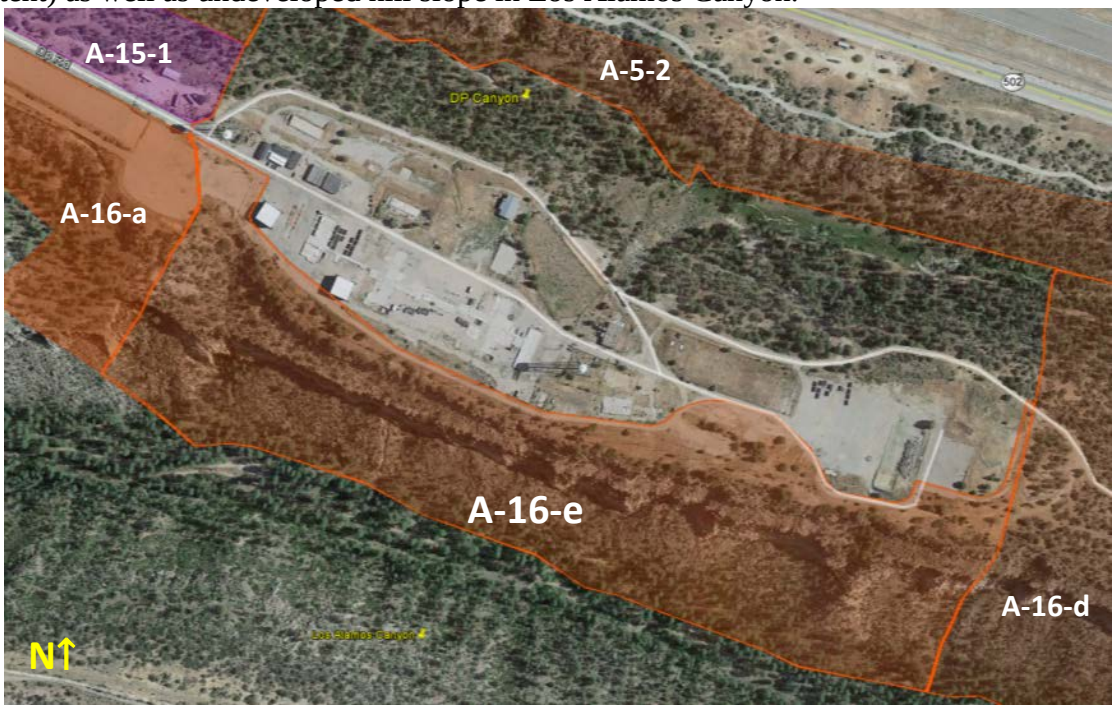

Figure 1. Aerial view of Tract A-16-e and its spatial relation to other land conveyance Tracts.
Note: Map locations and boundaries are approximate and subject to change.

2.2 General history

Historical maps from the pre-LANL era, aerial photographs, and historical accounts of life in the area show little development prior to LANL occupancy (pre-World War II). Detroit businessman Ashley Pond started the "Los Alamos Ranch School" in 1917. The school began with a few ranch buildings from the Harold H. Brook homestead. The Mattie Brooke Trail was originally a wagon road that came up from Los Alamos Canyon onto the mesa in the vicinity of what is now called DP Mesa.

Laboratory operations began on nearby DP Mesa in the late 1940s. Plutonium processing operations were conducted on DP Mesa in Technical Area-21. Additionally, waste disposal operations were conducted at areas now designated as Material Disposal Areas A, B, T, U, and V (MDA-A, MDA-B, etc. – see Figure 2) on the mesa-top. There are multiple Potential Release Sites (PRSs) that intersect with Tract A-16-e (see section 2.4 and Attachment 1) due to historical Laboratory operations on DP Mesa. PRSs are identified under the 2005 Compliance Order on Consent (Consent Order – superseded by the 2016 Consent Order) between DOE, the New Mexico Environment Department (NMED), and the Laboratory.

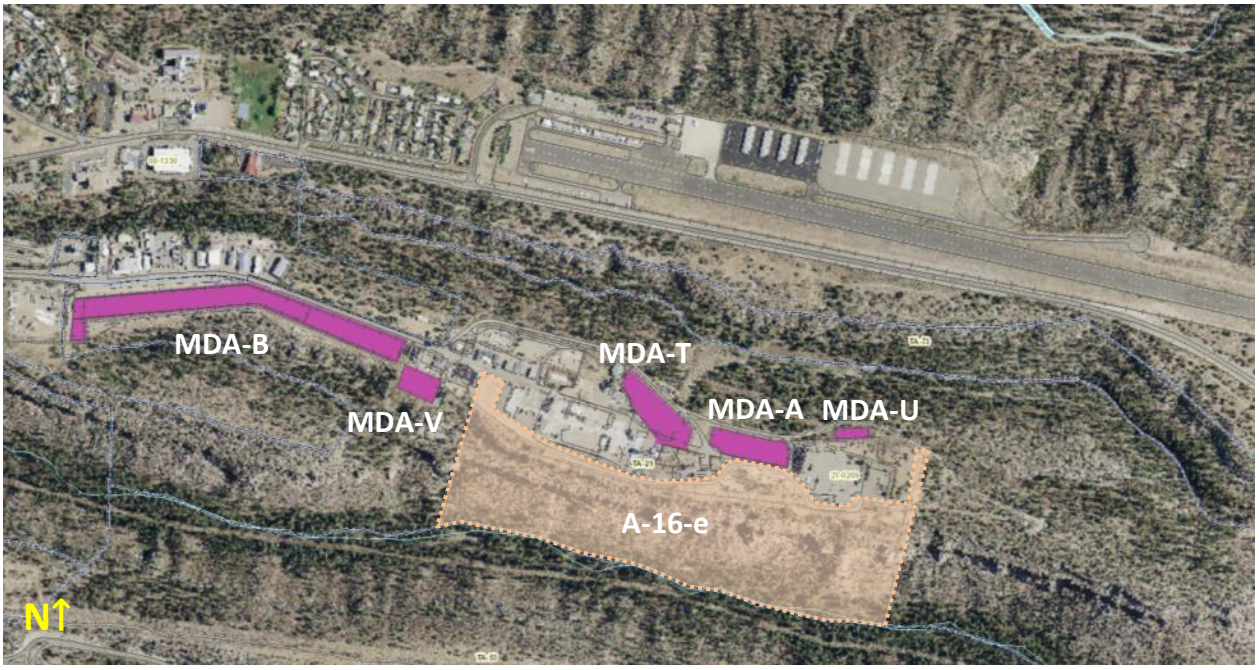

Figure 2. Approximate spatial locations of the MDAs at TA-21 (LANL Decision Support Application, 2015). The approximate boundary of A-16-e is indicated in orange.

2.3 Current use

Tract A-16-e is unoccupied, vacant land. No structures or facilities associated with LANL's federal, state, or local permits (such as air monitoring stations, radiation monitoring stations, or wastewater discharge outfalls) are located within A-16-e.

2.4 Historical evaluation of LANL radiological impact

The Los Alamos canyon drainage is considered an Area of Concern (AOC), labeled C-00-006, which runs through the southern edge of the tract. Additionally, the full area of the Tract is included within the air shed Potential Release Site (PRS) labeled SWMU 21-021. This PRS is associated with historical stack emissions from TA-1 and TA-21. Within SWMU 21-021, there is increased potential for elevated surface soil concentrations of plutonium-239 and americium-241 above background.

Other PRSs identified in a spatial query using the Environmental Decision Support Application are labeled in Figure 3 and described in Table 1. Many of these PRSs have undergone remediation, and 9 out of 22 have received Certificates of Completion (CoCs) without controls under the Consent Order or No Further Action approvals (NFAs) under the earlier Resource Conservation and Recovery Act (RCRA) guidance. Either of these designations indicates that the site requires no further corrective actions to meet RCRA requirements and is administratively closed (all documentation complete). In these cases, NMED agrees that the nature and extent of chemicals and/or radionuclides has been well characterized and there is no human health risk associated with the PRS. Additional information about PRSs within Tract A-16-e is provided in Attachment 1.

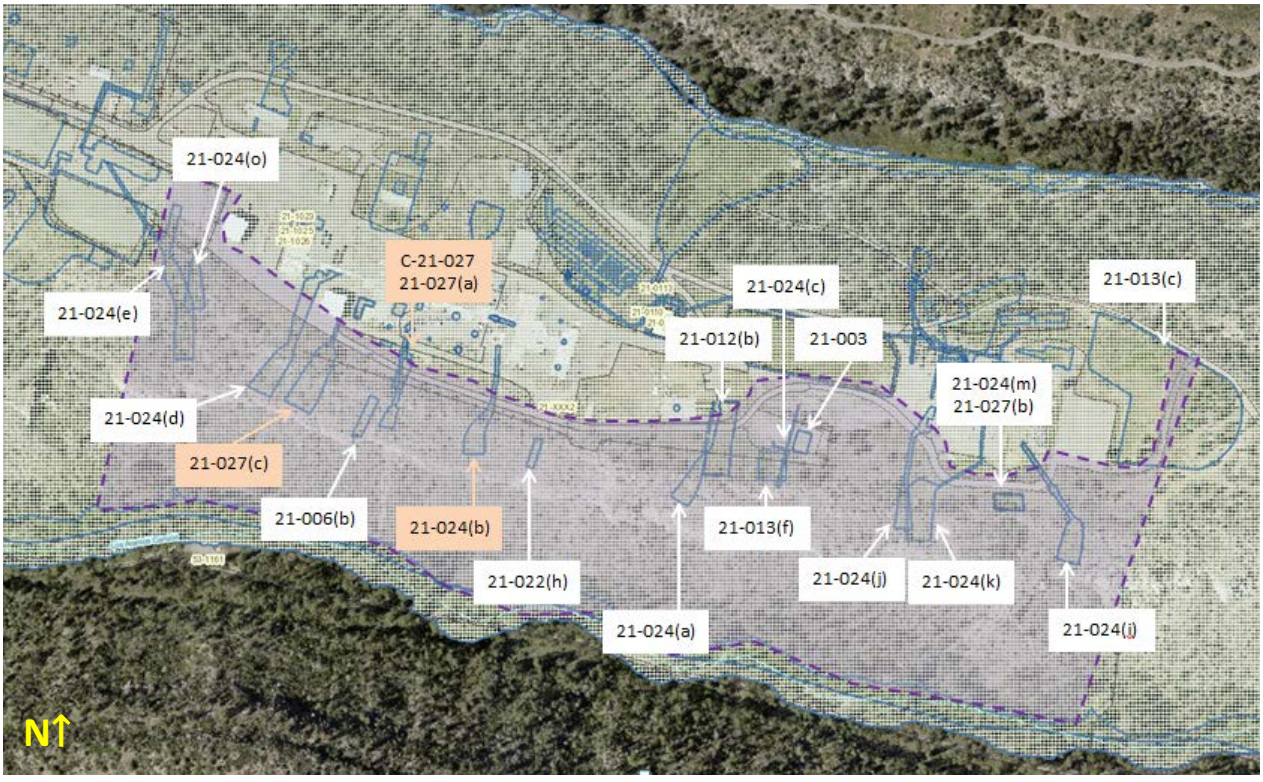

Figure 3. DP Mesa south side PRSs identified within the approximate boundary of Tract A-16-e using the LANL Decision Support Application. Orange-highlighted PRSs pass through the Class 2 decision unit described in section 2.6. The full tract falls within SWMU 21-021 and is bordered on its southern edge by C-00-006.

Table 1. A-16-e PRS information summary. Numbers 3-22 are depicted in Figure 3, and orange-highlighted PRSs pass through the Class 2 decision unit described in section 2.6. The right column indicates the status of RCRA/Consent Order approvals, according to the PRS database. All PRSs described as "in progress" in this list are considered appropriate for corrective actions complete without controls. See Attachment 1 for more details.			
1	21-021	TA-21 air shed	In progress
2	C-00-006	AOC for Los Alamos canyon – Southern edge of A-16-e	In progress
3	21-024(e)	Septic system for laundry and diesel plant	CoC w/o controls
4	21-024(o)	Drain line for diesel plant	CoC w/o controls
5	21-024(d)	Septic system for 21-0001	In progress
6	21-027(c)	Drain line and outfall	Pending receipt of CoC
7	21-006(b)	Seepage pit, drain line and outfall for 21-0002	In progress
8	C-21-027	Chilled water re-circulator, acid tank, and drain line for 21-0003	In progress
9	21-027(a)	Drain lines from 21-0003 floor drains, surface storm water drain	In progress
10	21-024(b)	Septic system from 21-0017	In progress
11	21-022(h)	Sump, drain line, and outfall for 21-0150 (Pu fuel service building)	In progress
12	21-024(a)	Septic system for 21-0009 (steam plant)	CoC w/o controls
13	21-012(b)	Dry well for 21-0009 (steam plant) boiler blowdown	CoC w/o controls
14	21-013(f)	Surface disposal area (assumed)	In progress
15	21-024(c)	Septic system for 21-0054, 21-0061	In progress
16	21-003	Former building 21-0061	In progress
17	21-024(j)	Sanitary septic system for 21-0155 TSTA facility	CoC w/o controls
18	21-024(k)	Septic tank, drain lines, leach field	In progress
19	21-024(m)	Clay pipe from 21-0209 (high temperature chemistry laboratory)	CoC w/o controls
20	21-027(b)	Fuel tank catch basin drain line for storm water	NFA
21	21-024(i)	Septic system for 21-0152 (Po processing laboratory) and 21-0209	CoC w/o controls
22	21-013(c)	Surface disposal area for construction debris	CoC w/o controls

2.4.1 Adjacent properties with known or suspected subsurface radioactivity

A-16-e is near four MDAs, but none are included within the boundaries of the tract. PRSs 21-013(f) and 21-013(c) were described as former surface disposal areas for dirt and/or construction debris and were not associated with burial of radioactive materials.

2.5 Preliminary results from process knowledge and surveys for residual radioactivity

Guidance in MARSSIM (2000) was used to develop this SAP, and previous sampling data were used to determine expected standard deviations. Summary statistics are provided in Attachment 2.

Tract A-16-e is considered radiologically impacted under DOE Order 458.1. Available data indicate that the levels of contamination in soils/sediments do not present a significant human health or ecological risk. LANL's Associate Directorate for Environmental Management (ADEM) (then ADEP) conducted characterization and remediation of the DP aggregate area under the Consent Order in the early 2000s. Investigations quantified the nature and extent of constituents in the PRSs, and cleanup was conducted using SALs based on a 15 mrem/y limit to a residential user. EM found that no further remedial action was required for radiological conditions.

Regarding the potential for human exposure, ADEM found that the steep cliff side on the south side of DP mesa restricted future use in the areas of highest potential contamination. As described in the ADEM Phase III Investigation Report for this area (LANL, 2016), "The main area of contamination is the around the outfall[s]. The contamination area is on the steep slope/cliff, with 45- to 90-degree slopes … unstable, highly weathered, fractured bedrock with approximately 15% soil, filling fractures and voids between rocks." In these areas, remediation was not conducted due to safety concerns, and the ADEM report stated "exposure of human receptors over this portion of the site has no likelihood of occurring because there is currently no access to the slope/cliff, there is no trail or path for someone to traverse if he or she were to gain access to the slope/cliff, and there are major safety concerns regarding any activity on the slope/cliff."

While the ADEM characterization and risk evaluation satisfy the requirements of the Consent Order, the available data and dose assessments are not consistent with MARSSIM guidance or O458.1 requirements. This SAP outlines soil collection and data analysis as part of a final status survey to support clearance of the property under O458.1. To calculate the number of required samples, all preliminary data available from EM characterizations were used except for data points which were specifically flagged as "excavated" in the database. For preliminary data analysis, the site was divided based on proposed use into two use types:

- Recreational use on the cliff extending to the south down the south-facing slope of Los Alamos Canyon
- Construction use on the flat mesa top from DP road to the south of the ongoing D&D project areas

2.6 Conclusions regarding the classification of A-16-e relative to potential for residual radioactive contamination

The Intellus soil data for nuclides of interest in soil/sediment suggest that soil radionuclide concentrations are likely to be substantially below all Screening Action Levels (SALs) for construction, or recreational use. Thus, remedial activities are unlikely to be required for radionuclides.

A-16-e has been subdivided into three statistical decision units using MARSSIM guidance, as described in Table 2 and Figure 4. If future-use designation changes in these areas, sampling plans for specifically identified exposure scenarios could be considered.

Table 2. Statistical decision areas in A-16-e.		
Decision Area	*Description*	*Justification*
Recreation Class 3	Cliffside and south-facing slope of LA canyon 191,000 m^2	Use limited by topography
Construction Class 3	West and East portions of DP Mesa within A-16-e from DP road South 22,000 m^2	Potential for future soil disturbance – low potential for residual radioactivity
Construction Class 2	Middle portion of DP road including PRSs C-21-027, 21-027(a), 21-027(c) and 21-024(b) 3200 m^2	Elevated radionuclide levels in soil, many locations indicate "excavated" or remediation took place Biased sampling in the outfall locations will supplement the standard grid sampling

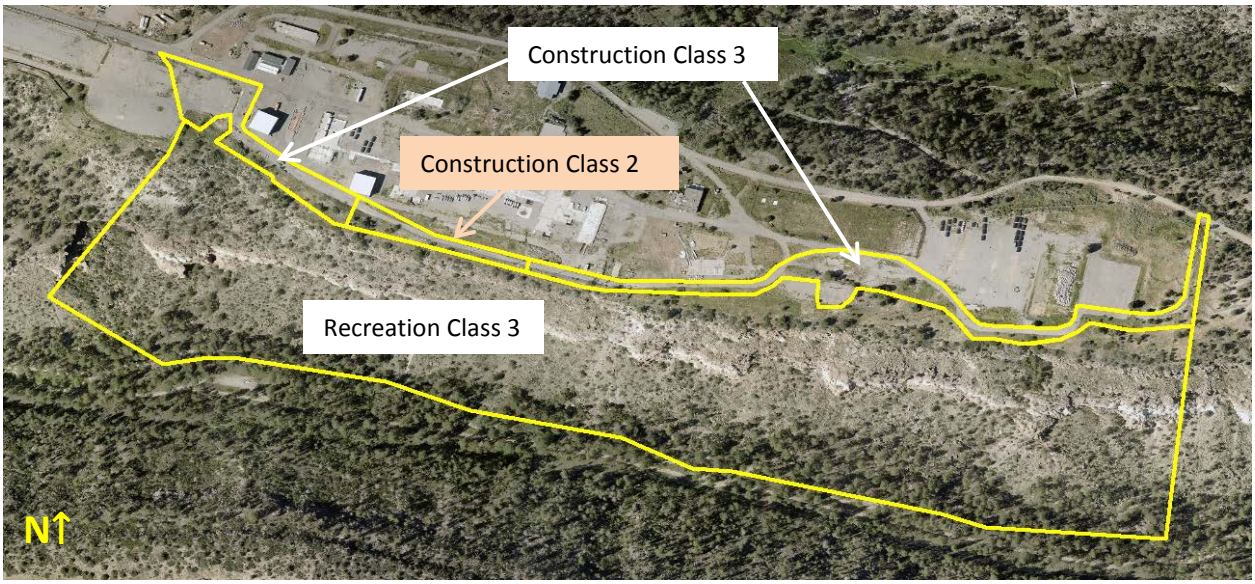

Figure 4. Statistical decision areas in A-16-e. ***Note***: Map locations and boundaries are approximate and subject to change. Additional D&D and material relocation on the mesa top may have occurred since this photo was taken.

3.0 Data Quality Objectives

3.1 Objective of the SAP

The objective of this SAP is to confirm, within the stated statistical confidence limits, that the mean levels of radioactive residual contamination in soils in A-16-e are documented in

appropriate units and estimated doses are below the dose limits of 15 mrem/y (150 µSv/y) for public release of real property. The SALs for the construction and recreation scenarios are provided in Attachment 2. SALs, as derived in LANL (2014), are identified as Authorized Limits (ALs) in the rest of this SAP with regard to statistical decisions. Currently, updated SALs are being prepared to support an Authorized Limit request as required by Order 458.1 (2013). The SALs may not be used as ALs for clearance decisions until DOE approves this request.

3.2 Decision identification

The principle study question is: Does the residual radioactive contamination exceed ALs for the proposed exposure scenario the decision area? The decision alternatives are:

- If results from the soil radioactive contamination measurements are at or above the AL (collectively), then the site is not a candidate for land transfer.
- If results from the soil radioactive contamination measurements are below the AL (collectively), then the site is a candidate for land transfer.

3.3 Inputs into the decision

Construction and recreation use scenarios were assumed for the purpose of selecting ALs and defining the MARSSIM Upper Bound of the Gray Region. 15 mrem/y (150 µSv/y) was the assumed dose constraint.

Data to be used in the analysis include surface soil/sediment concentration measurements for radionuclides. The unity (sum of fractions) rule will be applied. The formula used in for the unity rule is:

$$\frac{C_1}{AL_1} + \frac{C_2}{AL_2} + \frac{C_3}{AL_3} \ldots\ldots \frac{C_n}{AL_n} \leq 1$$

where $C_{1\text{-}n}$ and $AL_{1\text{-}n}$ are the upper-bound estimates of the mean concentrations for radionuclides (e.g., upper 95% values) and Authorized Limits 1 through n, respectively.

3.4 Study boundaries

The study is limited to Tract A-16-e, as identified in Figure 1. The list of radionuclides in the analysis includes: americium-241, cesium-134, cesium-137, hydrogen-3, strontium-90, plutonium-238, plutonium-239/240, uranium-234, uranium-235, and uranium-238.

3.5 Decision rule

Three decision areas were defined in A-16-e, as described in Section 2.6 and detailed in the Visual Sample Plan (VSP) output in Attachment 3. The decision rule is based on the following:

- Null hypothesis: mean residual contamination levels in soil/sediment in the decision area combined over all radionuclides is *above* the AL and *likely* to result in an all-pathway radiation dose to the receptor above 15 mrem/yr (150 µSv/y)
- Alternative hypothesis: mean residual contamination levels in soil/sediment in the decision area combined over all radionuclides is *below* the AL and *not likely* to result in an all-pathway radiation dose to the receptor above 15 mrem/yr (150 µSv/y).

3.6 Limits on decision errors

The distribution for the preliminary data is *not* assumed to be normal. The acceptable statistical errors for this analysis are:

- Type 1 error < 0.05 (incorrectly reject null hypothesis, i.e., conclude contamination level is < AL when in fact it is > AL)
- Type 2 error < 0.1 (incorrectly fail to reject null hypothesis, i.e., conclude soil contamination level is > AL when in fact it is < AL)

3.7 Optimization

The survey design was optimized by analyzing historical data. Outside of the central DP road portion (Construction Class 2 decision area), the radiological concentrations measured in soil are very low relative to the SALs. Treating these areas as Class 3 optimizes the number of required sample locations based on construction land use on the mesa top and recreation use along the canyon wall. Randomly located sample points are beneficial in the two Class 3 decision areas to allow the sampling team flexibility due to safety concerns for sampling inaccessible areas on the cliff side or underneath the paved road.

An ongoing discussion for the remainder of Land Conveyance sampling in the A-16 tracts will be the need to sample at depth. MARSSIM guidance is limited to surface sampling, however depth sampling has been used to characterize land tracts with a history of subsurface disposal of radioactive materials (A-16-a contains the footprint of MDAs B and V).

EPC-ES has determined that surface characterization of A-16-e is sufficient for dose assessment, ALARA evaluation, and release decisions regarding the Tract for the following reasons:

1. Process knowledge for A-16-e does not indicate burial of radioactive materials in the tract. There are no known MDAs within the tract boundaries and a PRS query did not identify any subsurface radioactive material concerns.
2. Nature and extent characterization was conducted by ADEM in the early 2000s. In the Phase III investigation report for the DP aggregate area, ADEM found that the lateral and vertical extents of constituents were well defined for the PRSs in the Tract. It is likely that existing data appropriately represents surface and subsurface concentrations of concern in the Tract.
3. Remediation has taken place on much of the accessible terrain in this tract using the approach adopted by ADEM under the NMED guidance. According to the Phase III Investigation Report for the DP aggregate area (LANL, 2016) the characterized and remediated areas present no human health or ecological risk.
4. After exclusion of historical data points flagged as “excavated,” the soil concentrations of radionuclides are expected to be well below the 15 mrem/y SALs for the recreation and construction use scenarios, as appropriate. EPC-ES anticipates that analysis of existing data and the additional samples described in this SAP will conclude that radiation doses for the tract are ALARA, especially in light of low radionuclide concentrations within the Tract and the high cost of any additional remediation.

3.8 Evaluation for number of samples required

ArcMap 10.3.1 was used to create the polygon boundary of A-16-e, and a shape file for the tract was imported into VSP (2015). The MARSSIM application within VSP was used to calculate and place the number of samples needed to compare a sample average to a fixed threshold (AL) given the statistical decision rule and acceptable error described above. The preliminary sampling data in Attachment 2 were used to estimate mean values and standard deviations for each of the identified radionuclides. All previous data, including the results of biased sampling, will be included in the dose assessment for radiological clearance.

3.9 Statistical evaluation of the survey results

All the applicable data that has passed the MQO evaluation will be used to determine the upper-bound estimate of the mean for soil concentrations (generally, the 95% value) for each radionuclide. The EPA software ProUCL (2013) will be used to determine this value. The statistical decision as to whether the residual soil contamination levels (i.e., the 95% UCLs) are below the ALs will be evaluated using the following criteria. All analyses and results will be documented.

Decision Criteria:

1) If all individual sample results are ≤ the AL, then no further action is required and the site passes the criteria for the specific use.
2) If all individual samples or the UCL are > the AL, then the site is not a candidate for release and site remediation followed by resampling is necessary before the tract can be released.
3) If the UCL is below the AL but some individual measurements are above the AL, then statistical analysis is needed. Non-parametric statistical approaches will be used to evaluate the null hypothesis. If contamination is present in background, the Wilcoxon Rank Sum test is used, and if contamination is not present in background or very low relative to the AL, the Sign Test is used. For this tract, the Sign Test will be used with a $p < 0.05$ decision threshold for significance. See MARSSIM Chapter 8 for details and examples (2000).
4) Alternatively, one could confirm that the ratio of the 95% UCL of the average concentration divided by the AL and the sum of hot spot activity ratios do not exceed unity:

$$\frac{\overline{C}_{UCL}}{C_{AL}} + \sum_{i=1}^{n} \frac{C_{i,C>AL}}{C_{AL} * AF} \leq 1$$

Here $\overline{C}_{UCL}$ is the 95% upper bound estimate of the concentration mean, C_{AL} is the AL (15 mrem/yr (150 µSv/y)), $C_{i,c>AL}$ is the sample concentration for a single sample above the AL (i.e., has elevated measured concentrations), and *AF* is the Area Factor [ratio of effective dose calculated for area of contamination normalized to effective dose calculated for 10,000 m^2 (RESRAD default)]. If the result of this calculation is > 1, the site is a candidate for further characterization of the nature and extent of the contamination, remediation of the site, follow up confirmatory sampling, and reanalysis

against the decision criteria in this section. Area Factors are dependent on the exposure scenario and should be calculated individually.

5) If there are multiple radionuclides (*i*) being evaluated in a sampling unit, the sum of the ratios should be less than or equal to 1.
6) The dose assessment based on the soil measurements will include the sum of doses from all radionuclides, and this sum will be compared to the 3 mrem/yr (30 μSv/yr) threshold for follow-up ALARA analysis.

4.0 Measurement Quality Objectives (MQOs) and applicable procedures

4.1 MQOs

1) Detection Capability: Minimum Detection Concentration should be below the MARSSIM-defined Upper Bound of the Gray Region (i.e. AL for the radionuclide of interest).
2) The degree of measurement uncertainty (combined precision and bias) should be reported and the level should be reasonable relative to the needed accuracy of the decision and accounted for in the statistical analysis.
3) Range of the instrument and measurement technique should be appropriate for the concentrations expected.
4) The instrument and measurement technique should be specific for the radionuclide(s) being measured. Specificity is the ability of the measurement method to measure the radionuclide of concern in the presence of interferences.
5) For field instruments, the instrument should be rugged enough to consistently provide reliable measurements. However, in this case, all samples will be analyzed in the laboratory.

4.2 Procedures used to meet these MQOs

1) Collection of valid soil sample appropriate for the dose assessment,
    a. ENV-ES-TP-006 (2015) *Sampling soil and vegetation at facility sites.*
    b. QAPP-0001 (2008) *Quality and assurance project plan for the soils, foodstuffs, and non-foodstuff biota monitoring project.*
2) Soil sample analysis will use EPA-approved analytical procedures for each radionuclide. The following will be used by the independent laboratory:
    a. EPA Method 901.1 *Gamma emitting radionuclides in drinking water*
    b. EPA Method 905.0 *Radioactive strontium in drinking water*
    c. EPA Method 906.0 *Tritium in drinking water*
    d. DOE Environmental Monitoring Laboratory HASL-300

After the measurements are completed, the laboratory results in units equivalent to the ALs will be evaluated with respect to the MQOs, as stated above.

5.0 Results of the analysis for sampling number and locations

Table 3 presents a summary of the number of sample locations for each decision area in A-16-e. The specific details of the analysis (specific statistical parameter values, analysis, results, and

approximate coordinates for the randomly selected sampling locations using MARSSIM) are provided in Attachment 3 of this report. Approximate locations are indicated in Figure 5, and coordinates are provided in Table 4.

Table 3. Sampling number for A-16-e decision areas. A total of 50 locations are proposed			
Decision Area	Random Samples	Grid Samples	Biased Samples
Recreation Class 3	11	NA	NA
Construction Class 3	11 • West 3 • East 8	NA	NA
Construction Class 2	NA	15	13, divided as follows: • 5 in 21-027(c) (left) • 4 in C-21-027 and 21-027(a) (middle) • 4 in 21-024(b) (right)

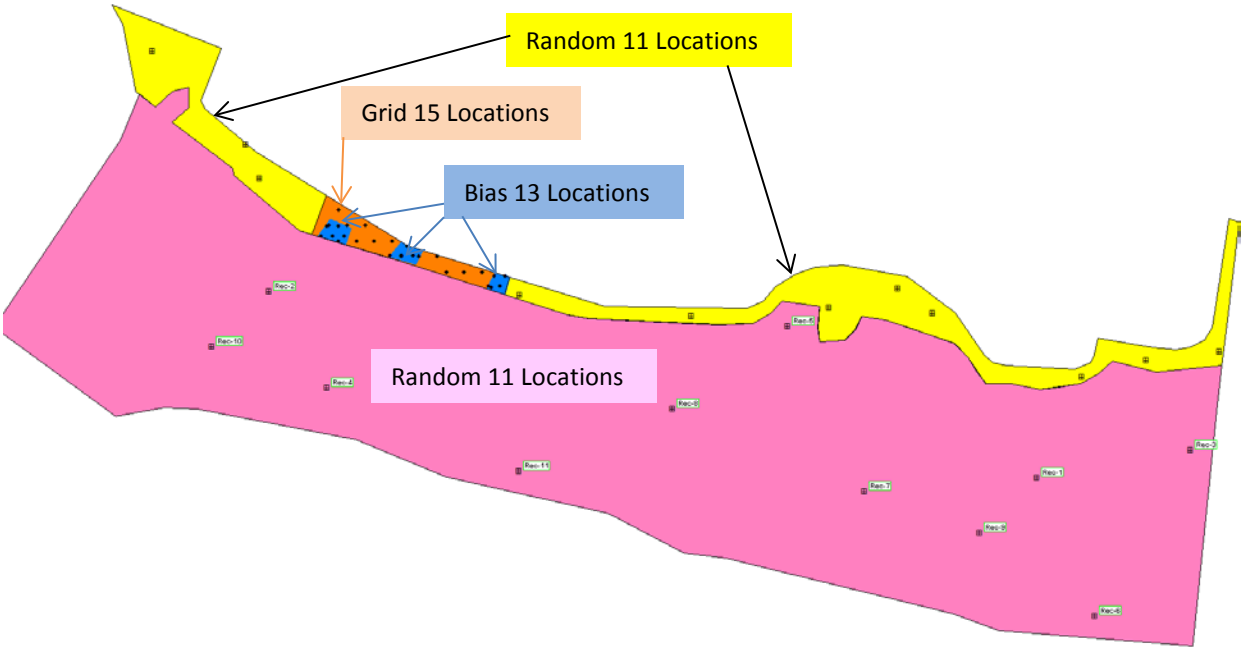

Figure 5. General locations of the 50 samples in A-16-e. The pink area is the Recreation Class 3 decision area, with 11 randomly-located samples. The yellow areas represent the Construction Class 3 decision area, with 11 randomly-located samples. The orange area represents the Construction Class 2 decision area, with 15 grid samples and 13 grid samples within the three inset blue bias sampling areas.

Table 4. Sample location coordinates in NAD 1983 (2011) New Mexico State Plane Central, ft, for A-16-e					
#	Decision Area	Label	Type	X Coordinate	Y Coordinate
1	Recreation Class 3	Rec-1	Random	1633930.4817	1773545.6952

2	Recreation Class 3	Rec-2	Random	1631839.1668	1774052.9161
3	Recreation Class 3	Rec-3	Random	1634348.7447	1773620.8391
4	Recreation Class 3	Rec-4	Random	1631996.0154	1773789.9127
5	Recreation Class 3	Rec-5	Random	1633250.8043	1773958.9863
6	Recreation Class 3	Rec-6	Random	1634087.3303	1773169.9761
7	Recreation Class 3	Rec-7	Random	1633459.9358	1773508.1233
8	Recreation Class 3	Rec-8	Random	1632937.1071	1773733.5548
9	Recreation Class 3	Rec-9	Random	1633773.6331	1773395.4076
10	Recreation Class 3	Rec-10	Random	1631682.3181	1773902.6285
11	Recreation Class 3	Rec-11	Random	1632518.8441	1773564.4812
12	Construction Class 3	Con West-1	Random	1631520.8838	1774708.4411
13	Construction Class 3	Con West-2	Random	1631812.6107	1774361.1549
14	Construction Class 3	Con West-3	Random	1631776.1449	1774453.7645
15	Construction Class 3	Con East-1	Random	1634227.6057	1773865.2442
16	Construction Class 3	Con East-2	Random	1632989.6035	1773986.1098
17	Construction Class 3	Con East-3	Random	1633364.5190	1774009.1318
18	Construction Class 3	Con East-4	Random	1633551.9767	1774060.9313
19	Construction Class 3	Con East-5	Random	1634051.8640	1773819.2002
20	Construction Class 3	Con East-6	Random	1634426.7795	1773888.2663
21	Construction Class 3	Con East-7	Random	1632520.9592	1774043.6648
22	Construction Class 3	Con East-8	Random	1633645.7056	1773994.4233
23	Construction Class 2	Class 2-1	Grid	1632445.5297	1774062.2292
24	Construction Class 2	Class 2-2	Grid	1632323.2521	1774104.5875
25	Construction Class 2	Class 2-3	Grid	1632372.1631	1774104.5875
26	Construction Class 2	Class 2-4	Grid	1632421.0742	1774104.5875
27	Construction Class 2	Class 2-5	Grid	1632200.9744	1774146.9457
28	Construction Class 2	Class 2-6	Grid	1632249.8854	1774146.9457
29	Construction Class 2	Class 2-7	Grid	1632298.7965	1774146.9457
30	Construction Class 2	Class 2-8	Grid	1632029.7856	1774189.3039
31	Construction Class 2	Class 2-9	Grid	1632078.6967	1774189.3039
32	Construction Class 2	Class 2-10	Grid	1632127.6078	1774189.3039
33	Construction Class 2	Class 2-11	Grid	1632176.5188	1774189.3039
34	Construction Class 2	Class 2-12	Grid	1632005.3301	1774231.6622
35	Construction Class 2	Class 2-13	Grid	1632054.2411	1774231.6622
36	Construction Class 2	Class 2-14	Grid	1632103.1522	1774231.6622
37	Construction Class 2	Class 2-15	Grid	1632029.7856	1774274.0204
38	Construction Class 2 21-027(c)	Bias-1	Bias	1631982.5656	1774203.2802
39	Construction Class 2 21-027(c)	Bias-2	Bias	1632013.9592	1774203.2802
40	Construction Class 2 21-027(c)	Bias-3	Bias	1632045.3529	1774203.2802
41	Construction Class 2 21-027(c)	Bias-4	Bias	1631998.2624	1774230.4679
42	Construction Class 2	Bias-5	Bias	1632029.6561	1774230.4679

	21-027(c)				
43	Construction Class 2 C-21-027, 21-027(a)	Bias-6	Bias	1632170.9276	1774148.9048
44	Construction Class 2 C-21-027, 21-027(a)	Bias-7	Bias	1632202.3212	1774148.9048
45	Construction Class 2 C-21-027, 21-027(a)	Bias-8	Bias	1632233.7149	1774148.9048
46	Construction Class 2 C-21-027, 21-027(a)	Bias-9	Bias	1632218.0181	1774176.0925
47	Construction Class 2 21-024(b)	Bias-10	Bias	1632437.7738	1774067.3416
48	Construction Class 2 21-024(b)	Bias-11	Bias	1632469.1674	1774067.3416
49	Construction Class 2 21-024(b)	Bias-12	Bias	1632453.4706	1774094.5294
50	Construction Class 2 21-024(b)	Bias-13	Bias	1632484.8643	1774094.5294

6.0 Attachments

Attachment 1: Review of Potential Release Sites (PRSs) in Tract A-16-e
Attachment 2: Preliminary Data for Tract A-16-e
Attachment 3: Visual Sample Plan Outputs for Tract A-16-e

7.0 References

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Attachment 1
Review of Potential Release Sites (PRSs) in Tract A-16-e

The language presented in this attachment is from LANL's PRS Database, 2016 (http://adeshwebsrv.lanl.gov/PRS/PRSMAIN.asp). Images of PRSs were obtained using the LANL Decision Support Application Tool (http://gis-arcserver-p/dsa/default.aspx). For some PRSs, additional information was obtained through consultation with the PRS office in ADEM (Paula Bertino, 2016). These evaluations indicate which dose scenarios were used by ADEM for remediation and risk decisions. Construction, industrial, and residential uses are discussed; recreational user risk is not evaluated due to the much higher SALs.

Note: Tract A-16-e boundaries are approximate for the purpose of this review.

21-024(e) - Certificate of Completion Received Without Controls

SWMU 21-024(e) is an inactive septic system that routed sewage from the former TA-21 laundry (Building 21-20) through a septic tank (structure 21-123) to the surface on the south rim of DP Mesa above Los Alamos Canyon. Building 21-20 was removed in 1965. SWMU 21-024(e) also served as the septic system for a former diesel power plant and shop (Building 21-14).

21-024(o) - Certificate of Completion Received Without Controls

SWMU 21-024(o) is a 4-in. VCP drainline that served the old diesel plant at TA-21 (Building 21-46). The building was converted to a warehouse in 1957 and used as such until 1964.

21-024(d) - Corrective Action Status: In Progress

SWMU 21-024(d) consists of a former location septic system that served building 21-01. The septic system was constructed in 1945 at the same time building 21-01 was built.

"In Progress" Notes:

Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval - Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	SWMU has been found to pose no potential unacceptable risks to human health under the residential scenario for the entire site and to ecological receptors. SWMU is appropriate for corrective actions complete without controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Site is not mentioned in the disapproval letter but is associated with report.
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the residential scenario and is considered appropriate for corrective actions complete without controls.

21-027(c) - Corrective Action Status: Pending Receipt of Certificate of Completion

SWMU 21-027(c) consists of a former drainline and outfall that discharged 50 ft inside the south TA-21 perimeter fence to a broad, gently sloping area on the south rim of DP mesa toward Los Alamos Canyon. Building 21-6 was constructed in 1945 as a cafeteria and machine shop.

21-006(b) - Corrective Action Status: In Progress

SWMU 21-006(b) was a seepage pit (former structure 21-202), drainline, and outfall installed in 1945 during the construction of building 21-2. Waste from the extraction process that was part of the original TA-21 plutonium purification process was discharged to a 3-in. cast iron drainline that exited the southeast side of building 21-2 and extended 160 ft to the south to the seepage pit.

“In Progress” Notes:
(Same as 21-024(d))

C-21-027 - Corrective Action Status: In Progress

Major Documents and Correspondence

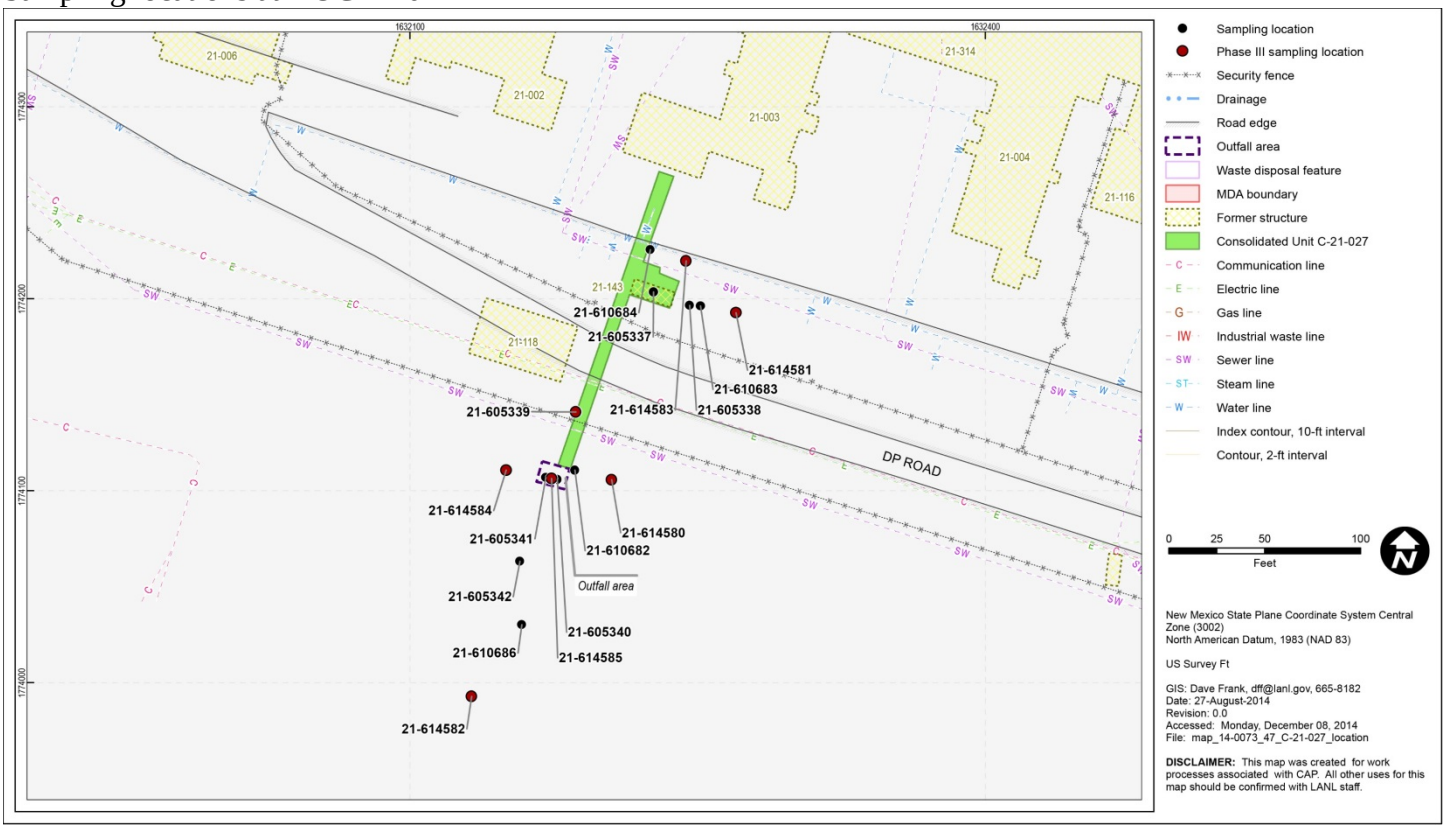
Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval - Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	AOC has been found to pose no potential unacceptable risks to human health under the industrial and construction worker scenarios. AOC is appropriate for corrective actions complete with controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Recommends revision of report to include discussions on implementation of any possible controls at site to prevent exposure to current or future human receptors.
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the industrial and construction worker scenarios and is considered appropriate for corrective actions complete with controls.

From Phase III Investigation Report:
AOC C-21-027 is the location of a former cooling tower (chilled water recirculator – structure 21-143) that received water from Building 21-3, circulated it, then returned it to the building in a closed loop. The cooling tower was connected to an acid tank and also had a 3-in. cast-iron drain that discharged into Los Alamos Canyon to the south. The cooling tower and subsurface structures were removed in 1994/1995, and three confirmation samples were collected from one location in the center of the cooling tower's footprint. Samples were not collected in the areas of the inlet or outlet piping, and no information is available that indicates they were removed; therefore, it is assumed these pipes are still in place. Calcium and chromium were detected above BVs; various organic chemicals were detected; americium-241 was detected above its FV; plutonium-239 and strontium-90 were detected at depths where FVs do not apply; and cobalt-60 and tritium were detected (no FVs available).

A Phase I investigation was conducted in 2009 to characterize the site. The Phase II report concluded lateral and/or vertical extent of some inorganic, organic, and radionuclide COPCs were not defined. In addition, the NMED approval with modification stated that the Phase III sampling must include americium-241, chromium, nitrate, perchlorate, and zinc analyses at one or two proposed locations to define extent. Sampling was completed as part of the 2011 investigation.

The nature and extent of inorganic, organic, and radionuclide COPCs at AOC C-21-027 addressed by the approved Phase III work plan are discussed below.

Sampling locations at AOC 21-027



The activities decreased laterally for all radionuclide COPCs from location 21-610684 to location 21-614583, except for plutonium-239/240 at one depth; plutonium-238, tritium, and uranium-234 were not detected or not detected above BVs/FVs in the 2011 samples. Activities also decreased or did not change substantially with depth for americium-241, plutonium-239/240, and uranium-235/236; activities for uranium-235/236 were slightly higher in the shallower soil samples (0.146 pCi/g and 0.14 pCi/g) but were below the soil BV. The lateral extent of americium-241, plutonium-238, plutonium-239/240, tritium, uranium-234, and uranium-235/236 is defined. The vertical extent of these radionuclides is defined to 3.0 ft bgs at location 21-605341. The activities increased with depth at location 21-605340 by approximately 0.21 pCi/g, 2.5 pCi/g, and 17 pCi/g, respectively. The residential SALs were approximately 30 times, 340 times, and 3.9 times the maximum activities (5.0–6.0 ft bgs) at location 21-605340. The industrial SAL was approximately 60 times the maximum plutonium-239/240 activity (5.0–6.0 ft bgs) at location 21-605340. Further sampling for vertical is not warranted.

Risk and dose assessments were not previously conducted for AOC C-21-027. The main area of contamination is the around the outfall. The contamination area is on the steep slope/cliff portion of the AOC, which is next to SWMU 21-027(a), and described in the approved Phase III work plan. The outfall area is on a steep cliff, with

45- to 90-degree slopes (Figure 6.14-1 and Appendix C, Photo 5) and consists of unstable, highly weathered, fractured bedrock with approximately 15% soil, filling fractures and voids between rocks.

In addition to evaluating the entire site for potential risk/dose, the mesa-top portion of the AOC was evaluated separately for potential risk/dose under the industrial, construction worker, and residential scenarios. Because of the site conditions on the slope/cliff described above, the outfall area would not serve as an exposure area to residents, construction workers, or industrial workers. Therefore, the exposure of human receptors over this portion of the site has no likelihood of occurring because there is currently no access to the slope/cliff, there is no trail or path for someone to traverse if he or she were to gain access to the slope/cliff, and there are major safety concerns regarding any activity on the slope/cliff. The steep slope/cliff portion of the site will not result in human exposure to contamination.

Based on the screening-assessment results, no potential unacceptable risks or doses exist for the industrial, construction worker, and residential scenarios on the mesa top. There are also no potential unacceptable HIs and doses under the scenarios for the entire site. There are potential unacceptable cancer risks for the industrial and residential scenarios for the entire site. However, the elevated dioxin and furan concentrations are on the slope/cliff portion of the site where no human exposure to the contamination exists.

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), and LOAEL analyses, no potential ecological risks to ecological receptors exist at AOC C-21-027.

21-027(a) - Corrective Action Status: In Progress

Major Documents and Correspondence

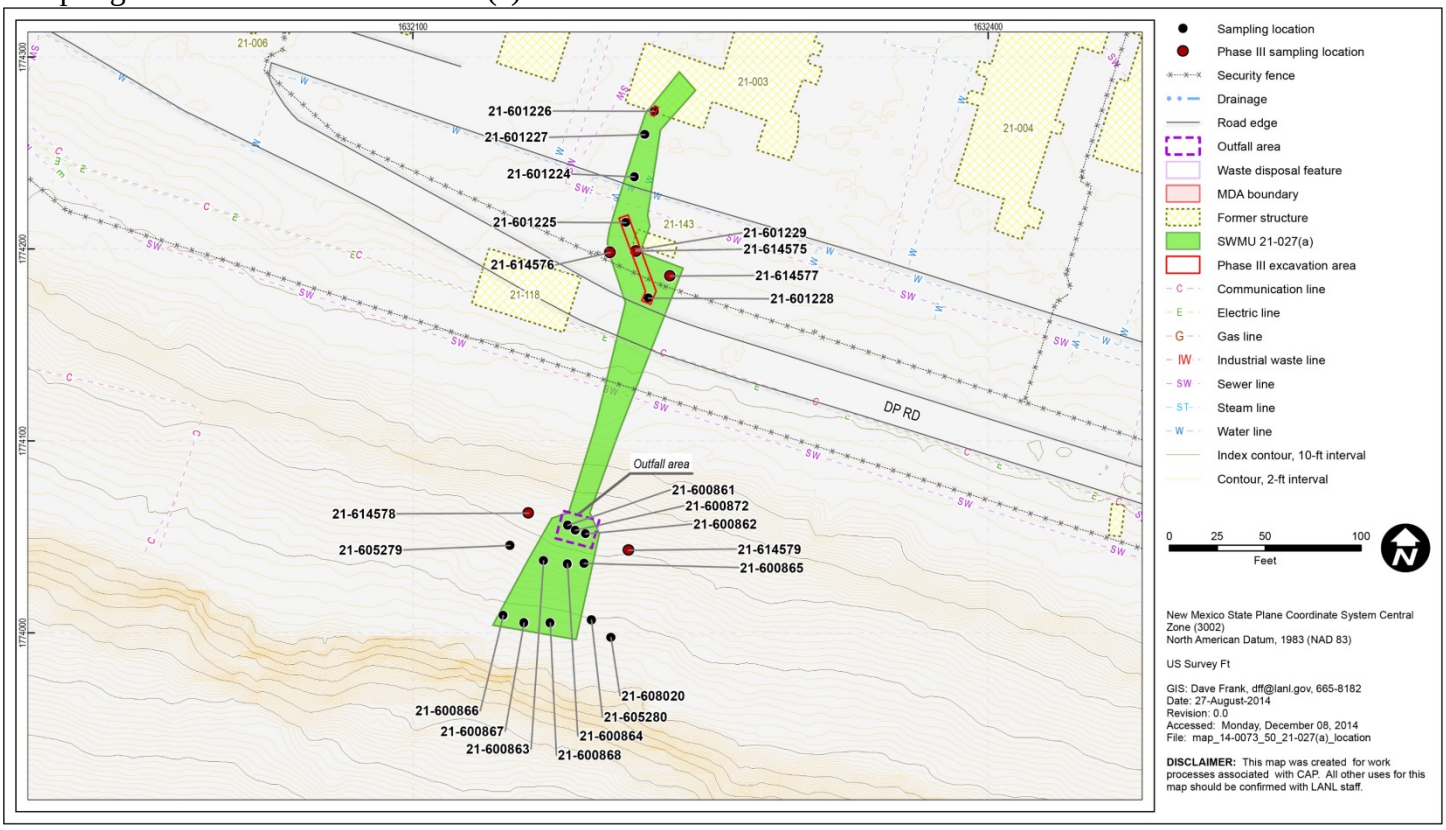
Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval – Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	SWMU has been found to pose no potential unacceptable risks to human health under the industrial and construction worker scenarios. SWMU is appropriate for corrective actions complete with controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Recommends revision of report to include discussions on implementation of any possible controls at site to prevent exposure to current or future human receptors.
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the industrial and construction worker scenarios and is considered appropriate for corrective actions complete with controls.

From Phase III Investigation Report:
SWMU 21-027(a) consists of former drainlines that received effluent from floor drains in building 21-3, a surface-drainage system, and a former outfall at the south of DP Canyon that discharged to Los Alamos Canyon. Building 21-3 was constructed in 1945 as part of original DP West plutonium facilities. In 1994/1995, the drains and the pipes beneath the surface and the cooling tower were removed during D&D activities. The 4-in. pipe beneath the paved area was left in place, as was the storm drain that collects runoff from nearby parking lots. The outfall was removed from Laboratory's NPDES permit, effective July 11, 1995.

In 2004, radiological and geophysical surveys were completed. The geophysical survey located a pipe beneath the paved area, corresponding to the expected path of the 12-in. storm drain. In 2006/2007, Phase I Consent Order investigation was conducted and soil and tuff samples were collected. Phase II Consent Order investigation was conducted in 2009 to define extent for COPCs.

The Phase II report concluded the lateral and vertical extent of COPCs was defined. Additionally, the Phase II report recommended remediation at SWMU 21-027(a) on the mesa top as well as at the associated outfall to remove elevated concentrations of dioxins/furans and activities of plutonium-239/240. Excavation was proposed on the mesa top at one location adjacent to former building 21-003, at the ponding area south of former building 21-003, and at the outlet connection to the former septic tank on the mesa top. Soil removal was also proposed in the outfall area on the canyon slope. Excavation removed contaminated media on the mesa top at one location adjacent to former building 21-003, at the ponding area south of former building 21-003, and at the outlet connection to the former septic tank on the mesa top. **As described in the approved Phase III work plan, the remediation in the outfall area was not conducted because of safety concerns associated with removing the contaminated media**. Samples were collected at three mesa-top locations during the Phase III investigations to determine the depth of excavation and to delineate the area above SSLs/SALs.

Sampling locations at SWMU 21-027(a)



The radionuclide COPCs for SWMU 21-027(a) as identified in the Phase I report and following remediation in 2011 include americium-241, cesium-137, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238.

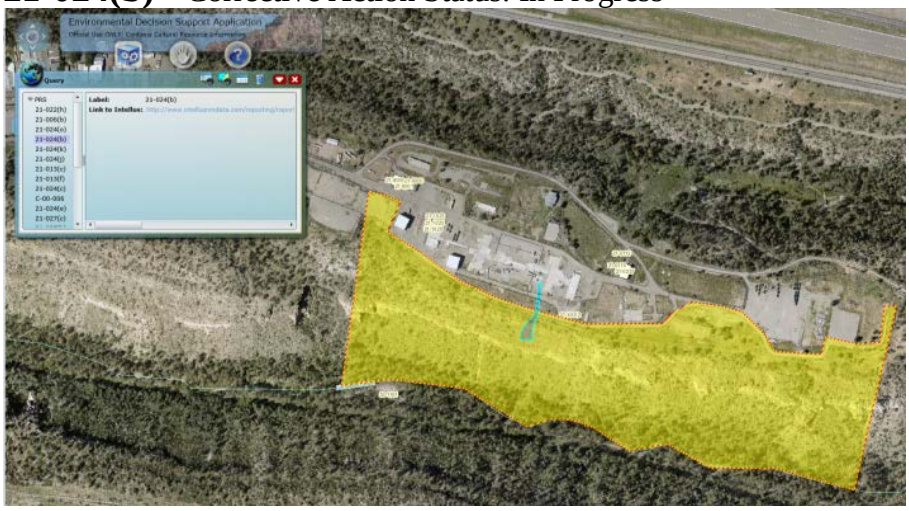
Plutonium-239/240 was not detected in the sample collected from 4.0–5.0 ft bgs at location 21-614575 in the ponding area, and plutonium-238 was detected at 0.529 pCi/g at this location, which is immediately adjacent to and downslope from location 21-601229. The plutonium-239/240 activity decreased with depth at location 21-601229 and was approximately 2 to 4 orders of magnitude below the SALs. The vertical extent of plutonium-238 and plutonium-239/240 is defined and the depth of the excavation in this area is limited to 4.0 ft bgs. The lateral extent of plutonium-238 and plutonium-239/240 is defined. The plutonium-238 activity decreased by more than an order of magnitude east of the outfall from location 21-600862 to location 21-614579, while the plutonium-239/240 activity decreased by 35 pCi/g from location 21-600862 to location 21-614579.

As noted above, the Phase III investigation at SWMU 21-027(a) included remediation on the mesa top to remove elevated activities of dioxins/furans and plutonium-239/240.
The outfall contamination area is on a steep cliff, with 45- to 90-degree. This area consists of unstable, highly weathered, fractured bedrock with approximately 15% soil, filling fractures and voids between rocks. As a result, the potential risk issue (dioxins/furans) was not addressed for either the industrial or residential scenario. Samples were collected on the canyon slope 20 ft east and west of the outfall area to delineate the area above SSLs/SALs. The human health risk-screening assessments for SWMU 21-027(a) were revised to reflect the removal of contaminated media and the collection of new data.

In addition to evaluating the entire site for potential risk/dose, the mesa-top portion of the SWMU was evaluated separately for potential risk/dose under the industrial, construction worker, and residential scenarios. Because of the site conditions on the slope/cliff described above, the outfall area would not serve as an exposure area to residents, construction workers, or industrial workers. Therefore, the exposure of human receptors over this portion of the site has no likelihood of occurring because there is currently no accessibility to the slope/cliff, there is no trail or path for someone to traverse if he or she were to gain access to the slope/cliff, and there are major safety concerns regarding any activity on the slope/cliff. The steep slope/cliff portion of the site will not result in human exposure to contamination.

Based on the screening-assessment results, no potential unacceptable risks or doses exist for the industrial, construction worker, and residential scenarios on the mesa top. There are potential unacceptable risks for the industrial, construction worker, and residential scenarios for the entire site. However, the elevated dioxin and furan concentrations are on the slope/cliff portion of the site where no human exposure to the contamination exists.

21-024(b) - Corrective Action Status: In Progress



SWMU 21-024(b) is a septic system that formerly routed sewage from Building 21-17 (a passageway connecting buildings 21-004 and 21-005 decommissioned in 1969) through a septic tank (structure 21-55) to the surface south of a laboratory building (Building 21-5).

Major Documents and Correspondence

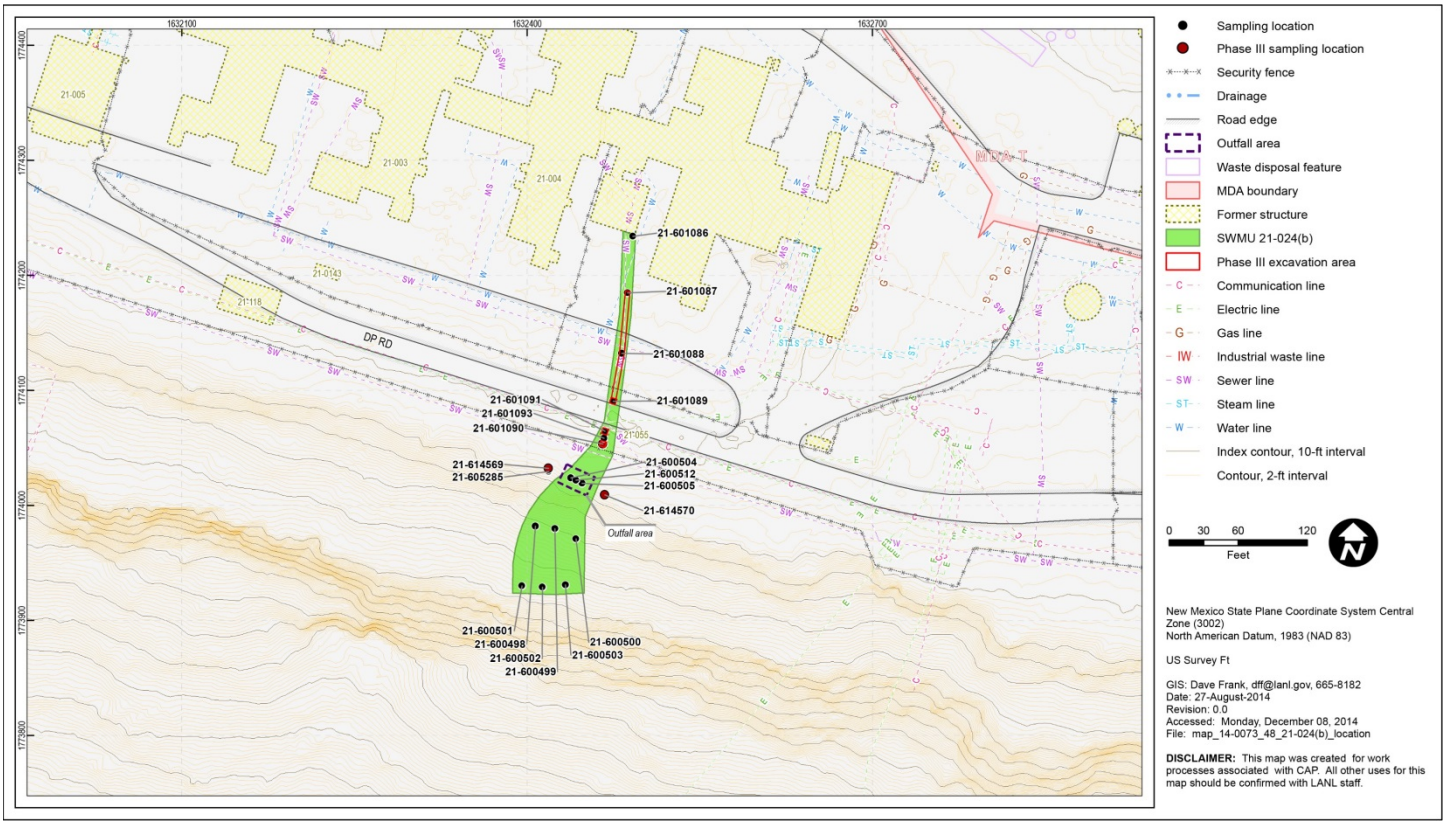
Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval - Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	SWMU has been found to pose no potential unacceptable risks to human health under the residential scenario for the entire site and to ecological receptors. SWMU is appropriate for corrective actions complete without controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Recommends revision of report to include discussions on implementation of any possible controls at site to prevent exposure to current or future human receptors.
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the residential scenario and is considered appropriate for corrective actions complete without controls.

From Phase III Investigation Report:
In 1992, RFI activities included conducting a radiological field survey and collection samples within the outfall drainage channel. Radiological and geophysical surveys were completed in 2004. The geophysical survey identified the septic tank, the pipeline from former building 21-017 to the septic tank, but not the outfall. In 2006/2007 Phase I Consent Order investigation was conducted and soil and tuff samples were collected, and in 2009 Phase II Consent Order investigation was conducted to define extent for COPCs. The Phase II report concluded the lateral and vertical extents of COPCs were defined.

The Phase II report recommended remediation at SWMU 21-024(b) on the mesa top as well as at the associated outfall to remove elevated activities of americium-241 and plutonium-239/240. Excavation was proposed beneath the septic tank inlet line north of DP Road, at the inlet connection to the former septic tank, and at the outlet connection to the former septic tank on the mesa top. Soil was removed beneath the septic tank inlet line north of DP Road, at the inlet connection to the former septic tank, and at the outlet connection to the former septic tank on the mesa top from approximately 5.0–8.0 ft bgs. Soil removal was also proposed in the outfall area. **As described in the approved Phase III work plan, the outfall area was not remediated because of safety concerns associated with removing the contaminated media**. However, samples were collected during the Phase III investigations to determine the depth of excavation at one mesa-top location and to delineate the area above SALs at the outfall.

The radionuclide COPCs for SWMU 21-024(b) as identified in the Phase I report and following remediation in 2011 include americium-241, cesium-137, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238. The Phase III investigation at SWMU 21-024(b) involved removing contaminated soil/tuff to depths ranging from 5.3–8.0 ft bgs at five locations. Five samples were collected (one sample on the mesa top and four samples around the outfall) from three locations to define excavation depth at location 21-601090 and lateral extent of contamination at the outfall.

Sampling locations at SWMU 21-024(b)



In addition to evaluating the entire site for potential risk/dose, the mesa-top portion of the SWMU was evaluated separately for potential risk/dose under the industrial, construction worker, and residential scenarios. As stated in the approved Phase III work plan, the outfall contamination area is on a steep slope/cliff, with 45- to 90-degree slopes. This area consists of unstable, highly weathered, fractured bedrock with approximately 20% soil, filling fractures and voids between rocks. This area would not serve as an exposure area to residents, construction workers, or industrial workers. Therefore, the exposure to human receptors over this portion of the site has no likelihood of occurring because there is currently no access to the slope/cliff, there is no trail or path for someone to traverse if he or she were to gain access to the slope/cliff, and there are major safety concerns regarding any activity on the slope/cliff. The steep slope/cliff portion of the site will not result in human exposure to contamination.

Based on the human health risk-screening assessments, no potential unacceptable risks or doses exist for the industrial, construction worker, and residential scenarios for the mesa top and for the entire site.

21-022(h) - Corrective Action Status: In Progress

Major Documents and Correspondence

Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval - Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	SWMU has been found to pose no potential unacceptable risks to human health under the industrial and construction worker scenarios. SWMU is appropriate for corrective actions complete with controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Recommends revision of report to include discussions on implementation of any possible controls at site to prevent exposure to current or future human receptors. In addition, data values do not match corresponding sample and location IDs- must revise.
12/19/2014	Submittal of the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Submittal Letter-Correspondence-Outgoing	14-29428	600091-01	
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the industrial and construction worker scenarios and is considered appropriate for corrective actions complete with controls.

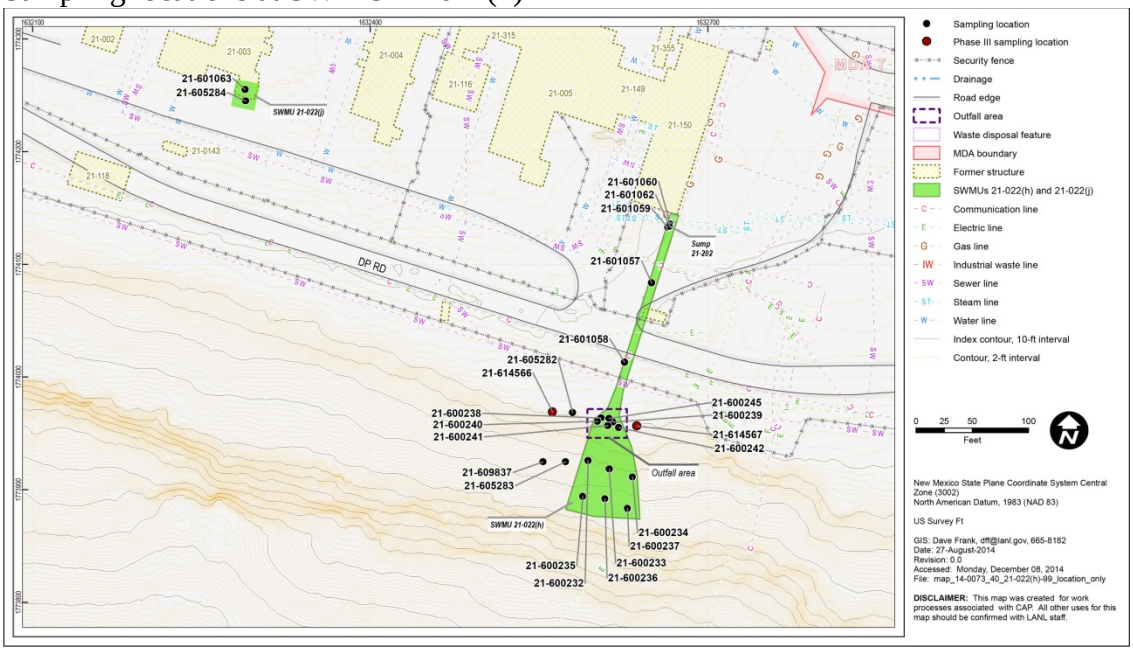
From Phase III Investigation Report:
SWMU 21-022(h) is the former location of a sump (structure 21-202), outlet drainline, and a formerly permitted outfall located at TA-21. Structure 21-202 was constructed in 1962. The sump received industrial wastewater and discharges from basement floor drains and roof drains in the plutonium fuel service building (21-150). There is no available documentation of the structures being removed.

Based on previous investigation results, further characterization was required to assess potential contamination at SWMU 21-022(h). The Phase II report concluded lateral and/or vertical extent of some inorganic, organic, and radionuclide COPCs (barium, isotopic plutonium, and SVOCs) were not defined. In addition, the Phase II report recommended remediation at the associated outfall to remove elevated activities of plutonium-239/240 and elevated concentrations of lead and benzo(a)pyrene. As described in the approved Phase III work plan, **the outfall area at SWMU 21-022(h) was not remediated because of safety concerns associated with removing**

the contaminated media. Samples were collected during the Phase III investigations to delineate the area above SSLs or SALs at the outfall. As a result, the following activities were completed as part of the 2011 investigation.

The radionuclide COPCs at SWMU 21-022(h) addressed in the approved Phase III work plan include plutonium-238 and plutonium-239/240. Plutonium-238 and plutonium-239/240 activities decreased laterally from location 21-600242 to location 21-614567 (approximately 10 ft east). The activities also decreased with depth at this location. The lateral extent of plutonium-238 and plutonium-239/240 is defined.

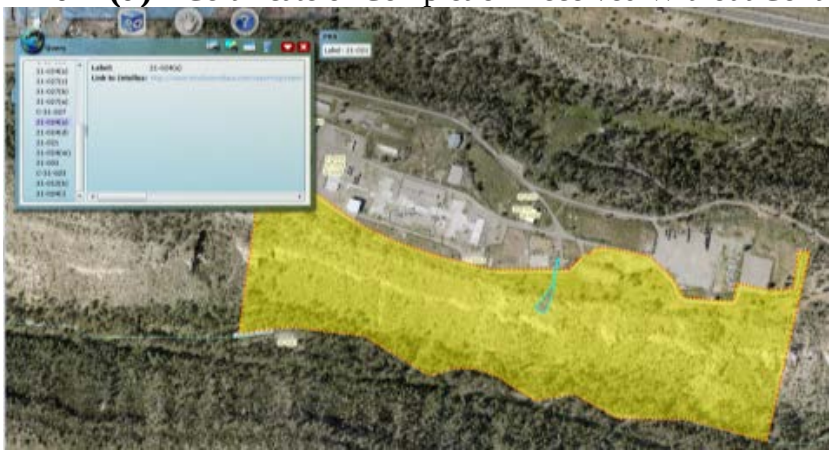
Sampling locations at SWMU 21-022(h)



In addition to evaluating the entire site for potential risk/dose, the mesa-top portion of the SWMU was evaluated separately for potential risk/dose under the industrial, construction worker, and residential scenarios. As stated in the approved Phase III work plan, the outfall contamination area is on a steep slope/cliff, with 45- to 90-degree slopes. This area consists of unstable, highly weathered, fractured bedrock with approximately 20% soil, filling fractures and voids between rocks. This area would not serve as an exposure area to residents, construction workers, or industrial workers. Therefore, the exposure to human receptors over this portion of the site has no likelihood of occurring because there is currently no access to the slope/cliff, there is no trail or path for someone to traverse if he or she were to gain access to the slope/cliff, and there are major safety concerns regarding any activity on the slope/cliff. The steep slope/cliff portion of the site will not result in human exposure to contamination.

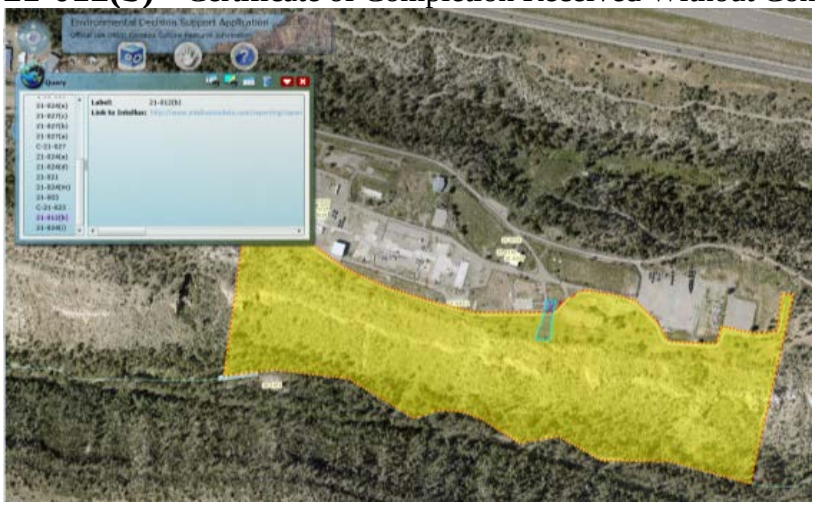
Based on the screening-assessment results, no potential unacceptable risks or doses exist for the industrial, construction worker, and residential scenarios on the mesa top at SWMU 21-022(h). There are potential unacceptable risks or doses for the industrial and residential scenarios for the entire site at SWMU 21-022(h). However, the elevated lead and PAH concentrations are on the slope/cliff portion of the site where there is no human exposure to the contamination.

21-024(a) - Certificate of Completion Received Without Controls



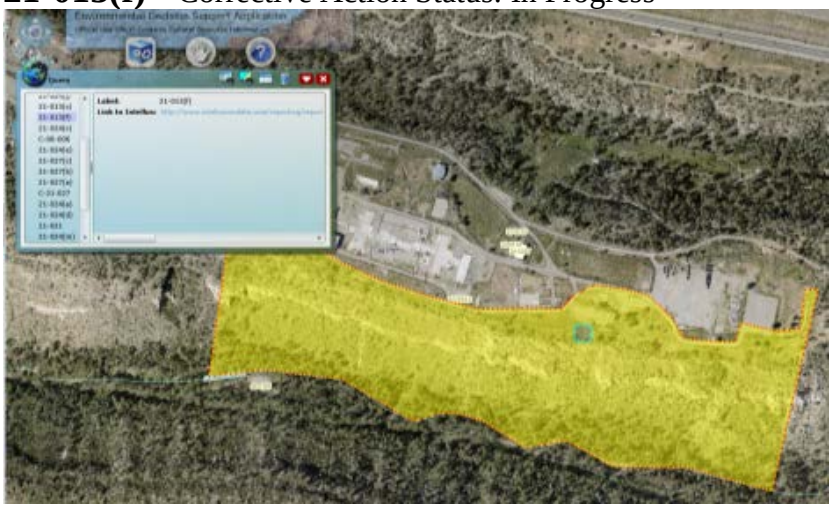
SWMU 21-024(a) consists of a former septic system that served the old steam plant (building 21-009) at TA-21.

21-012(b) - Certificate of Completion Received Without Controls



SWMU 21-012(b) is a dry well, constructed in 1980 to receive boiler blowdown from the former TA-21 steam plant (Building 21-9).

21-013(f) - Corrective Action Status: In Progress

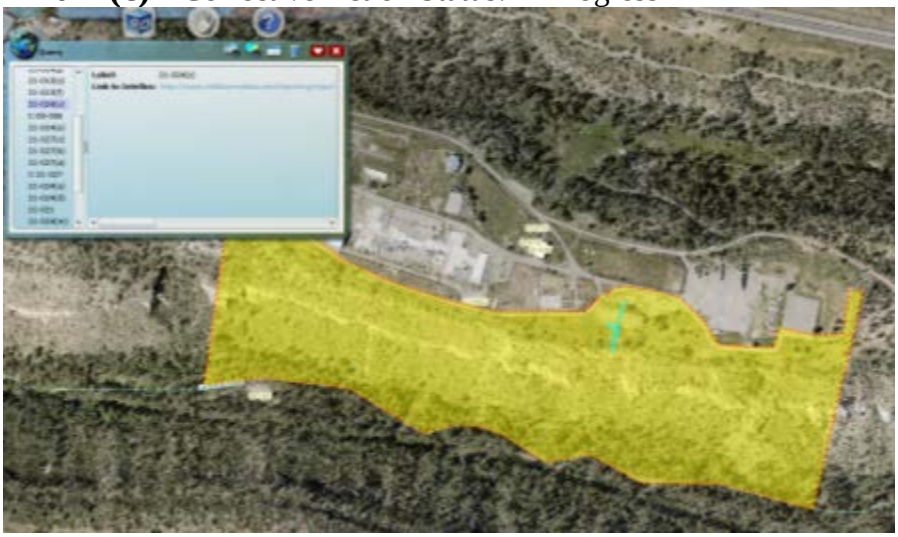


AOC 21-013(f) is defined as a surface disposal area based on aerial photos from 1949. Mounds (assumed to be dirt) were located in the same area as the current location of Building TA-21-61.

Major Documents and Correspondence

Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval - Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	SWMU has been found to pose no potential unacceptable risks to human health under the residential scenario for the entire site and to ecological receptors. SWMU is appropriate for corrective actions complete without controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Report states that two samples were collected from two locations, but in appendix G of the report, it indicates that four samples were collected from three locations, rather than two samples from two locations. Recommends revision of section 6.2.4.1, page 17 to resolve the discrepancy.
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the residential scenario and is considered appropriate for corrective actions complete without controls.

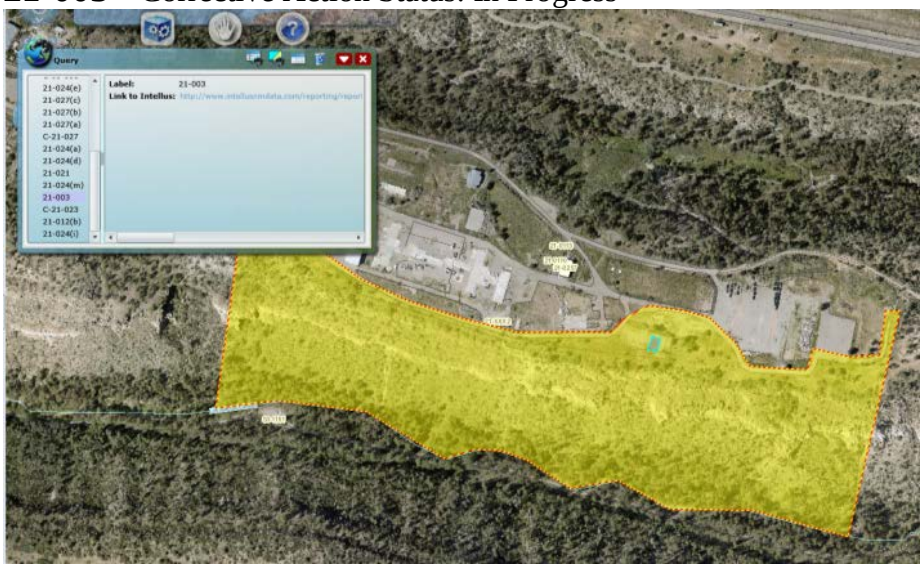
21-024(c) - Corrective Action Status: In Progress



SWMU 21-024(c) consists of a former septic system that served buildings 21-54 and 21-61 at TA-21. The septic system was constructed in 1945.

"In Progress" Notes:
(Same as 21-013(f))

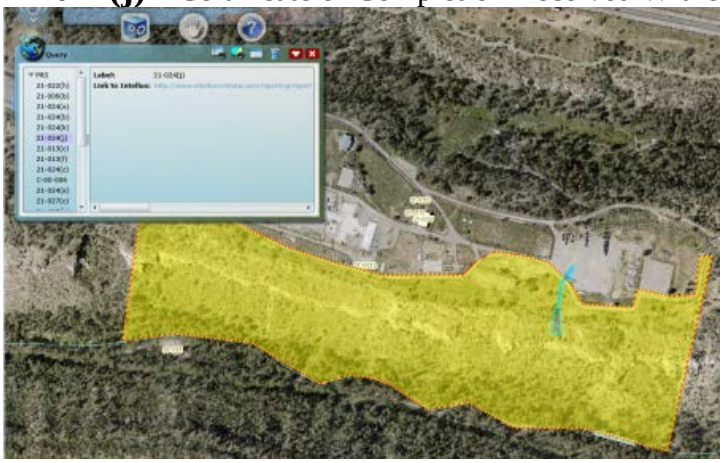
21-003 - Corrective Action Status: In Progress



SWMU 21-003 is Building TA-21-61. Building TA-21-61 was built in 1950 to support the ROVER project (Nuclear Rocket Program). The operations included the use of an electric furnace to coat reactor parts (including fuel rods). The building was also used as a metal fabrication shop in the late 1960s and early 1970s. Building TA-21-61 was then used as a storage area for PCB-bearing equipment and PCB-contaminated waste, oils, solvents and trash. PCB management operations stopped in 1989.

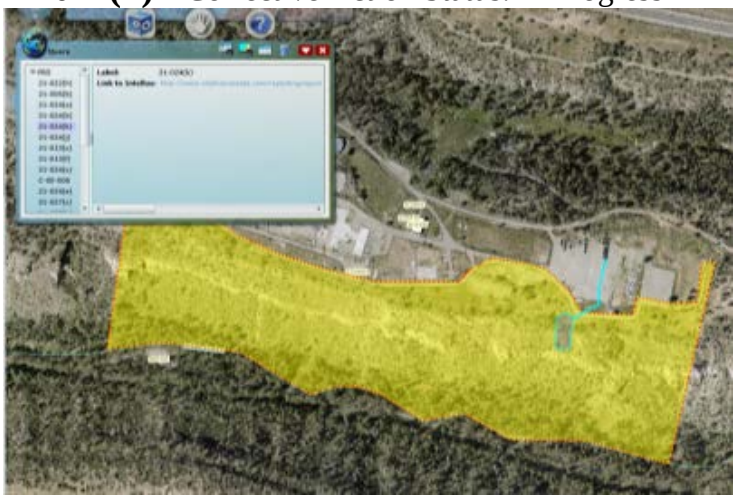
"In Progress" Notes:
(Same as 21-013(f))

21-024(j) - Certificate of Completion Received Without Controls



SWMU 21-024(j) consists of a septic system that routed sanitary sewage from building 21-155, a warehouse/laboratory through a septic tank (structure 21-94) to the surface on the south rim of DP Mesa above Los Alamos Canyon. Building 21-155 housed the TSTA facility.

21-024(k) - Corrective Action Status: In Progress

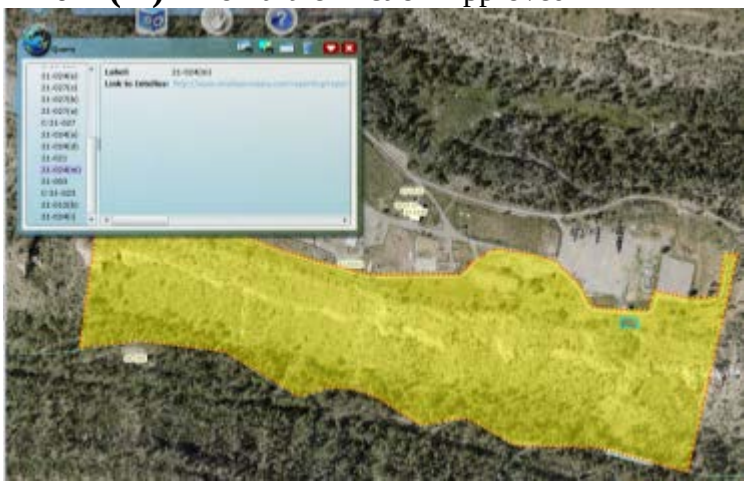


SWMU 21-024(k) consists of an inactive septic tank (structure 21-219), associated drainlines, and a leach field.

Major Documents and Correspondence

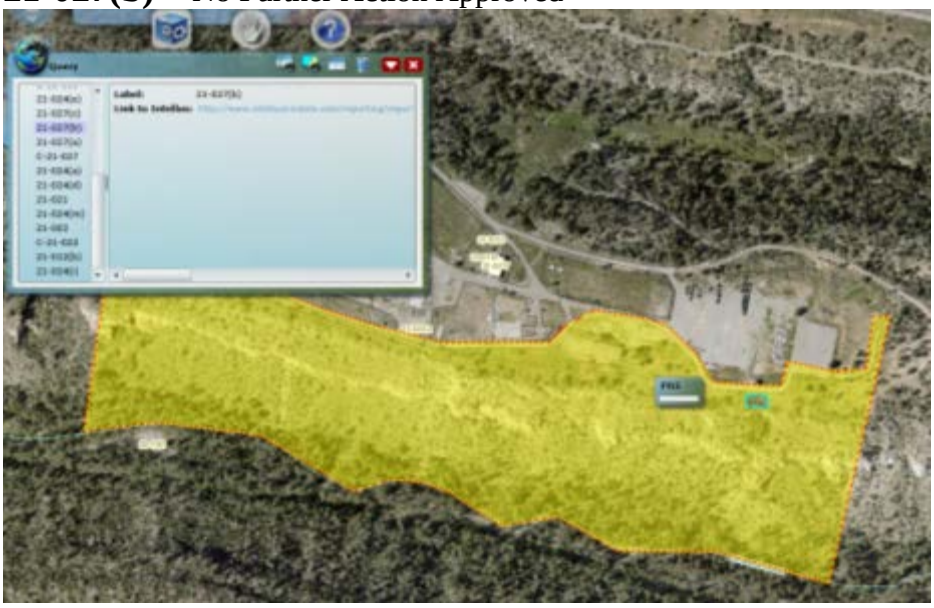
Document Date	Title	DocType	LAUR No.	Record No.	PRS Specific Synopsis
7/1/2016	Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21 (EP2016-0048)	Notice of Disapproval - Response-Correspondence-Outgoing	16-24015	No ERId in DB	
7/1/2016	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, Revision 1	Phase III Investigation Report, Revised	16-24014	No ERId in DB	SWMU has been found to pose no potential unacceptable risks to human health under the residential scenario for the entire site and to ecological receptors. SWMU is appropriate for corrective actions complete without controls.
6/30/2016	Submittal of the Response to the Disapproval for the Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21, and Revision 1 of the Report	Submittal Letter-Correspondence-Outgoing	16-24015; 16-24014	601598	
3/2/2016	Disapproval Phase III Investigation Report For Delta Prime Site Aggregate Area at Technical Area 21	Notice of Disapproval-Correspondence-Incoming	No LA-UR	601251	Recommends revision of report to provide information addressing the disposal of the waste line removed from site during the Phase III investigation.
12/19/2014	Phase III Investigation Report for Delta Prime Site Aggregate Area at Technical Area 21	Phase III Investigation Report	14-29428	600091-01	Recommends that site poses no potential unacceptable risks to human health under the residential scenario and is considered appropriate for corrective actions complete without controls.

21-024(m) - No Further Action Approved



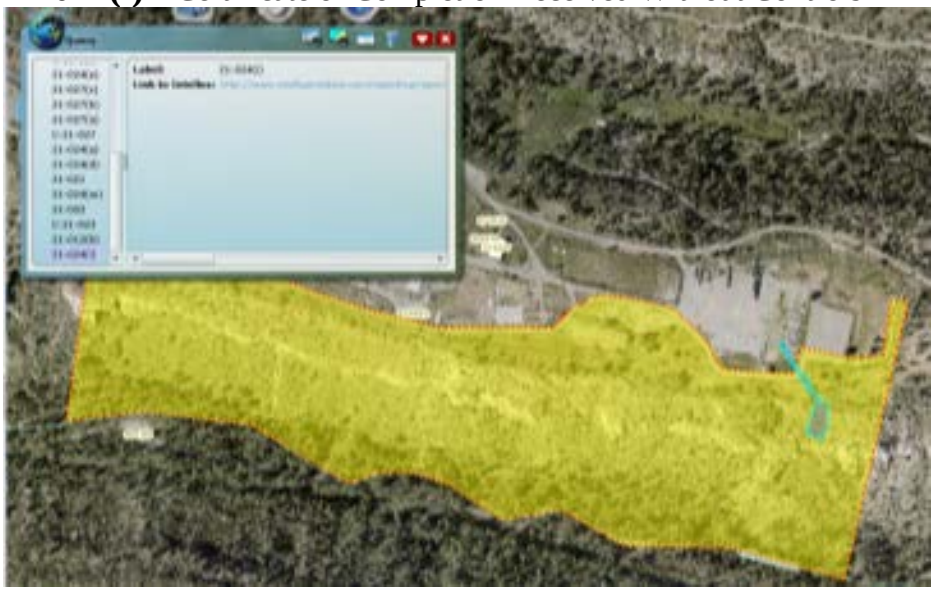
SWMU 21-024(m) was identified as an 8-in vitrified clay pipe that exited building TA-21-209, the high-temperature chemistry laboratory, and continued south toward Los Alamos Canyon.

21-027(b) – No Further Action Approved



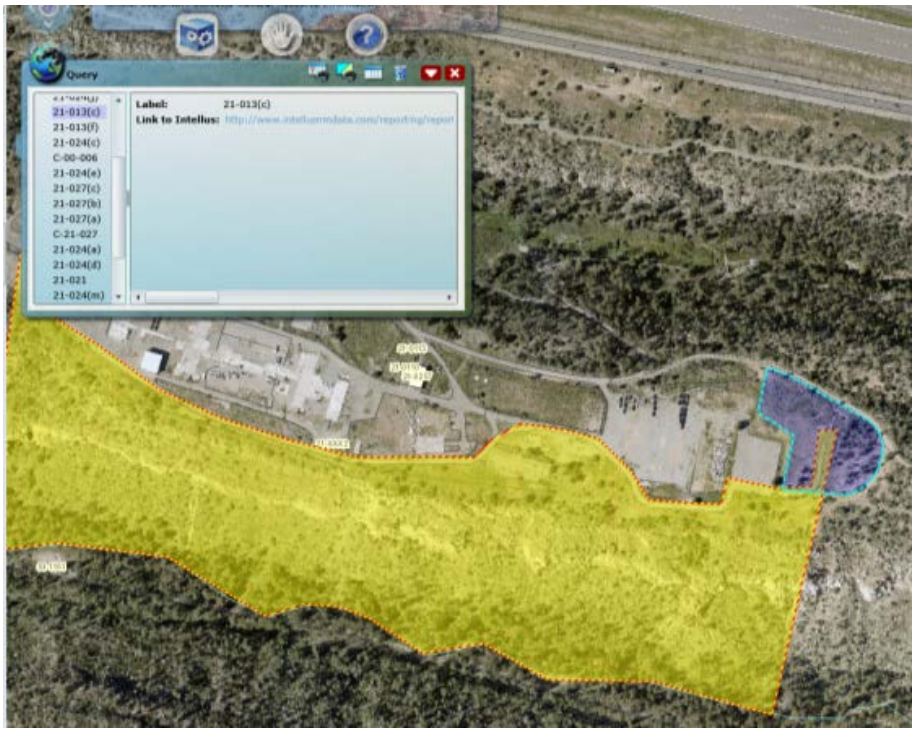
SWMU 21-027(b) consisted of a 4-in. steel drainline that extended from the catch basin around a fuel tank (Structure TA-21-0047) south toward Los Alamos Canyon. The line drained storm water runoff from a bermed area. The drainline was removed in March of 1965.

21-024(i) - Certificate of Completion Received Without Controls



SWMU 21-024(i) consists of a former septic system that served polonium-processing laboratory, structure 21-152, and high-temperature chemistry building, structure 21-209. The septic tank also received blowdown from former cooling towers 21-166 and 21-167.

21-013(c) - Certificate of Completion Received Without Controls



SWMU 21-013(c) is the former location of a surface disposal area located at the eastern end of DP Mesa. The site consisted only of construction debris, including piles of fill, asphalt, and concrete, an excavated trench, an earthen berm that contained scattered concrete, asphalt, and metal debris, and four large concrete pylons. Other surface debris included glass, scrap metal, wood, cans, paper, and plastic.

Attachment 2
Preliminary Data for Tract A-16-e

This attachment summarizes the preliminary data collected in each of the three A-16-e decision units. The "confidence level" indicates an estimated value that, if added to the mean, provides a 95% Upper Confidence Limit (UCL). Screening Action Levels (SALs) represent the 15 mrem/y (150 µSv/y) threshold for the expected use scenario.

Los Alamos Canyon – Recreation Class 3 Summary Statistics

Am-241 [pCi/g]	
Mean	0.9
Standard Error	0.2
Median	0.1
Standard Deviation	4.7
Minimum	-0.4
Maximum	90.6
Count	785
Confidence Level(95.0%)	0.3
UCL Estimate	1.2
Recreation SAL (Rev 3)	890

Tritium [pCi/g]	
Mean	2.4
Standard Error	0.7
Median	0.1
Standard Deviation	18.3
Minimum	-2.6
Maximum	285
Count	628
Confidence Level(95.0%)	1.4
UCL Estimate	3.8
Recreation SAL (Rev 3)	7.10E+05

Cs-137 [pCi/g]	
Mean	0.38
Standard Error	0.02
Median	0.25
Standard Deviation	0.47
Minimum	-0.04
Maximum	3.62
Count	400
Confidence Level(95.0%)	0.05
UCL Estimate	0.43
Recreation SAL (Rev 3)	210

Pu-239 [pCi/g]	
Mean	8.4
Standard Error	1.2
Median	0.6
Standard Deviation	28.2
Minimum	0.0
Maximum	324
Count	544
Confidence Level(95.0%)	2.4
UCL Estimate	10.7
Recreation SAL (Rev 3)	770

DP Mesa – Construction Class 3 Summary Statistics

Am-241 [pCi/g]	
Mean	0.04
Standard Error	0.01
Median	0.02
Standard Deviation	0.10
Minimum	-0.33
Maximum	0.41
Count	129
Confidence Level(95.0%)	0.02
UCL Estimate	0.06
Construction SAL (Rev 3)	85

Tritium [pCi/g]	
Mean	0.27
Standard Error	0.05
Median	0.06
Standard Deviation	0.52
Minimum	-0.03
Maximum	3.31
Count	109
Confidence Level(95.0%)	0.10
UCL Estimate	0.37
Construction SAL (Rev 3)	3.7E+04

Cs-137 [pCi/g]	
Mean	0.10
Standard Error	0.02
Median	0.03
Standard Deviation	0.20
Minimum	-0.05
Maximum	1.19
Count	65
Confidence Level(95.0%)	0.05
UCL Estimate	0.15
Construction SAL (Rev 3)	18

Pu-239 [pCi/g]	
Mean	0.32
Standard Error	0.07
Median	0.09
Standard Deviation	0.67
Minimum	-0.03
Maximum	3.26
Count	83
Confidence Level(95.0%)	0.15
UCL Estimate	0.46
Construction SAL (Rev 3)	72

DP Mesa – Construction Class 2 Summary Statistics

Am-241 [pCi/g]	
Mean	1.0
Standard Error	0.1
Median	0.7
Standard Deviation	1.0
Minimum	-0.3
Maximum	4.2
Count	52
Confidence Level(95.0%)	0.3
UCL Estimate	1.3
Construction SAL (Rev 3)	85

Tritium [pCi/g]	
Mean	0.04
Standard Error	0.01
Median	0.02
Standard Deviation	0.06
Minimum	-0.01
Maximum	0.24
Count	25
Confidence Level(95.0%)	0.02
UCL Estimate	0.06
Construction SAL (Rev 3)	3.7E+04

Cs-137 [pCi/g]	
Mean	0.22
Standard Error	0.05
Median	0.08
Standard Deviation	0.29
Minimum	-0.01
Maximum	1.12
Count	29
Confidence Level(95.0%)	0.11
UCL Estimate	0.33
Construction SAL (Rev 3)	18

Pu-239 [pCi/g]	
Mean	15.3
Standard Error	3.6
Median	9.5
Standard Deviation	19.7
Minimum	0.2
Maximum	85
Count	30
Confidence Level(95.0%)	7.4
UCL Estimate	22.7
Construction SAL (Rev 3)	72

Attachment 3
Visual Sample Plan Outputs for Tract A-16-e

Recreation Class 3 Decision Area

Random sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

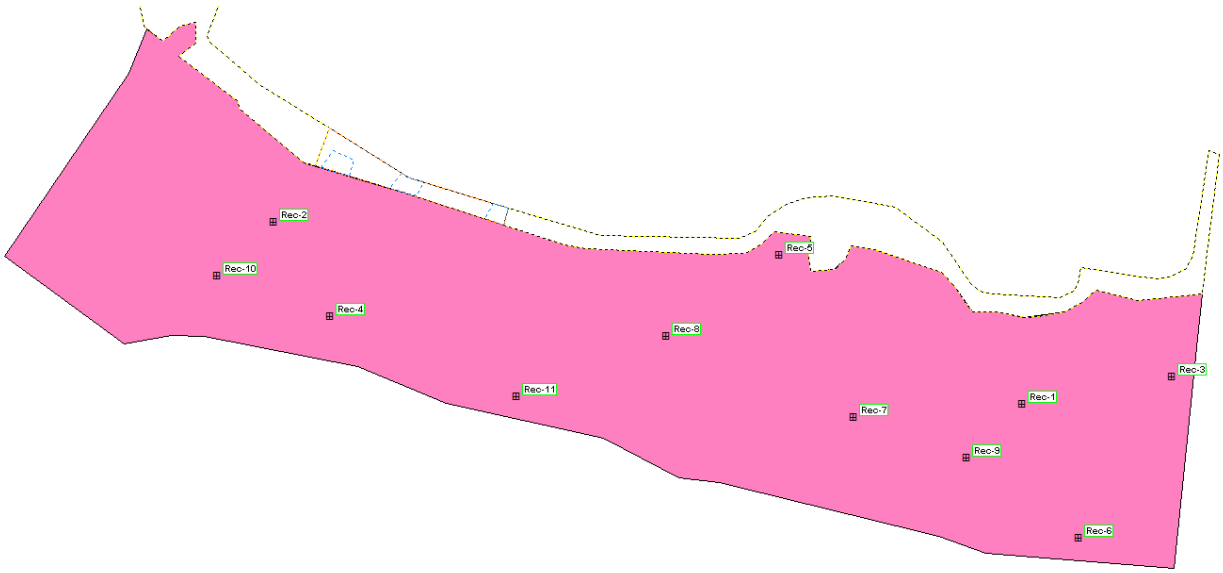
Summary

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	11

Area: Rec					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1633930.4817	1773545.6952	Rec-1		Random	
1631839.1668	1774052.9161	Rec-2		Random	
1634348.7447	1773620.8391	Rec-3		Random	
1631996.0154	1773789.9127	Rec-4		Random	
1633250.8043	1773958.9863	Rec-5		Random	
1634087.3303	1773169.9761	Rec-6		Random	
1633459.9358	1773508.1233	Rec-7		Random	
1632937.1071	1773733.5548	Rec-8		Random	
1633773.6331	1773395.4076	Rec-9		Random	
1631682.3181	1773902.6285	Rec-10		Random	
1632518.8441	1773564.4812	Rec-11		Random	



Primary Sampling Objective
The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median (mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median (mean) value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach
A nonparametric random sampling approach was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

Locating the sample points randomly provides data that are separated by many distances, whereas systematic samples are all equidistant apart. Therefore, random sampling provides more information about the spatial structure of the potential contamination than systematic sampling does. As with systematic sampling, random sampling also provides information regarding the mean value, but there is the possibility that areas of the site will not be represented with the same frequency as if uniform grid sampling were performed.

Number of Total Samples: Calculation Equation and Inputs
The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the

median(mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2} \qquad SignP = \Phi\left(\frac{\Delta}{s_{total}}\right)$$

where

$\Phi(z)$ is the cumulative standard normal distribution on $(-\infty,z)$ (see PNNL-13450 for details),
n is the number of samples,
S_{total} is the estimated standard deviation of the measured values including analytical error,
Δ is the width of the gray region,
α is the acceptable probability of incorrectly concluding the site median (mean) is less than the threshold,
β is the acceptable probability of incorrectly concluding the site median (mean) exceeds the threshold,
$Z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$,
$Z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in MARSSIM (EPA 2000, p. 5-33).
The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Am-241	11	4.7 pCi/g	889.1 pCi/g	0.05	0.1	1.64485	1.28155
Cs-137	11	0.47 pCi/g	209.62 pCi/g	0.05	0.1	1.64485	1.28155
Pu-239	11	28.2 pCi/g	761.6 pCi/g	0.05	0.1	1.64485	1.28155

[a] The final number of samples has been increased by the MARSSIM Overage of 20%.
[b] This value is automatically calculated by VSP based upon the user defined value of α.
[c] This value is automatically calculated by VSP based upon the user defined value of β.

Statistical Assumptions
The assumptions associated with the formulas for computing the number of samples are:
1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected randomly or systematically with a randomized start.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the standard deviation, lower bound of gray region (% of action level), beta (%), probability of mistakenly concluding that $\mu >$ action level and alpha (%), probability of mistakenly concluding that $\mu <$ action level. The following table shows the results of this analysis.

Number of Samples							
AL=72		α=5		α=10		α=15	
		s=0.58	s=0.29	s=0.58	s=0.29	s=0.58	s=0.29
LBGR=90	β=5	14	14	11	11	10	10
	β=10	11	11	9	9	8	8
	β=15	10	10	8	8	6	6
LBGR=80	β=5	14	14	11	11	10	10
	β=10	11	11	9	9	8	8
	β=15	10	10	8	8	6	6
LBGR=70	β=5	14	14	11	11	10	10
	β=10	11	11	9	9	8	8
	β=15	10	10	8	8	6	6

s = Standard Deviation
LBGR = Lower Bound of Gray Region (% of Action Level)
β = Beta (%), Probability of mistakenly concluding that $\mu >$ action level
α = Alpha (%), Probability of mistakenly concluding that $\mu <$ action level
AL = Action Level (Threshold)

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the site median (mean) value with a threshold value, the data will be assessed in this context. Assuming the data are adequate, at least one statistical test will be done to perform a comparison between the data and the threshold of interest. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.

Construction Class 3 Decision Area

Random sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

Summary

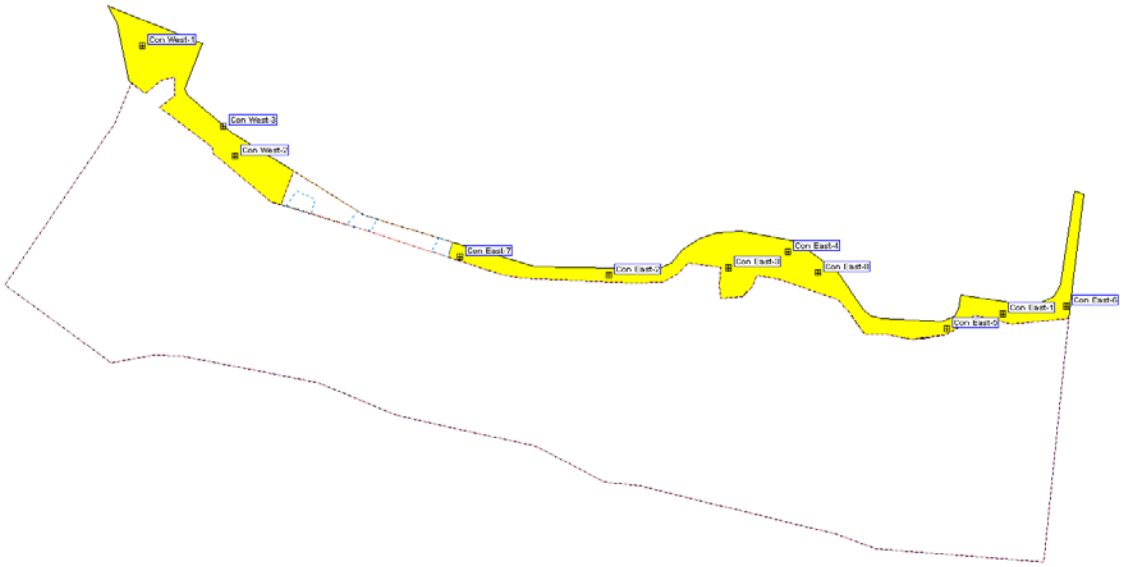
This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	11

Area: Con West					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1631520.8838	1774708.4411	Con West-1		Random	
1631812.6107	1774361.1549	Con West-2		Random	
1631776.1449	1774453.7645	Con West-3		Random	

Area: Con East					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1634227.6057	1773865.2442	Con East-1		Random	
1632989.6035	1773986.1098	Con East-2		Random	
1633364.5190	1774009.1318	Con East-3		Random	
1633551.9767	1774060.9313	Con East-4		Random	
1634051.8640	1773819.2002	Con East-5		Random	
1634426.7795	1773888.2663	Con East-6		Random	
1632520.9592	1774043.6648	Con East-7		Random	
1633645.7056	1773994.4233	Con East-8		Random	



The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Am-241	11	0.1 pCi/g	84.96 pCi/g	0.05	0.1	1.64485	1.28155
Cs-137	11	0.2 pCi/g	17.9 pCi/g	0.05	0.1	1.64485	1.28155
Pu-239	11	0.67 pCi/g	71.68 pCi/g	0.05	0.1	1.64485	1.28155

[a] The final number of samples has been increased by the MARSSIM Overage of 20%.
[b] This value is automatically calculated by VSP based upon the user defined value of α.
[c] This value is automatically calculated by VSP based upon the user defined value of β.

Construction Class 2 Decision Area

Systematic sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

Summary

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Systematic with a random start location
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	11
Number of samples on map	15 grid, 13 bias

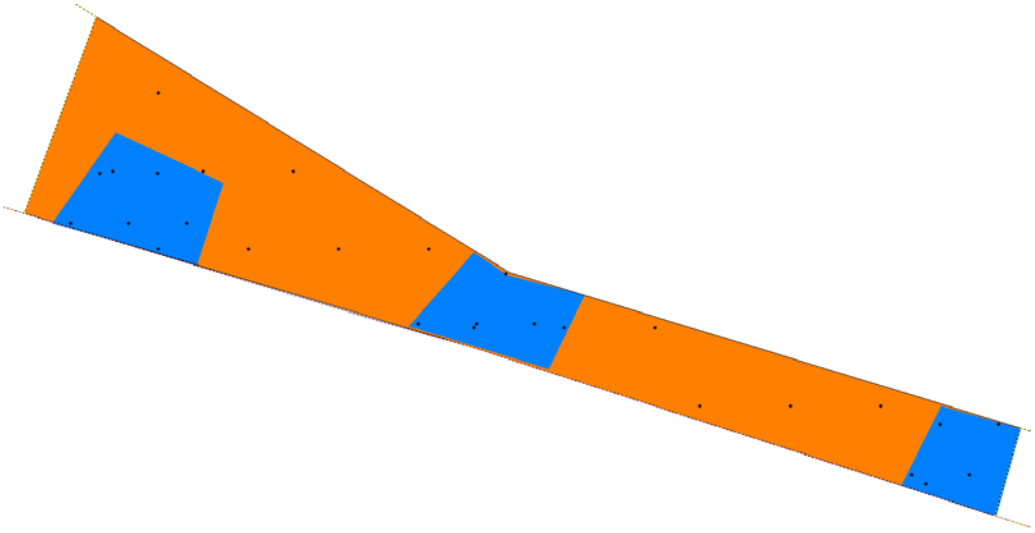
Area: Con Class 2					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1632445.5297	1774062.2292			Systematic	
1632323.2521	1774104.5875			Systematic	
1632372.1631	1774104.5875			Systematic	
1632421.0742	1774104.5875			Systematic	
1632200.9744	1774146.9457			Systematic	
1632249.8854	1774146.9457			Systematic	
1632298.7965	1774146.9457			Systematic	
1632029.7856	1774189.3039			Systematic	
1632078.6967	1774189.3039			Systematic	
1632127.6078	1774189.3039			Systematic	
1632176.5188	1774189.3039			Systematic	
1632005.3301	1774231.6622			Systematic	
1632054.2411	1774231.6622			Systematic	
1632103.1522	1774231.6622			Systematic	
1632029.7856	1774274.0204			Systematic	

Area: 21-027(c)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1631982.5656	1774203.2802			Systematic	

1632013.9592	1774203.2802			Systematic	
1632045.3529	1774203.2802			Systematic	
1631998.2624	1774230.4679			Systematic	
1632029.6561	1774230.4679			Systematic	

Area: C-21-027, 21-027(a)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1632170.9276	1774148.9048			Systematic	
1632202.3212	1774148.9048			Systematic	
1632233.7149	1774148.9048			Systematic	
1632218.0181	1774176.0925			Systematic	

Area: 21-024(b)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
1632437.7738	1774067.3416			Systematic	
1632469.1674	1774067.3416			Systematic	
1632453.4706	1774094.5294			Systematic	
1632484.8643	1774094.5294			Systematic	



The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Am-241	11	1.0 pCi/g	84 pCi/g	0.05	0.1	1.64485	1.28155
Cs-137	11	0.29 pCi/g	17.78 pCi/g	0.05	0.1	1.64485	1.28155
Pu-239	11	19.7 pCi/g	56.7 pCi/g	0.05	0.1	1.64485	1.28155

[a] The final number of samples has been increased by the MARSSIM Overage of 20%.
[b] This value is automatically calculated by VSP based upon the user defined value of α.
[c] This value is automatically calculated by VSP based upon the user defined value of β.