ENVIRONMENTAL RESTORATION PROJECT

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Interim Action Plan for Potential Release Site 53-002(a)

Los Alamos NATIONAL LABORATORY

Los Alamos NM 87545

Produced by the Remedial Actions Focus Area

EXECUTIVE SUMMARY

This interim action (IA) plan summarizes the proposed corrective action activities at consolidated potential release site (PRS) 53-002(a)-99, in Los Alamos National Laboratory (LANL or the Laboratory). The consolidated PRS consists of three impoundments (two northern and one southern) that were once identified as a treatment, storage, and disposal (TSD) unit, regulated under the Resource Conservation and Recovery Act (RCRA), and are now being addressed under corrective action. These two northern surface impoundments received sanitary wastewater (1969–1993) and radioactive and industrial wastewater (1969–1989) from various Technical Area 53 (TA-53) facilities, as well as septic tank sludge from other Laboratory facilities. Both impoundments are currently inactive and dry.

In 1994/1995, and again in 1999/2000, samples were collected within and around the northern surface impoundments to characterize the nature and extent of the contamination. Analysis of the data has determined that the concentrations of the radionuclides and carcinogenic chemicals within the dried sludge and clay liner of both impoundments surpass the target levels of 15 mrem/yr and 10^{-5} risk, respectively. Therefore, the Laboratory proposes cleanup activities to reduce the contaminant risk to acceptable levels.

This plan summarizes the data from the sampling activities and describes the field activities and methods that the Laboratory proposes to use to remove the dried sludge and clay liner within the boundaries of the northern surface impoundments. Confirmatory samples will be collected to verify that the sludge and clay liner have been removed. A risk/dose assessment will be conducted following the completion of this corrective action to determine if the level of risk/dose associated with contaminants in the underlying tuff is within acceptable levels.

Contents

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
CA	corrective action
COPC	chemical of potential concern
DOE	US Department of Energy
EPA	US Environmental Protection Agency
ER	environmental restoration
FIMAD	Facility for Information Management, Analysis, and Display
FR	Federal Register
HASL	Health and Safety Laboratory
HI	hazard index
HQ	hazard quotient
HSWA	Hazardous and Solid Waste Amendments
IA	interim action
IM	interim measure
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
NMED-HRMB	New Mexico Environment Department Hazardous and Radioactive Materials Bureau
NMED-HWB	New Mexico Environment Department Hazardous Waste Bureau (formerly NMED-HRMB)
NFA	no further action
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
PRS	potential release site
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RESRAD	residual radioactive material (computer code)
RFI	RCRA facility investigation
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
TAL	target analyte list
TSD	treatment, storage, and disposal
UCL	upper confidence limit
VOC	volatile organic compound

1.0 INTRODUCTION

This document describes the IA proposed for consolidated PRS 53-002(a)-99 within TA-53 of the Laboratory. The IA activities will be conducted by LANL's Environmental Restoration (ER) Project RCRA Corrective Action Focus Area and its subcontractors. Figure 1.0-1 shows the location of TA-53 relative to other TAs within Laboratory boundaries. Figure 1.0-2 shows the location of the PRS within TA-53.

1.1 Purpose and Scope

The objective and scope of the IA for PRS 53-002(a)-99 include the following tasks:

- Removing all of the dried sludge and the clay liner from both surface impoundments to reduce the concentrations of chemicals of potential concern (COPCs) within those media,
- Managing the waste,
- Packaging and transporting the waste to an appropriate facility,
- Confirming that all of the sludge and all of the clay liner have been removed,
- Verifying that removal activities have reduced the potential risk and dose to acceptable levels by collecting confirmatory samples, and
- Preparing an IA report that describes the remedial activities performed at the site, the analytical results of samples collected following the IA, and the data assessments.

The boundaries of the impoundments will determine the extent of the removal. Each impoundment is 210 ft long by 210 ft wide by 6 ft deep. The clay liner is approximately 4 in. deep, with up to 6 in. of accumulated dried sludge overlying the liner.

1.2 Regulatory History

PRS 53-002(a) is a solid waste management unit (SWMU) listed in Module VIII of the Laboratory's Hazardous Waste Facility Permit. The two northern impoundments were combined with the southern impoundment [formerly PRS 53-002(b)] to form consolidated unit PRS 53-002(a)-99 as part of the Annual Unit Audit in April of 1999 (LANL and DOE 1999, 63175).

The status of the TA-53 impoundments was changed from RCRA TSD units to corrective action (CA) units, which are addressed by RCRA's Hazardous and Solid Waste Amendments (HSWA). This was done by means of a letter from the New Mexico Environment Department Hazardous and Radioactive Materials Bureau (NMED-HRMB) to the Department of Energy (DOE)/LANL dated July 21, 1997. The letter states that "a change in status of the three Surface Impoundments at TA-53 from a Treatment, Storage, Disposal (TSD) Unit to a Corrective Action Status under the Hazardous and Solid Waste Act (HSWA) has been approved" (NMED 1997, 56380). This change was established with NMED through an extensive hazardous-waste determination process, which was substantiated through verbal discussions as well as supporting correspondence. The following discussion summarizes the activities that led the NMED-HRMB (now the NMED-HWB) to approve the change in status of TA-53 impoundments from RCRA TSD units to HSWA CA units.

The impoundments had been "protectively" included in the Laboratory's RCRA Hazardous Waste Permit Application based upon the presence of hazardous constituents; Part A was submitted in January 1991 and Part B was submitted in July 1991. In November 1991, initial discussions with NMED were held regarding the possibility that the hazardous constituents present in the impoundments might not have originated from hazardous waste. This is consistent with the clarification within the final rule from the Environmental Protection Agency (EPA), which states that wastes are not presumed to be hazardous under RCRA merely because they contain hazardous constituents (57 FR 12, January 2, 1992). On January 15, 1992, the DOE forwarded a letter to NMED to follow up on the discussions from the initial meeting (DOE 1992, 64216).

To make a waste determination regarding the materials within the impoundments, LANL embarked on an extensive process of objectively reviewing the operational processes as well as past and present waste-management practices associated with the generation of wastes discharged to the impoundments. These activities were consistent with EPA's rule regarding hazardous waste determinations (47 FR 12727, February 26, 1980, and 48 FR 2519, January 19, 1983).

The result of this exhaustive review of information was the determination that the wastes discharged to the impoundments did not originate from listed hazardous waste. In addition, sampling and analysis of the contents of the impoundments verified that the impoundments did not contain characteristic hazardous waste. This information was shared and discussed with NMED at an April 15, 1997, monthly meeting, where it was decided to change the three impoundments at TA-53 from TSD status to CA status.

On May 19, 1997, DOE forwarded a letter (DOE 1997, 64130) to NMED to confirm the change in status. NMED officially approved the change in status of the TA-53 impoundments in a July 21, 1997, letter. In this letter, NMED-HRMB stated that "a closure plan for the impoundments is no longer necessary" (NMED 1997, 56380).

In response to the change in regulatory status, and as requested by NMED (NMED 1997, 56380), ER Project personnel prepared and submitted the "RCRA Facility Investigation RFI Work Plan and SAP for Potential Release Sites 53-002(a), 53-002(b) and Associated Piping and Drainages" (LANL 1998, 58841). This work plan/SAP and a SAP addendum were both approved by NMED on August 8, 2000 (NMED 2000, 64821).

1.3 Rationale for Proposed IA

The rationale for conducting the IA at PRS 53-002(a)-99 is to reduce the potential risk/dose associated with contaminants present at the impoundments by removing the source. The screening levels that were used to determine the potential risk and dose at the impoundments are based on residential and industrial exposure scenarios. They correspond to a dose of 15 mrem/yr for a residential scenario and a dose of 30 mrem/yr for an industrial scenario for radionuclides, a 10^{-5} cancer risk for carcinogens, and a hazard quotient/hazard index (HQ/HI) of 1 for noncarcinogens. Following the IA, a risk/dose assessment of the impoundments and the surrounding area will be performed to determine whether residual contamination, if any exists, poses an unacceptable level of risk or dose under current and projected future land use.

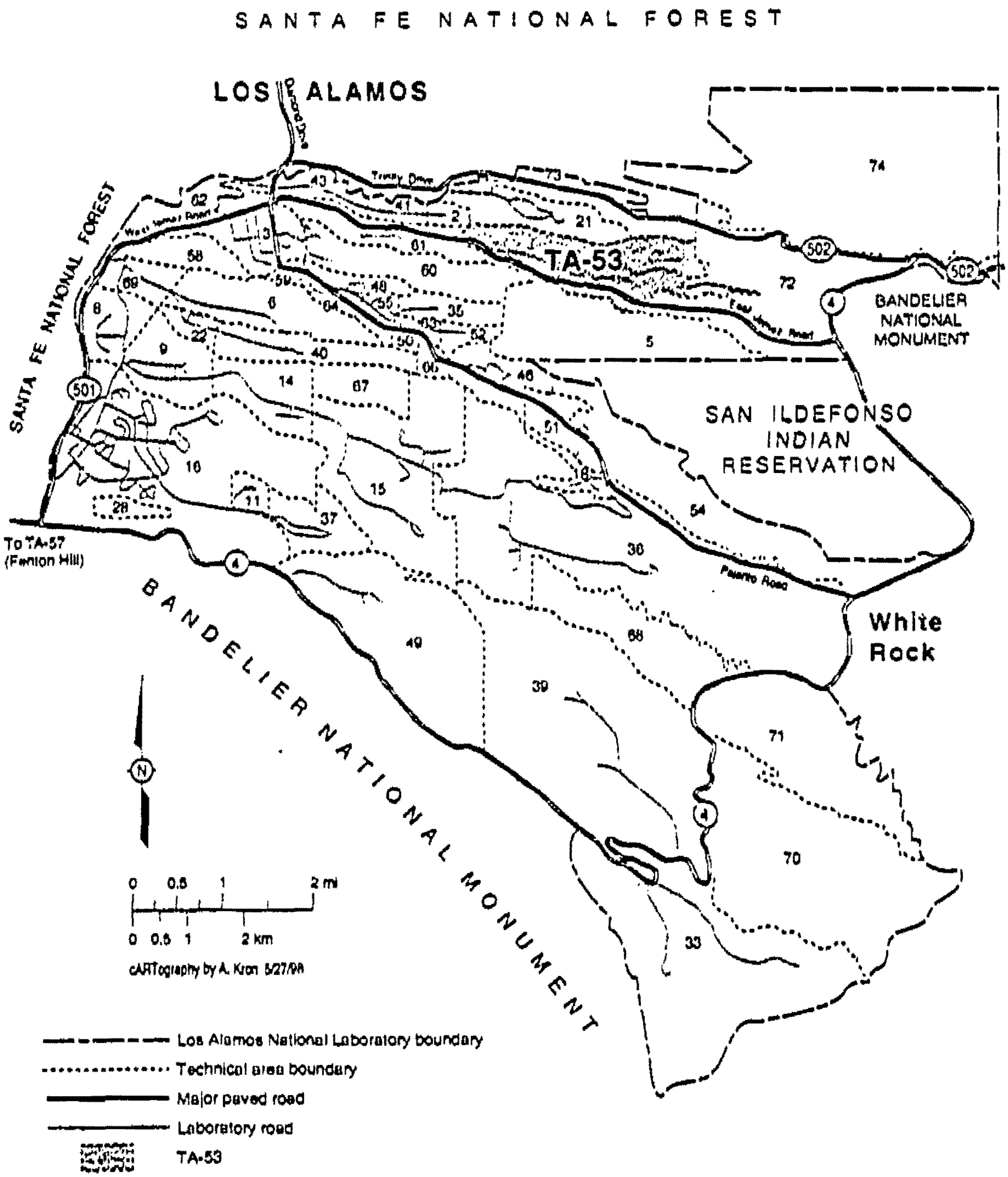

Figure 1.0-1. Location of TA-53 with respect to other Laboratory technical areas

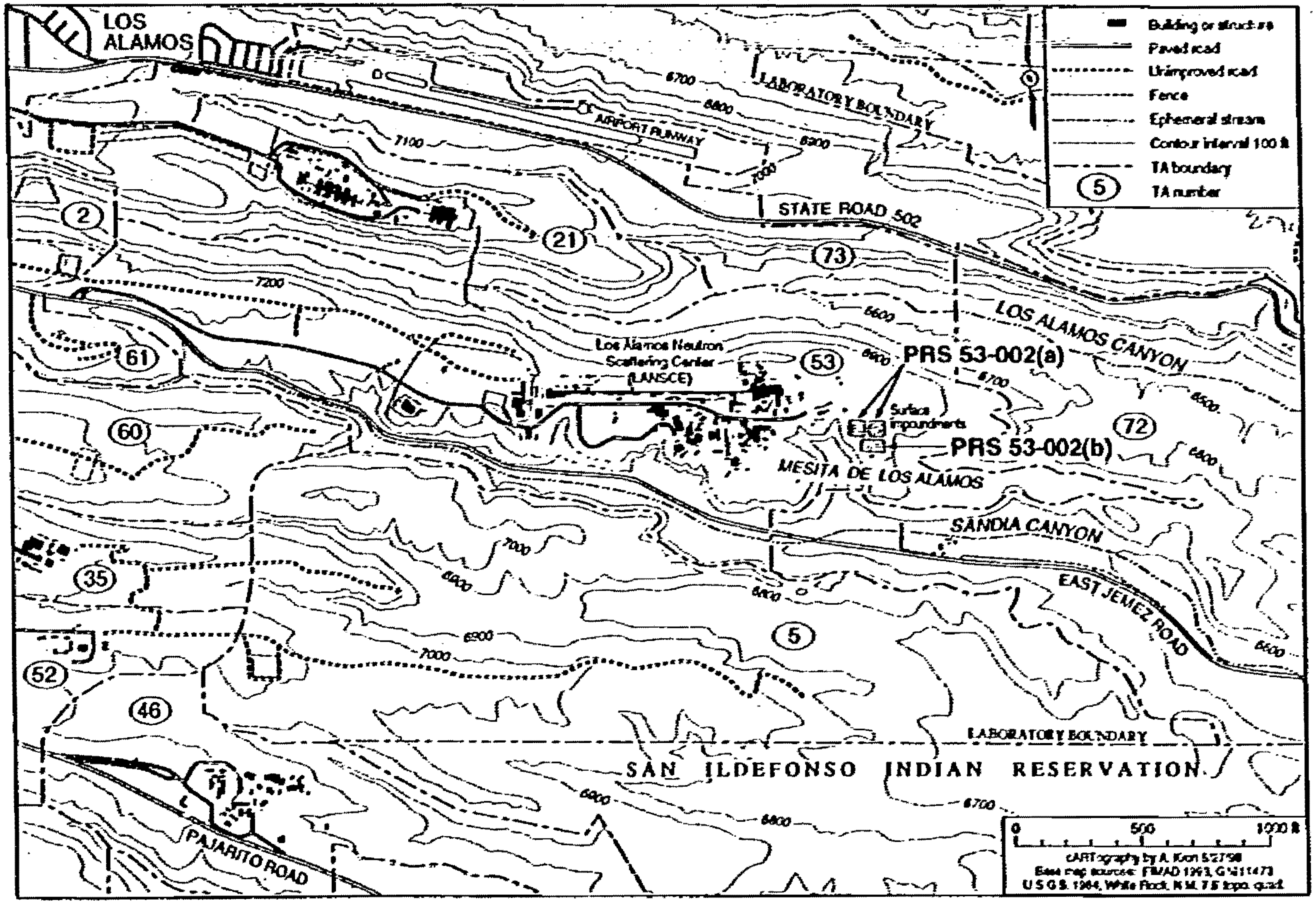

Figure 1.0-2. Location of PRS 53-002(a) and PRS 53-002(b) within TA-53

2.0 PREVIOUS SITE CHARACTERIZATION

2.1 Site Description and Operational History

PRS 53-002(a)-99 is located in TA-53 on Mesita de Los Alamos, which is bounded to the north by Los Alamos Canyon and to the south by Sandia Canyon. Mesita de Los Alamos is comprised of Bandelier Tuff, which is a series of ashfall and ashflow units that cap the mesa. The surface impoundments were excavated into Tshirege Unit 2b (Qbt 2) of the Bandelier Tuff. Cooling and tectonic fractures and fracture zones are common in the unit. The depth to the regional aquifer at TA-53 is estimated to be 1000 ft below land surface. The main activity at TA-53 centers around Los Alamos Neutron Science Center (LANSCE) and associated experimental areas. LANSCE comprises a high-power proton linear accelerator and a variety of associated experimental areas and spectrometers.

PRS 53-002(a)-99 includes the three surface impoundments and associated piping and drainages within TA-53. This IA will focus on only the two northern surface impoundments, which were constructed in 1969 and are clay-lined engineered structures designed to treat wastewaters via retention of solids and evaporation of liquids. The surface impoundments were constructed by excavating into native tuff which was then pulverized and used as engineered material for constructing the side slopes. The pulverized tuff was placed in layers and compacted to 90% of the maximum density as defined by the Modified Proctor (ASTM D1557) as the first layer of the engineered structure (LANL 1992, 29413).

The clay liner, the next layer of engineered material overlying the pulverized tuff, consists of a 4-in. layer of bentonite clay. The clay liner was compacted to 95% of maximum density (LANL 1992, 29413). Gunite was applied to the side slopes of the northern impoundments as a liner (4 to 6 in. thick) for the side walls. Each impoundment is 210 ft long by 210 ft wide by 6 ft deep and has a liquid storage capacity of approximately 1.6 million gal. The primary discharges into the surface impoundments included sanitary and radioactive wastewater from various TA-53 facilities, as well as septic tank sludge from other Laboratory facilities. To minimize the volume of water discharged to the outfall, two Aqua Aerobics surface turbine aerators were used in each impoundment for aeration and enhanced evaporation. Currently, the northern surface impoundments are inactive and dry.

TA-53 is an industrial area currently used for various experimental physics programs. The Laboratory does not anticipate any change from this industrial use in the future (LANL 1995, 57224). Security measures such as laboratory badges or escort for entry, along with the locked gate at the road to the impoundments, effectively reduce the possibility of inadvertent site intrusion.

2.2 Previous Field Investigations

The sludge and water in the two northern surface impoundments were characterized by four separate events:

1. sampling by the DOE Headquarters environmental survey in 1988 (DOE 1989, 15367),
2. sampling by the Laboratory Environmental Compliance Group (ESH-8) in 1991 and 1992,
3. sampling by the Laboratory ER Project in 1994/1995, and
4. sampling by the Laboratory ER Project in 1999/2000.

2.2.1 1988, 1991, and 1992 Sampling Campaigns

The data generated during the first two sampling campaigns were not able to be validated due to a lack of quality control measures. Therefore they could only be used for qualitative purposes (in accordance with ER Project protocols). The data were used to guide the selection of analytical suites for the interim status closure plan, which was submitted to NMED lin 1994.

2.2.2 1994/1995 Sampling Campaign

The ER Project conducted sampling at the northern surface impoundments in 1994/1995 to assess the nature of the contamination and to determine if contaminants were migrating out of the surface impoundments. Samples of the sludge, the bentonite clay liner, the tuff below the bentonite liner, and the tuff below the gunite liner around the periphery were collected from the northern surface impoundments. These samples were analyzed for target analyte list (TAL) metals (EPA SW-846 Method 6010A); mercury (EPA SW-846 Method 7471); total cyanide (EPA SW-846 Method 9010); reactive sulfides (EPA SW-846 Method 6030); semivolatile organic compounds (SVOCs) (EPA SW-846 Method 8270); volatile organic compounds (VOCs) (EPA SW-846 Method 8260); pesticides and polychlorinated biphenyls (PCBs) (EPA SW-846 Method 8080); herbicides (EPA SW-846 Method 8152); isotopic uranium and plutonium (alpha spectroscopy); and strontium-90, tritium, and gamma-emitting isotopes (gamma spectroscopy, HASL-300). Sample locations for the 1994/1995 sampling campaign are shown in Figure 2.2-1. Data from the 1994/1995 sampling campaign were used quantitatively to help design the 1998 RFI work plan and SAP (LANL 1998, 58841).

2.2.3 1999/2000 Sampling Campaign

There were gaps in the source term data that existed for this site after the 1994/1995 sampling campaign. In addition, NMED had required the Laboratory to submit an RFI work plan for the corrective action process for the impoundments. A decision had been made that the site would not follow the RCRA closure path. Subsequent sampling per the 1998 RFI work plan (LANL 1998, 58841) was conducted in 1999/2000. Samples collected at depth beneath the clay liner were needed to assess the movement of contaminants through the vertical profile. The PCB data collected during the 1994/1995 sampling campaign at the northern surface impoundments were of questionable quality; therefore, PCBs were resampled and reanalyzed. It was also unknown what percentage of chromium VI made up the total chromium concentrations. Sample locations for the 1999/2000 sampling campaign are also shown in Figure 2.2-1.

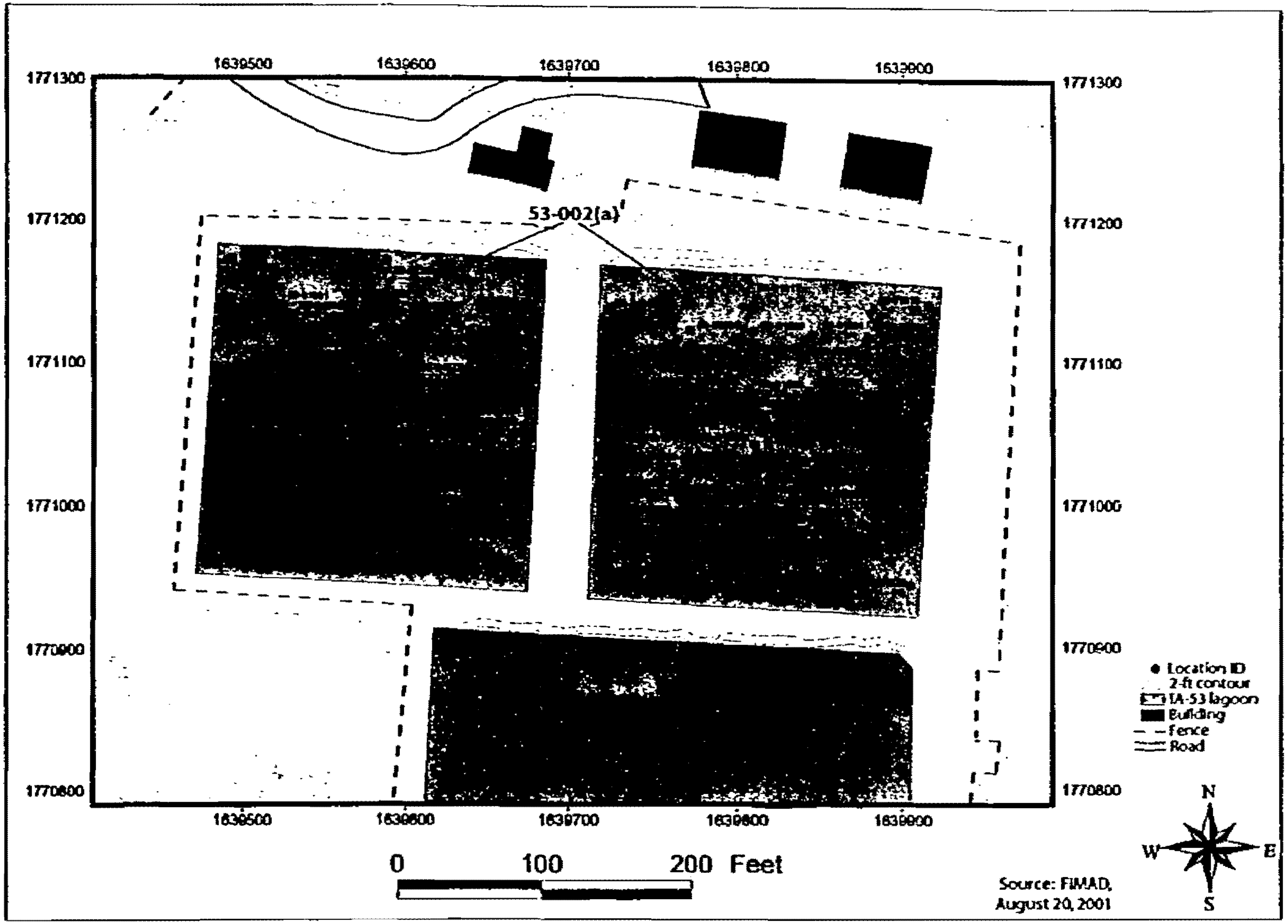

Figure 2.2-1. Sample location IDs for northern surface impoundments

2.3 Assessment of the 1994/1995 and 1999/2000 Sampling Data

This section addresses the sampling campaigns (data gathered by the ER Project) in 1994/1995 and 1999/2000. Samples of the sludge, bentonite clay liner, and the tuff below the clay liner were collected from the northern surface impoundments. These samples were analyzed for TAL metals (EPA SW-846 Method 6010A); mercury (EPA SW-846 Method 7471); total cyanide (EPA SW-846 Method 9010); reactive sulfides (EPA SW-846 Method 9030); SVOCs (EPA SW-846 Method 8270); VOCs (EPA SW-846 Method 8260); pesticides and PCBs (EPA SW-846 Method 8080); herbicides (EPA SW-846 Method 8152); isotopic uranium and plutonium (alpha spectroscopy); and strontium-90, tritium, and gamma-emitting isotopes (gamma spectroscopy, HASL-300).

All the available ER data were compiled for PRS 53-002(a)-99 and validated by a chemist in the Analysis and Assessments Focus Area of the ER Project. The validated data were obtained from the Facility for Information Management, Analysis, and Display (FIMAD). The data from each impoundment (northeast and northwest) were evaluated separately. Nondetect and rejected data (U-, UJ -, or R-qualified) were eliminated from the organic and radionuclide contaminant groups for the screening assessment. The R-qualified data do not affect the decision to conduct this corrective action. Field duplicate samples were also eliminated from the screening assessment.

The inorganic and radionuclide data were initially compared to soil background and fallout values obtained from "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier *Tuff at Los Alamos National Laboratory*" (LANL 1998, 59730). The clay liner and sludge samples were compared to the all-horizons background values, and the tuff samples were compared to the Qbt 2 background data. The all-horizons background values represent concentrations of naturally occurring chemicals in the surrounding soil. Although there are no established background values for either sludge or engineered materials, the all-horizons background comparison was done to help identify those inorganic chemicals and radionuclides elevated above naturally occurring concentrations.

Any inorganic chemicals and radionuclides that were not detected above background or fallout values were assumed not to pose a potential risk/dose and were therefore eliminated from further evaluation. However, because the intent of this IA is to completely remove the sludge and clay liner, any potential risk/dose associated with the excluded inorganic chemicals and radionuclides in the sludge and clay liner will be eliminated. Tables 2.3-1 through 2.3-3 contain the frequency of detection above background values for the inorganic chemicals, the frequency of detection above background/fallout values for the radionuclides, and the frequency of detection for organic chemicals. Any analyte that had no detected values was also eliminated. Although the frequency-of-detection tables include essential nutrient (i.e., calcium, magnesium, potassium, and sodium) and reactive sulfide data, these data were not screened as COPCs for this IA because no toxicity data exist for these analytes. Essential nutrients are not toxic at ambient or near-ambient concentrations.

Based on the comparison to background and fallout values, as well as the evaluation of detected organic chemicals, the following COPCs have been identified in the sludge and clay liner:

- Inorganic chemicals—antimony, cadmium, calcium, total chromium, copper, lead, magnesium, mercury, nickel, selenium, silver, thallium, and zinc;
- Radionuclides—cesium-134, cobalt-60, europium-152, plutonium-238, plutonium-239, sodium-22, strontium-90, and tritium; and
- Organic chemicals—acetone, aroclor-1254, aroclor-1260, benzene hexachloride (BHC)[alpha-], BHC[gamma-], bis(2-ethylhexyl)phthalate, 2-butanone, 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, dieldrin, endosulfan I, endrin, heptachlor, methylene chloride, toluene, and trichloroethene.

Table 2.3-1
Frequency of Inorganic Chemicals Detected Above Background Values in Sludge and Clay Liner

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Background Value (mg/kg)	Frequency of Detects Above Background Value
Aluminum	Sludge	34	34	1370 to 8110	29200	0/34
	Clay liner	34	34	215 to 9160	29200	0/34
Antimony	Sludge	34	26	0.12 to 3.02	0.83	1/34
	Clay liner	34	18	0.093 to [1][a]	0.83	0/34
Arsenic	Sludge	34	34	1.02 to 6.72	8.17	0/34
	Clay liner	34	34	0.57 to 3.71	8.17	0/34
Barium	Sludge	34	34	23 to 173	295	0/34
	Clay liner	34	34	2.9 to 95	295	0/34
Beryllium	Sludge	34	34	0.11 to 0.71	1.83	0/34
	Clay liner	34	34	0.21 to 0.89	1.83	0/34
Cadmium	Sludge	34	34	0.23 to 3.29	0.4	31/34
	Clay liner	34	34	0.026 to 0.77	0.4	2/34
Calcium	Sludge	34	34	2370 to 19900	6120	15/34
	Clay liner	34	34	540 to 4600	6120	0/34
Chromium, hexavalent	Sludge	4	0	[0.04 to 210]	NA	0/4
	Clay liner	NA[b]	NA	NA	NA	NA
Chromium, total	Sludge	34	34	7.61 to 31.7	19.3	8/34
	Clay liner	34	34	1.06 to 16.1	19.3	0/34
Cobalt	Sludge	34	34	1.55 to 7.18	8.64	0/34
	Clay liner	34	34	0.059 to 3.33	8.64	0/34
Copper	Sludge	34	34	39.4 to 1070	14.7	34/34
	Clay liner	34	34	0.44 to 88.7	14.7	15/34
Cyanide, total	Sludge	34	0	[244 to 500]	NA	0/34
	Clay liner	NA	NA	NA	NA	NA
Iron	Sludge	34	34	3590 to 10300	21500	0/34
	Clay liner	34	34	558 to 8340	21500	0/34
Lead	Sludge	34	34	8.71 to 135	22.3	16/34
	Clay liner	34	34	5.92 to 33.9	22.3	1/34
Magnesium	Sludge	34	34	484 to 6160	4610	3/34
	Clay liner	34	34	73.4 to 1760	4610	0/34
Manganese	Sludge	34	34	49.2 to 369	671	0/34
	Clay liner	34	34	63.4 to 226	671	0/34
Mercury	Sludge	34	34	0.23 to 2.88	0.1	34/34
	Clay liner	34	34	0.0035 to 0.11	0.1	1/34
Nickel	Sludge	34	34	3.15 to 17.1	15.4	1/34
	Clay liner	34	34	0.88 to 10.5	15.4	0/34

Table 2.3-1 (continued)

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Background Value (mg/kg)	Frequency of Detects Above Background Value
Potassium	Sludge	34	34	313 to 2810	3460	0/34
	Clay liner	34	34	105 to 1580	2460	0/34
Selenium	Sludge	34	33	0.201 to 2.15	1.52	12/34
	Clay liner	34	15	0.15 to [0.5]	1.52	0/34
Silver	Sludge	34	34	0.702 to 19.7	1	31/34
	Clay liner	34	1	0.29 to [1]	1	0/34
Sodium	Sludge	34	34	116 to 3530	915	13/34
	Clay liner	34	34	89.8 to 387	915	0/34
Sulfide, reactive	Sludge	34	34	0.015 to 4.79	NA	34/34
	Clay liner	NA	NA	NA	NA	NA
Thallium	Sludge	34	23	0.208 to [1]	0.73	1/34
	Clay liner	34	14	0.204 to 2.14	0.73	5/34
Vanadium	Sludge	34	34	4.47 to 33.5	39.6	0/34
	Clay liner	34	34	0.75 to 12.6	39.6	0/34
Zinc	Sludge	34	34	69.4 to 838	48.8	34/34
	Clay liner	34	34	12.7 to 131	48.8	12/34

[a] Values in square brackets indicate nondetected results.

[b] NA = Not analyzed.

Table 2.3-2
Frequency of Radionuclides Detected
Above Background/Fallout Values in Sludge and Clay Liner

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (pCi/g)	Background/ Fallout Values (pCi/g)	Frequency of Detects Above Background/ Fallout Values
Americium-241	Sludge	34	0	[-1.88 to 2.65][a]	0.013	0/34
	Clay liner	34	0	[-0.22 to 0.18]	0.013	0/34
Cesium-134	Clay liner	34	33	[-0.0047] to 22.6	NA[b]	33/34
Cesium-137	Sludge	34	0	[-0.73 to 1.61]	1.65	0/34
	Clay liner	34	0	[-0.032 to 0.14]	1.65	0/34
Cobalt-60	Sludge	34	34	35.8 to 4740	NA	34/34
	Clay liner	34	33	[0.17] to 42.3	NA	33/34
Europium-152	Sludge	34	11	[-0.83] to 5.68	NA	11/34
	Clay liner	34	0	[-0.17 to 0.23]	NA	0/34
Plutonium-238	Sludge	25	19	[-0.01] to 0.03	0.023	19/25
	Clay liner	34	0	[-0.0033 to 0.066]	0.023	0/34
Plutonium-239	Sludge	28	14	[0] to 0.06	0.054	14/28
	Clay liner	34	0	[-0.0077 to 0.088]	0.054	0/34

Table 2.3-2 (continued)

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (pCi/g)	Background/ Fallout Values (pCi/g)	Frequency of Detects Above Background/ Fallout Values
Ruthenium-106	Sludge	34	0	[-7.57 to 17.3]	NA	0/34
	Clay liner	34	0	[-0.43 to 0.64]	NA	0/34
Sodium-22	Sludge	34	7	[-0.048] to 2.4	NA	7/34
	Clay liner	34	0	[0 to 0.22]	NA	0/34
Strontium-90	Sludge	34	9	[-0.83] to 3.86	1.31	9/34
	Clay liner	34	4	[-1.22] to 2.11	1.31	4/34
Tritium	Sludge	34	34	2.38 to 404.57	0.76	34/34
	Clay liner	34	34	0.31 to 4.77	0.76	29/34
Uranium-234	Sludge	34	34	0.47 to 2.58	2.59	0/34
	Clay liner	34	30	0.74 to 1.23	2.59	0/34
Uranium-235	Sludge	34	28	[0.01] to 0.12	0.2	0/34
	Clay liner	34	0	[-0.0083 to 0.16]	0.2	0/34
Uranium-238	Sludge	34	34	0.45 to 1.64	2.29	0/34
	Clay liner	34	33	0.74 to 1.2	2.29	0/34

[a] Values in square brackets indicate nondetected results.

[b] NA = Not analyzed.

Table 2.3-3
Frequency of Organic Chemicals Detected in Sludge and Clay Liner

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Frequency of Detects
Acetone	Sludge	36	27	[0.0066][a] to 1.85	27/36
	Clay liner	34	15	0.0033 to [0.1]	15/34
Aroclor-1254	Sludge	70	59	[0.034] to 25	59/70
	Clay liner	69	15	[0.00406] to 10	15/69
Aroclor-1260	Sludge	70	19	[0.033 to 7]	19/70
	Clay liner	69	15	[0.00406 to 3.9]	15/69
BHC[alpha-]	Sludge	70	5	[0.0017 to 0.35]	5/70
BHC[gamma-]	Sludge	70	1	[0.0017 to 0.35]	1/70
	Clay liner	69	1	0.00076 to [1.32]	1/69
Bis(2-ethylhexyl) phthalate	Sludge	34	14	1.95 to 94.9	14/34
	Clay liner	34	7	0.17 to [3.32]	7/34
Butanone[2-]	Sludge	36	19	0.021 to 0.24	19/36
DDD[4,4'-]	Clay liner	69	1	[0.0019 to 0.39]	1/69
DDE[4,4'-]	Sludge	70	8	[0.0033 to 0.7]	8/70

Table 2.3-3 (continued)

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Frequency of Detects
DDT[4,4'-]	Sludge	70	3	[0.0033 to 0.7]	3/70
	Clay liner	69	2	[0.0019 to 0.39]	2/69
Dieldrin	Clay liner	69	4	[0.0016 to 0.39]	4/69
Endosulfan I	Sludge	70	7	[0.0017 to 0.35]	7/70
	Clay liner	69	2	[0.0016 to 0.33]	2/69
Endrin	Sludge	70	3	[0.0033 to 0.7]	3/70
	Clay liner	69	8	[0.0016 to 0.39]	8/69
Heptachlor	Clay liner	69	1	[0.0016 to 0.33]	1/69
Methylene chloride	Sludge	36	15	[0.0055] to 0.063	15/36
	Clay liner	34	8	0.0027 to [0.05]	8/34
Toluene	Sludge	36	3	[0.0055 to 0.02]	3/36
	Clay liner	34	1	0.0012 to [0.02]	1/34
Trichloroethene	Sludge	36	2	0.00027 to [0.02]	2/36

* Values in square brackets indicate nondetected results.

2.4 Screening Evaluation

The maximum detected concentration for each COPC was compared with the appropriate screening action level (SAL). The SALs for nonradionuclides were calculated based on the methodology in Appendix C of the approved Installation Work Plan (LANL 1998, 62060) or provided in NMED guidance (NMED 2000, 68554). The parameters used included the most current values presented in EPA Region 6 and /or NMED guidance (EPA 2000, 68410; NMED 2000, 68554). The SALs for radionuclide COPCs used in this evaluation were calculated using RESRAD Version 5.95 computer code and based on the approach described in "Derivation and Use of Radionuclide Screening Action Levels," (LANL 2001, 69683). The SALs reflect a residential exposure scenario in which exposure is based on 24 hours per day and 350 days per year. The comparison is done separately for noncarcinogens, carcinogens, and radionuclides. The SALs for noncarcinogens are based on an HQ of 1; those for carcinogens are based on a target cancer risk of 10^{-6}; and those for radionuclides are based on a radiation dose of 15 mrem/yr.

The maximum detected concentration for each COPC was also compared with the appropriate industrial screening level. The industrial screening levels for nonradionuclides were calculated based on the methodology and parameters provided in EPA Region 6 guidance (EPA 2000, 68410). The industrial screening levels for radionuclide COPCs used in this evaluation were calculated using RESRAD Version 6.1 and based on parameters presented in LANL guidance (LANL 2000, 66801). The industrial screening levels reflect a industrial exposure scenario for an outdoor worker in which exposure is based on 8 hours per day and 250 days per year. The comparison is done separately for noncarcinogens, carcinogens, and radionuclides. The industrial screening levels for noncarcinogens are based on an HQ of 1; those for carcinogens are based on a target cancer risk of 10^{-6}; and those for radionuclides are based on a radiation dose of 30 mrem/yr.

Appendix B presents the maximum concentrations of each COPC in each medium and impoundment. Appendix C contains the calculated risk/dose for the residential and industrial scenarios for each COPC. Of the COPCs presented in Appendix C, only those that were greater than their SALs in at least one medium for each lagoon are presented in Tables 2.4-1, 2.4-2, 2.4-3, and 2.4-4. The tables include the risk/dose calculations for media as well as either the residential or industrial exposure scenarios.

Table 2.4-1
SALs, COPC Concentrations and Resultant Doses, Cancer Risk, and HQs for the Sludge Layer in the Northern Impoundments at TA-53

Analyte	SALs	Maximum Concentration	Dose (mrem/yr)	Cancer Risk	HQ
NORTHEAST IMPOUNDMENT					
Radionuclides (pCi/g)					
Cesium-134	2.3	NA[a]	—[b]	—	—
Cobalt-60	1.2	1070	8917	—	—
Europium-52	2.7	5.7	21.0	—	—
Sodium-22	1.5	2.4	16.0	—	—
Strontium-90	5.7	3.9	6.8	—	—
Tritium	880	406	4.6	—	—
Carcinogens (mg/kg)					
Aroclor-1254	0.22	25	—	1.14E-04	—
Aroclor-1260	0.22	3.5	—	1.59E-05	—
Dieldrin	0.03	ND[c]	—	—	—
Noncarcinogens (mg/kg)					
Aroclor-1254	1.1	25	—	—	22.7
Copper	2800	1070	—	—	0.38
Cyanide, total	1200	500	—	—	0.42
Lead	400	135	—	—	0.34
Thallium	6.1	0.92	—	—	0.15
NORTHWEST IMPOUNDMENT					
Radionuclides (pCi/g)					
Cesium-134	2.3	NA	—	—	—
Cobalt-60	1.2	4740	39500	—	—
Sodium-22	1.5	2.1	14	—	—
Strontium-90	5.7	2.2	3.8	—	—
Carcinogens (mg/kg)					
Aroclor-1254	0.22	9.0	—	4.09E-05	—
Aroclor-1260	0.22	3.9	—	1.77E-05	—
BHC[alpha-]	0.09	0.12	—	1.29E-06	—
Bis(2-ethylhexyl)phthalate	35	94.9	—	2.71E-06	—
Noncarcinogens (mg/kg)					
Aluminum	74000	8110	—	—	0.11
Aroclor-1254	1.1	9	—	—	8.2
Copper	2800	569	—	—	0.20
Lead	400	77	—	—	0.19
Mercury	23	2.9	—	—	0.13
Thallium	6.1	0.66	—	—	0.11

[a] NA = Not analyzed.

[b] — = Not applicable.

[c] ND = Not detected.

Table 2.4-2
SALs, COPC Concentrations and Resultant Doses, and HQs for the Clay Liner in the Northern Impoundments at TA-53

Analyte	SALs	Maximum Concentrations	Dose (mrem/yr)	Cancer Risk	HQ
NORTHEAST IMPOUNDMENT					
Radionuclides (pCi/g)					
Cesium-134	2.3	22.6	98	—[a]	—
Cobalt-60	1.2	6.23	52	—	—
Europium-152	2.7	ND[b]	—	—	—
Sodium-22	1.5	ND	—	—	—
Strontium-90	5.7	1.9	3.3	—	—
Tritium	880	4.8	0.05	—	—
Carcinogens (mg/kg)					
Aroclor 1254	0.22	10	—	4.55E-05	—
Aroclor-1260	0.22	0.3	—	1.37E-06	—
Dieldrin	0.03	0.032	—	1.07E-06	—
Noncarcinogens (mg/kg)					
Aroclor 1254	1.1	10	—	—	9.1
Copper	2800	44.8	—	—	0.016
Cyanide, Total	1200	ND	—	—	ND
Lead	400	19.4	—	—	0.049
Thallium	6.1	2.14	—	—	0.35
NORTHWEST IMPOUNDMENT					
Radionuclides (pCi/g)					
Cesium-134	2.3	10.3	45	—	—
Cobalt-60	1.2	42.3	353	—	—
Sodium-22	1.5	ND	—	—	—
Strontium-90	5.7	2.1	3.7	—	—
Carcinogens (mg/kg)					
Aroclor-1254	0.22	0.62	—	2.81E-06	—
Aroclor-1260	0.22	ND	—	—	—
BHC[alpha]	0.09	ND	—	—	—
Bis(2-ethylhexyl)phthalate	35	0.39	—	1.10E-08	—
Noncarcinogens (mg/kg)					
Aroclor 1254	1.1	0.62	—	—	0.56
Copper	2800	88.7	—	—	0.03
Lead	400	33.9	—	—	0.08
Mercury	23	0.11	—	—	0.00
Thallium	6.1	0.32	—	—	0.05

[a] — = Not applicable.

[b] ND = Not detected.

Table 2.4-3
Industrial Screening Values, COPC Concentrations and Resultant Doses, Cancer Risk, and HQs for the Sludge Layer in the Northern Impoundments at TA-53

Analyte	Industrial Screening Value	Maximum Concentrations	Dose (mrem/yr)	Cancer Risk	HQ
NORTHEAST IMPOUNDMENT					
Radionuclides (pCi/g)					
Cesium-134	16.5	NA[a]	NA	—[b]	—
Cobalt-60	8.8	1070	1222	—	—
Europium-152	19.4	5.7	2.9	—	—
Sodium-22	11.1	2.4	2.2	—	—
Strontium-90	3210	3.9	0.01	—	—
Tritium	6921	405	0.58	—	—
Carcinogens (mg/kg)					
Aroclor-1254	0.93	25	—	2.69E-05	—
Aroclor 1260	0.93	3.5	—	3.76E-06	—
Dieldrin	0.13	ND[c]	—	—	—
Noncarcinogens (mg/kg)					
Aroclor 1254	13	25	—	—	1.9
Copper	47000	1070	—	—	0.023
Cyanide, total	15000	500	—	—	0.033
Lead	2000	135	—	—	0.068
Thallium	100	0.92	—	—	0.009
NORTHWEST IMPOUNDMENT					
Radionuclides (pCi/g)					
Cesium-134	16.5	NA	—	—	—
Cobalt-60	8.8	4740	5413	—	—
Sodium-22	11.1	2.1	1.9	—	—
Strontium-90	3210	2.2	0.01	—	—
Carcinogens (mg/kg)					
Aroclor 1254	0.93	9.0	—	9.68E-06	—
Aroclor 1260	0.93	3.9	—	4.2E-06	—
BHC[alpha]	0.45	0.12	—	2.58E-07	—
Bis(2-ethylhexyl)phthalate	150	94.9	—	6.33E-07	—
Noncarcinogens (mg/kg)					
Aluminum	100000	8110	—	—	0.08
Aroclor 1254	13	9	—	—	0.69
Copper	47000	569	—	—	0.01
Lead	2000	77	—	—	0.04
Mercury	380	2.9	—	—	0.01
Thallium	100	0.66	—	—	0.01

[a] NA = Not analyzed.

[b] — = Not applicable.

[c] ND = Not detected.

Table 2.4-4
Industrial Screening Values, COPC Concentrations and Resultant Doses, and HQs for the Clay Liner in the Northern Impoundments at TA-53

Analyte	Industrial Screening Value	Maximum Concentrations	Dose (mrem/yr)	Cancer Risk	HQ
		NORTHEAST IMPOUNDMENT			
Radionuclides (pCi/g)					
Cesium-134	16.5	22.6	13.7	—[a]	—
Cobalt-60	8.8	6.2	7.1	—	—
Europium-152	19.4	ND[b]	—	—	—
Sodium-22	11.1	ND	—	—	—
Strontium-90	3210	1.9	0.01	—	—
Tritium	6921	4.8	0.01	—	—
Carcinogens (mg/kg)					
Aroclor 1254	0.93	10	—	1.08 E-05	—
Aroclor 1260	0.93	0.3	—	3.24E-07	—
Dieldrin	0.13	0.032	—	2.48E-07	—
Noncarcinogens (mg/kg)					
Aroclor 1254	13.0	10	—	—	0.77
Copper	47000	44.8	—	—	0.001
Cyanide, total	15000	ND	—	—	—
Lead	2000	19.4	—	—	0.01
Thallium	100	2.1	—	—	0.021
		NORTHWEST IMPOUNDMENT			
Radionuclides (pCi/g)					
Cesium-134	16.5	10.3	6.2	—	—
Cobalt-60	8.8	42.3	48.3	—	—
Sodium-22	11	ND		—	—
Strontium-90	3210	2.1	0.01	—	—
Carcinogens (mg/kg)					
Aroclor 1254	0.93	0.62	—	6.65E-07	—
Aroclor 1260	0.93	ND	—	—	—
BHC[alpha]	0.45	ND	—	—	—
Bis(2-ethylhexyl)phthalate	150	0.39	—	2.57E-09	—
Noncarcinogens (mg/kg)					
Aluminum	100000	9160	—	—	0.09
Aroclor 1254	13	0.62	—	—	0.05
Copper	47000	88.7	—	—	0.00
Lead	2000	33.9	—	—	0.02
Mercury	380	0.1	—	—	0.00
Thallium	100	0.32	—	—	0.00

[a] — = Not applicable.

[b] ND = Not detected

2.5 Results of Screening Assessment

Tables 2.5-1 and 2.5-2 provide a summary of primary COPCs that were greater than SALs and industrial screening values or contribute significantly to total risk/dose. Many of the COPCs that surpass the screening levels are the same for both the northeast and northwest impoundments.

The HI (the sum of the individual hazard quotients) for noncarcinogens is above 1 in the sludge in both lagoons and in the clay liner in the northeast impoundment using a residential land-use scenario. Aroclor-1254 is the only noncarcinogenic COPC in either impoundment. Using industrial screening values, the HI is above 1 only in the sludge in the northeast impoundment, with Aroclor 1254 being the primary contributor.

The NMED target risk level for total cancer risk is 10^{-5} (NMED 2000, 68554). Any COPC with a potential cancer risk greater than 10^{-5} was identified as a risk driver. Aroclor-1254 and Aroclor-1260 were the only chemicals in either impoundment to generate this level of potential risk based on residential exposure. The potential risk for both these chemicals was limited to the sludge in both lagoons and to the clay liner for Aroclor-1254 in the northeast impoundment. Using industrial screening values, the total cancer risk surpasses the 10^{-6} target cancer risk for Aroclor-1254 in the sludge and clay liner in the northeast impoundment. A cumulative risk for both Aroclors exists in the sludge of the northwest impoundment.

Radionuclides are the overwhelming COPCs for both impoundments, with cobalt-60 and cesium-134 being the primary radionuclide COPCs. Using a residential land-use scenario, cobalt-60 surpasses 15 mrem/yr in the sludge and clay liner in both impoundments. Cesium-134 dose estimates are above 15 mrem/yr in the clay liner in both impoundments. Although cesium-134 was not sampled in the sludge layer, it is reasonable to assume that the dose would be above 15 mrem/yr in this layer as well. Europium-152 and sodium-22 dose calculations surpass the residential dose level in the sludge layer in the northeast impoundment. Using industrial screening values, cobalt-60 surpasses 30 mrem/yr in the sludge of both lagoons, while the cumulative dose for cobalt-60 and cesium-134 is above 30 mrem/yr in the clay liner in the northwest impoundment.

Table 2.5-1
Residential and Industrial Risk/Dose Values in the Sludge and Clay Liner in the Northeast Impoundment

Sludge			Clay Liner		
Analyte	Residential Risk/Dose	Industrial Risk/Dose	Analyte	Residential Risk/Dose	Industrial Risk/Dose
Radionuclides (mrem/yr)					
Cobalt-60	8917	1222	Cesium-134	98.3	13.7
Europium-152	21.0	2.9	Cobalt-60	51.9	7.1
Sodium-22	16.0	2.2			
Carcinogens (cancer risk)					
Aroclor-1254	1.14E-04	2.69E-05	Aroclor-1254	4.55E-05	1.08E-05
Aroclor-1260	1.59E-05	3.76E-06			
Noncarcinogens (HQs)					
Aroclor-1254	22.7	1.9	Aroclor-1254	9.1	0.77

Note: *Risk* refers to nonradionuclide values; *dose* refers to radionuclide values.

Table 2.5-2
Residential and Industrial Risk/Dose Values in the Sludge and Clay Liner in the Northwest Impoundment

Sludge			Clay Liner		
Analyte	Residential Risk/Dose	Industrial Risk/Dose	Analyte	Residential Risk/Dose	Industrial Risk/Dose
Radionuclides (mrem/yr)					
Cobalt-60	39500	5413	Cobalt-60	353	48.3
Sodium-22	14.3	1.9	Cesium-134	44.8	6.2
Carcinogens (cancer risk)					
Aroclor-1254	4.09E-05	9.68E-06			
Aroclor-1260	1.77E-05	4.19E-06			
Noncarcinogens (HQs)					
Aroclor-1254	8.2	0.69	Aroclor-1254	0.56	0.05

Note: *Risk* refers to nonradionuclide values; *dose* refers to radionuclide values.

The total risk or dose is substantially less for an industrial exposure than for a residential exposure. However, there still exists an unacceptable risk and dose due to radionuclide and carcinogen concentrations in the sludge and clay liner in both lagoons, regardless of the future land use for this site. Therefore, removal of the sludge and the clay liner from both impoundments will be conducted to reduce the potential risk and dose to human health from radionuclides and other contaminants within the impoundments. After confirmation samples have been collected, further risk and dose analyses will be performed to determine if further action is needed for the material below the clay liner.

3.0 BASIS FOR CLEANUP LEVELS

There are no cleanup levels proposed for this IA. The objective of the IA is to remove all of the sludge and the clay liner, thereby reducing the potential risk and dose to receptors at the site. The sludge and clay liner are very distinct layers within the confines of the impoundment, and therefore the precise removal of each of the layers can be achieved. Radiological screening tools and visual inspection will be used to guide the complete removal of these two layers. It is assumed that the potential risk and dose from the impoundments will be substantially reduced once the layers are completely removed.

4.0 PROPOSED CORRECTIVE ACTION/MEASURE

4.1 Conceptual Model

The conceptual model embodies all current understanding and best scientific expectations/judgment for describing contaminant distribution, migration, fate, and exposure as affected by site physical properties and environmental conditions. It comprises the assumptions used to guide the IA activities and cleanup design. The conceptual model provides an understanding of the distribution of the contaminants, the potential contaminant pathways and transport mechanisms, and the potential contaminant exposure pathways to receptors. This IA will address only the potential vertical migration of contaminants within the impoundments. The extent of contamination surrounding the impoundments, including the drainage, will be addressed in a future report.

4.1.1 Potential Contaminant Transport Pathways

One release mechanism at the surface impoundments is hypothesized to be the leaching of contaminants from the sludge through the impoundment liners to the surrounding tuff. The sludge in the surface impoundments is believed to be the major contaminant source based on both the physical properties of the sludge and the sampling in the northern surface impoundments.

Transport of radionuclides will occur in a manner identical to their nonradioactive analogs. In addition, radioactive decay will decrease the concentrations of radionuclides according to their respective half-lives. Tritium will move as water, either in the liquid or vapor phase. Tritium is the only COPC that is known to have migrated into the tuff below the sludge and liner. To understand the vertical extent of tritium below the impoundments, further characterization will be conducted after the IA is completed, and it is not part of the scope of this proposed action. In general, the maximum concentrations of radionuclides were detected in the sludge, and these subsequently decreased in the clay liner. Similarly, concentrations in the tuff, if detected, were less than concentrations in the clay liner, indicating that the clay liner was impeding the migration of contaminants into the underlying tuff, as intended. Therefore, the data confirm the model of radionuclide transport that there would be little, if any, vertical migration of radionuclides.

Potential mechanisms of migration for PCBs (i.e., Aroclor-1254 and Aroclor-1260) include adsorption to organic matter, silts, and clays, and mobilization by water within the surface impoundments. The greatest limiting factor in the transport of PCBs from the surface impoundments to the environment is the solubility of PCBs in water. Limited migration of the PCBs is expected in the subsurface because of a marked decrease in permeability of the native tuff, which is directly beneath the surface impoundments, as compared to the soils. Thus, the PCBs tend to remain in the soil/sand and not be available for further transport. PCBs adsorb relatively quickly onto plastic, silts, and organic material. Thus, the organic matter with adsorbed PCBs would be resistant to migration. The highest concentrations of PCBs were detected in the sludge, with lower concentrations in the clay liner and subsequent lower concentrations in the underlying tuff. This indicates that the clay liner was impeding the migration of contaminants into the underlying tuff, as designed. Therefore, the data confirm the model of PCB transport that there would be little, if any, vertical migration of PCBs.

The limiting factor for the transport of metals from the surface impoundments to the environment is the solubility of metals in water. The solubility of metal ions is greatly increased by the presence of chelating agents. The chelating molecule forms a ring in which the metal ion is held so that it is not free to form insoluble salts. The equilibrium between the inorganic salts and the chelated metal ions is not known. Thus, chelated metal ions (in solution) could migrate with the water from the surface impoundments to adjacent soil through the liner. Both metal and radionuclide mobilities vary with the individual contaminant but, in general, the clay liner has a very high ion-exchange capacity and greatly retards the movement of these species. In general, the maximum concentrations of inorganics were detected in the sludge, and these subsequently decreased in the clay liner. Similarly, concentrations in the tuff, if detected, were less than concentrations in the clay liner, indicating that the clay liner was impeding the migration of contaminants into the underlying tuff, as intended. Therefore, the data confirm the model of metal transport that there would be little, if any, vertical migration of metals.

Because groundwater is approximately 1000 ft below the PRS, most contaminants will not migrate to groundwater due to unsaturated conditions and the lack of hydrostatic pressure. Tritium was detected at a concentration of 100 pCi/L at 100-ft depth during the 1988 sampling campaign; this concentration is approximately 100–1000 times greater than the level in a borehole located approximately 450 ft upgradient from the impoundments (LANL 1998, 58841). Measurements of other contaminants (metals, VOCs, SVOCs) indicate that tritium is the only contaminant present in the vadose zone below the surface impoundments.

4.1.2 Distribution of Contaminants

Based on the findings of the screening assessment, radionuclides and carcinogens are the major COPCs at this PRS. At the northwest impoundment, cobalt-60 is the primary risk driver in the sludge, with levels of concern for sodium-22, Aroclor-1254, and Aroclor-1260. Cesium-134 and cobalt-60 are the primary risk drivers in the clay liner. Cobalt-60 is the main COPC in the sludge at the northeastern impoundment, with levels of concern for europium-52, sodium-22, Aroclor-1254, and Aroclor-1260. Cobalt-60 and cesium-134 are the risk drivers in the clay liner at the northeastern impoundment, with levels of concern for Aroclor-1254. The concentrations of these COPCs result in a potential unacceptable risk or dose to human health.

The bubble plot in Figure 4.1-1 displays the distribution of contaminant concentrations for cobalt-60. The smallest bubbles display data points that fall below screening levels. The medium-sized bubbles represent all data points between the screening level and one order of magnitude greater than the screening level. The largest bubbles represent the data points between that level and the highest concentration in any of the represented media. Using these groupings, the distribution of cobalt-60 appears fairly consistent throughout the impoundments. Data points for tuff are displayed on top; under those are the data for the clay liner; the dried sludge data points are displayed below that. Therefore, some data points may be hidden by overlying bubbles. However, with very few exceptions, if a data point exists for tuff, there exists an equal or greater concentration in the clay liner and sludge. Correspondingly, if a data point exists for the clay liner, there exists an equal or greater concentration in the sludge.

Although variance in vertical distribution exists for each chemical, a similar trend in decreasing concentrations from the sludge to the tuff was observed for all radionuclides and organic chemicals.

The data confirm the conceptual model that contaminants did not migrate vertically into the underlying tuff to any considerable depth (tritium is an exception to this observation).Tuff data were presented here as part of the conceptual model to visually display the vertical trend in decreasing concentrations in the media. The analytical data for tuff will be presented and assessed for risk/dose in a future RFI report.

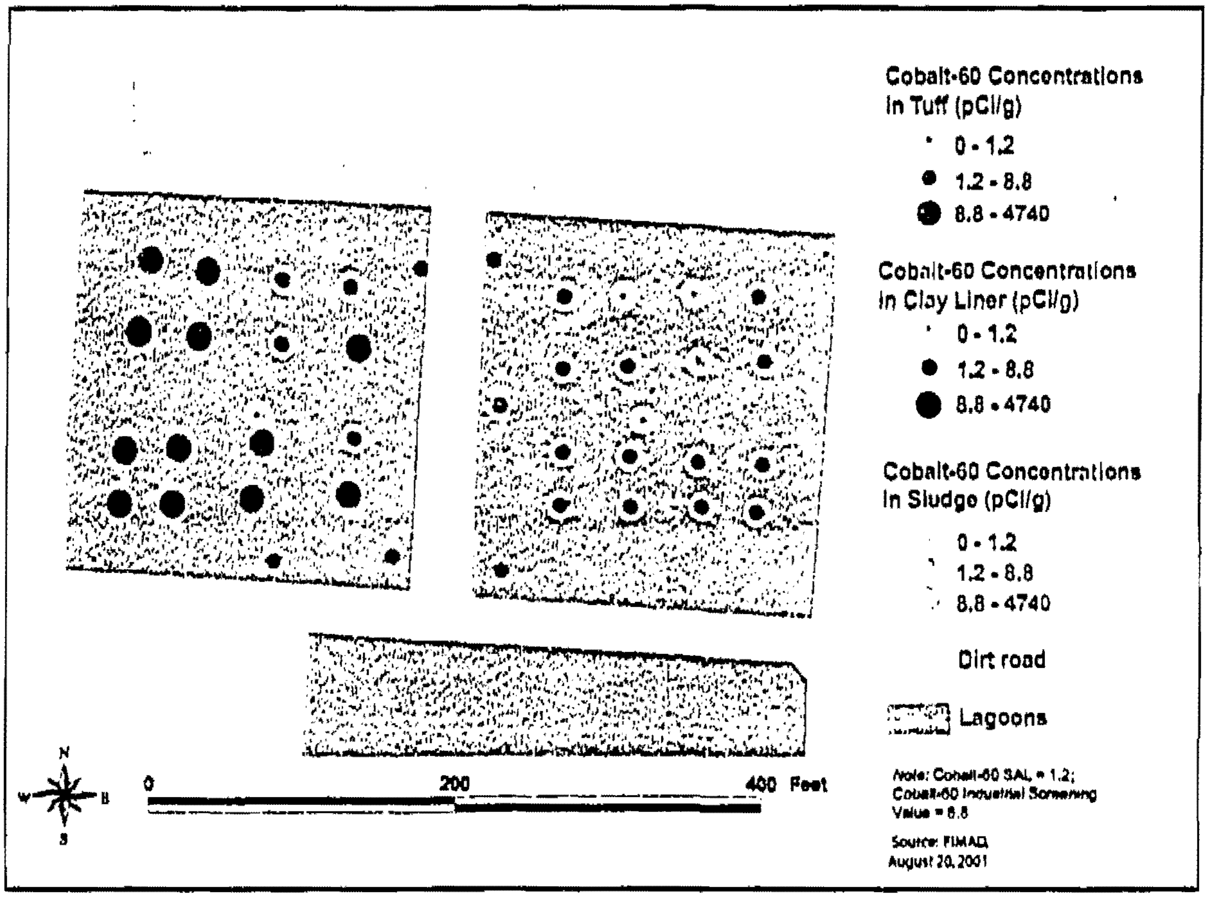

Figure 4.1-1. Cobalt-60 concentrations in the northern surface impoundments

4.2 Supplemental Sampling

Supplemental sampling is neither needed nor required for this IA.

4.3 Cleanup Activities

The objective of the IA is to remove all of the sludge and the clay liner, thereby reducing the potential risk and dose to receptors at the site. The sludge and clay liner are very distinct layers within the confines of the impoundments and therefore the precise removal of each layer can be achieved. Radiological screening tools and visual inspection will be used to guide the complete removal of these two layers. It is expected that the potential risk and dose from the impoundments will be substantially reduced once the layers are completely removed.

A field implementation plan (or equivalent planning document) describing the field activities necessary for removing the sludge and clay liner within the lagoons will be prepared prior to mobilizing in the field. The plan will detail the equipment to be used and describe the specifics of the field operations.

4.4 Site Restoration

Depending upon the post-excavation conditions, the best restoration approach will be devised. The site-restoration design will be addressed following excavation when the physical aspects of the site are known.

The LANL ER stormwater pollution prevention plan (SWPPP) will be updated at the start of IA activities (by submitting site-specific information on the LANL SWPPP update form). LANL will consult with ESH-18 and facility management regarding the SWPPP.

5.0 CONFIRMATORY SAMPLING

Confirmatory sampling will be conducted following the removal activities. Sampling will be performed to verify that

- all of the sludge and all of the clay liner have been removed, and that any residual material (if any) does not contain concentrations of COPCs that pose an unacceptable risk or dose to human health, and
- the extent of radiological contamination associated with the PRS has been vertically bounded (with the exception of tritium).

The proposed sampling strategy is based on data which demonstrate that contaminant distribution is homogeneous in the sludge and liner (see Figure 4.1-1) and therefore any residual contamination (after the sludge and the liner are removed) would also be evenly distributed. The sludge will be removed prior to removing the clay liner (and will be segregated during removal activities). This will prevent the sludge, which contains higher levels of contamination, from cross-contaminating the tuff below the liner. The confirmation sampling will be used to verify the assumption that tuff will not be cross-contaminated during the cleanup activities.

The radionuclides present in the sludge and liner that are the risk drivers at the site include cesium-134, cobalt-60, europium-152, sodium-22, strontium-90, and tritium. The sampling strategy is based on the fact that radionuclides are the major risk drivers for the site and represent the highest levels of contamination. Samples will be collected and analyzed, by gamma spectroscopy, to verify the contaminants that are present at highest concentrations. Strontium-90, which is one of the contaminants driving risk, is present at much lower concentrations, and it is collocated with gamma-emitting radionuclides. It is for this reason that only gamma spectroscopy is proposed for confirmatory sample analysis. Tritium is the only COPC that is known to have migrated into the tuff below the sludge and liner. To understand the vertical extent of tritium below the impoundments, further characterization will be conducted after the IA is completed (this further characterization is not within the scope of this proposed action). Therefore, it will not be sampled as part of the confirmatory sampling.

To ensure that the removal of the sludge and the liner is complete, and to verify that cross-contamination did not occur, LANL proposes collecting at least 10 verification samples in tuff (5 in each impoundment) to be submitted for off-site laboratory analyses. Field-screening will be used to select additional sample locations, or additional samples may be collected at deeper depths if it is deemed appropriate based on field conditions. Table 5.0-1 summarizes the proposed confirmation sampling. Samples will be collected, at the surface, near each corner of each lagoon and in the center. Figure 5.0-1 shows the proposed location of the verification samples.

Table 5.0-1
Proposed Confirmation Sample Locations and Analyses

Sample ID	Location	Analyses
RE53-02-0001	NW impoundment NW corner	Gamma spectroscopy*
RE53-02-0002	NW impoundment NE corner	Gamma spectroscopy
RE53-02-0003	NW impoundment SW corner	Gamma spectroscopy
RE53-02-0004	NW impoundment SE corner	Gamma spectroscopy
RE53-02-0005	NW impoundment center	Gamma spectroscopy
RE53-02-0006	NE impoundment NW corner	Gamma spectroscopy
RE53-02-0007	NE impoundment NE corner	Gamma spectroscopy
RE53-02-0008	NE impoundment SW corner	Gamma spectroscopy
RE53-02-0009	NE impoundment SE corner	Gamma spectroscopy
RE53-02-0010	NE impoundment center	Gamma spectroscopy
RE53-02-0011	Based on field-screening and observation	Gamma spectroscopy
RE53-02-0012	Based on field-screening and observation	Gamma spectroscopy

* Gamma spectroscopy suite includes Cs-134, Co-60, Eu-152, Na-22, Np-237.

Samples will be collected from depths of 0–0.5 ft using ER-SOP-6.28, Rev. 0, "Chip Sampling of Porous Surfaces," or ER-SOP-6.09, Rev. 0, "Spade and Scoop Method for Collection of Soil Samples," and/or ER-SOP-6.10, Rev. 1, "Hand Auger and Thin-Wall Tube Sampler." Tuff samples will be collected using a manually operated drill, or by chiseling pieces of tuff. The sample will be described and logged into the sample collection log forms (ER-SOP-01.04, "Sample Control and Field Documentation," Rev. 3). The samples will be screened for radionuclides to ensure that they can be transported without special packaging. The sample locations will be surveyed.

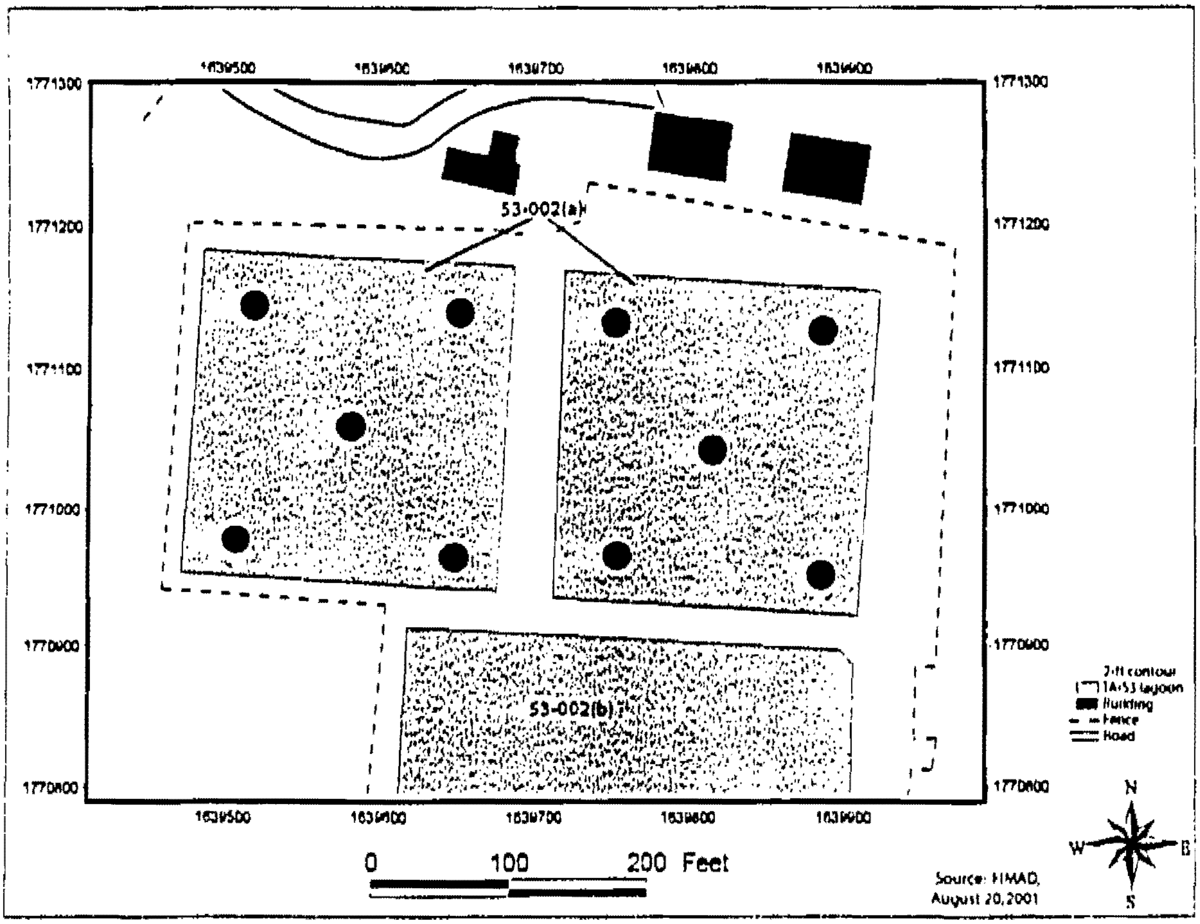

Figure 5.0-1. Proposed locations for confirmatory samples at PRS 52-002(a)

6.0 WASTE MANAGEMENT

6.1 Estimated Types and Volumes of Waste

It is estimated that 2230 yd^3 of low-level radiological waste (LLW) will need to be disposed of. The waste will not exceed Department of Transportation shipping requirements for the limits of transportation on roads to TA-54.

6.2 Method of Management and Disposal

Cleanup activities at PRS 53-002(a)-99 will involve removing the dried sludge and clay liner from both the northeastern and northwestern impoundments. Based on the characterization of waste from the previous sampling campaigns, the waste has been determined to be low-level radiological waste. As such, the waste will be transferred to TA-54 for storage and disposal. The waste has been characterized by a waste coordinator as LLW and confirmed to not be classified as PCB remediation waste or hazardous waste.

7.0 PROPOSED SCHEDULE AND UNCERTAINTIES

The estimated scheduled required for completing the IA at PRS 53-002(a)-99 is presented below:

Task Name	Task Duration (Days)	Total Elapsed Time from Project Start
Readiness review	30	30
Mobilization	10	40
Excavation	60	100
Waste management	70	110
Post-excavation sampling	10	120
Site restoration	5	125
Demobilization	10	135
Sample analysis	50	185
Data assessment and analysis	30	215
Interim action report	60	275

The greatest uncertainty associated with this schedule is funding availability: it will determine if all the activities will take place in parallel or if there will be pauses between activities due to budget constraints. No time schedule has been given because the starting date for the project is unknown at this time.

8.0 REFERENCES

The following list includes all references cited in this document. The parenthetical information that follows each reference provides the author, publication date, and the ER Record Identification (ER ID) Number. This information also is included in the citations in the text and can be used to locate copies of the actual documents at the ER Project's Records Processing Facility or in the reference library.

Copies of the reference library are maintained at the New Mexico Environment Department Hazardous and Radioactive Materials Bureau; the Department of Energy-Los Alamos Area Office; United States Environmental Protection Agency, Region 6; and the ER Project. This library is a living document that was developed to ensure that the administrative authority (AA) has all the necessary material to review the decisions and actions proposed in this document. However, documents previously submitted to the AA are not included in the reference library.

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Appendix A

Detected Chemical Data for the Sludge and Clay Liner

Table A-1
Detected Inorganic Chemical Data in Sludge(mg/kg)

Sample ID	Location ID	Depth(ft)	Medium	Antimony	Cadmium	Calcium	Chromium, total	Copper	Lead	Magnesium	Mercury	Nickel	Selenium	Silver	Sodium	Thallium	Zinc
Soil Background Value	[redacted]			0.83	0.4	6120	19.3	14.7	22.3	4610	0.1	15.4	1.52	1	915	0.73	48.8
0253-95-0101	53-01001	0.00-0.33	Sludge	—	3.29	—	31.5	412	44.5	—	1.56	—	1.53	11.9	—	—	625
0253-95-0104	53-01002	0.00-0.33	Sludge	—	3.29	—	25.3	444	48.2	—	2.09	—	1.59	14	—	—	700
0253-95-0107	53-01003	0.00-0.33	Sludge	—	1.73	8760	—	205(J)	22.9	—	1.37	—	1.62	5.12(J)	—	—	381
0253-95-0111	53-01004	0.00-0.33	Sludge	—	1.76	6910	—	199	23.2	—	1.15	—	—	7.33	—	—	332
0253-95-0114	53-01005	0.00-0.33	Sludge	—	1.28	—	—	182	25.4	—	1.6	—	—	5.08	—	—	266
0253-95-0117	53-01006	0.00-0.33	Sludge	—	2.67	—	31.7	524	64.4	—	2.88	17.1	—	14.6	—	—	362
0253-95-0120	53-01007	0.00-0.33	Sludge	—	0.85	—	—	133	22.5	—	2.61	—	—	2.9	—	—	208
0253-95-0123	53-01008	0.00-0.33	Sludge	—	0.895	—	—	114	—	—	0.847	—	—	8.56	—	—	193
0253-95-0127	53-01009	0.00-0.33	Sludge	—	2.02	—	—	488	77	—	1.62	—	—	7.08	—	—	156
0253-95-0130	53-01010	0.00-0.33	Sludge	—	2.64	—	22.7	419	40.2	—	1.45	—	—	11.4	—	—	823
0253-95-0133	53-01011	0.00-0.33	Sludge	—	2.17	—	29	396	43.5	—	1.12	—	—	7.3	—	—	604
0253-95-0136	53-01012	0.00-0.33	Sludge	—	2.48	9270	23.1	315	34.1	—	1.56	—	1.85	6.56	—	—	608
0253-95-0140	53-01013	0.00-0.33	Sludge	—	1.12	—	—	139	—	—	0.878	—	—	3.27	—	—	291
0253-95-0143	53-01014	0.00-0.33	Sludge	—	3.11	—	28.2	569	56.7	—	0.889	—	—	19.7	—	—	806
0253-95-0146	53-01015	0.00-0.33	Sludge	—	3.22	—	24.7	489	51.9	—	1.23	—	1.56	17.1	—	—	838
0253-95-0149	53-01016	0.00-0.33	Sludge	—	1.47	—	—	196	22.4	—	1.08	—	—	4.11	—	—	318
0253-95-0152	53-01017	0.00-0.33	Sludge	—	0.851	—	—	106	—	—	0.264	—	—	2.77	—	—	176
0253-95-0175	53-01018	0.00-0.08	Sludge	—	—	—	—	39.4(J)	—	—	0.25	—	—	—	1250	—	111(J)
0253-95-0178	53-01019	0.00-0.08	Sludge	—	0.691	17000	—	89.5	—	—	0.233	—	1.98	2.15	2630	—	160
0253-95-0182	53-01020	0.00-0.17	Sludge	—	0.602	10400	—	99.8	—	—	0.368	—	—	2.01	1690	—	203
0253-95-0185	53-01021	0.00-0.33	Sludge	—	0.678	9970	—	117	—	—	0.413	—	—	2.23	1010	—	225
0253-95-0188	53-01022	0.00-0.08	Sludge	—	0.543	11500	—	77.5	—	—	0.257	—	1.6	1.41	1490	—	130

Sample ID	Location ID	Depth(ft)	Medium	Antimony	Cadmium	Calcium	Chromium, total	Copper	Lead	Magnesium	Mercury	Nickel	Selenium	Silver	Sodium	Thallium	Zinc
Soil Background Value				0.83	0.4	6120	19.3	14.7	22.3	4610	0.1	15.4	1.52	1	915	0.73	48.8
0253-95-0191	53-01023	0.00-0.08	Sludge	—	0.462(J)	11800	—	63.1	—	—	0.292	—	—	1.33	2880	—	113
0253-95-0194	53-01024	0.00-0.08	Sludge	—	0.598	17700	—	87.5	—	4850	0.27	—	—	1.98	3030	—	150
0253-95-0197	53-01025	0.00-0.25	Sludge	—	0.44(J)	—	—	77.9(J)	—	—	0.271	—	—	1.38	—	0.915 (J)	156(J)
0253-95-0206	53-01026	0.00-0.50	Sludge	3.02	1.67	—	—	1070	135	—	2.03	—	—	6.26	—	—	207
0253-95-0209	53-01027	0.00-0.08	Sludge	—	1.13	10200	—	189	28.3	—	0.376	—	2.09	5.25	1400	—	325
0253-95-0212	53-01028	0.00-0.08	Sludge	—	0.782	19900	—	99.9	—	—	0.494	—	2.05	2.17	2430	—	166
0253-95-0215	53-01029	0.00-0.08	Sludge	—	0.707	19000	—	102	—	5340	0.306	—	1.72	2.21	3530	—	160
0253-95-0218	53-01030	0.00-0.17	Sludge	—	—	—	—	50.5	—	—	0.24	—	—	—	—	—	93.1
0253-95-0221	53-01031	0.00-0.17	Sludge	—	0.493(J)	—	—	90.3	—	—	0.386	—	—	1.78	—	—	178
0253-95-0224	53-01032	0.00-0.08	Sludge	—	0.628	18200	—	84.6	—	—	0.249	—	1.66	1.85	1870	—	142
0253-95-0228	53-01033	0.00-0.08	Sludge	—	—	7240	—	41.6	—	—	0.25	—	—	—	1810	—	69.4
0253-95-0231	53-01034	0.00-0.17	Sludge	—	0.879	19700	—	135	—	6160	0.392	—	2.15	2.97	2940	—	214
RE53-99-0057	53-01575	0.00-0.33	Sludge	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE53-99-0060	53-01576	0.00-0.33	Sludge	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE53-99-0105	53-01591	0.00-0.33	Sludge	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE53-99-0102	53-01592	0.00-0.33	Sludge	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-2
Detected Inorganic Chemical Data in Clay Liner (mg/kg)

Sample ID	Location ID	Depth(ft)	Medium	Cadmium	Copper	Lead	Mercury	Thallium	Zinc
Soil Background Value				0.4	14.7	22.3	0.1	0.73	48.8
0253-95-0102	53-01001	0.33-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0105	53-01002	0.33-1.00	Clay Liner	—	—	—	—	—	—
0253-95-0108	53-01003	0.33-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0112	53-01004	0.33-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0115	53-01005	0.33-0.75	Clay Liner	—	—	—	—	—	—
0253-95-0121	53-01007	0.33-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0125	53-01008	0.33-0.83	Clay Liner	—	16.5	—	—	—	—
0253-95-0131	53-01010	0.33-0.83	Clay Liner	—	15.9	—	—	—	57
0253-95-0134	53-01011	0.33-0.83	Clay Liner	—	17.1	—	—	—	104
0253-95-0137	53-01012	0.33-0.83	Clay Liner	—	40.3	—	—	—	131
0253-95-0141	53-01013	0.33-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0144	53-01014	0.33-0.83	Clay Liner	—	15.7	—	—	—	78.7
0253-95-0147	53-01015	0.33-0.83	Clay Liner	—	23.1	—	—	—	54.2
0253-95-0150	53-01016	0.33-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0153	53-01017	0.33-0.83	Clay Liner	—	18	—	—	—	—
0253-95-0176	53-01018	0.04-0.33	Clay Liner	—	—	—	—	—	—
0253-95-0180	53-01019	0.04-0.33	Clay Liner	—	—	—	—	—	—
0253-95-0183	53-01020	0.08-0.83	Clay Liner	—	—	—	—	—	—
0253-95-0186	53-01021	0.08-0.42	Clay Liner	—	—	—	—	—	—
0253-95-0189	53-01022	0.04-0.50	Clay Liner	0.452(J)	44.8(J)	—	—	2.14(J)	78.8
0253-95-0192	53-01023	0.04-0.50	Clay Liner	—	—	—	—	0.923(J)	—
0253-95-0195	53-01024	0.04-0.33	Clay Liner	—	—	—	—	0.738(J)	—
0253-95-0198	53-01025	0.33-0.83	Clay Liner	—	—	—	—	1.5(J)	—
0253-95-0207	53-01026	0.25-0.58	Clay Liner	—	28.2	—	—	2.09(J)	49.8

Sample ID	Location ID	Depth(ft)	Medium	Cadmium	Copper	Lead	Mercury	Thallium	Zinc
Soil Background Value				0.4	14.7	22.3	0.1	0.73	48.8
0253-95-0216	53-01029	0.04-0.38	Clay Liner	—	19	—	—	—	—
0253-95-0219	53-01030	0.08-0.33	Clay Liner	—	18.8	—	—	—	54.3
0253-95-0222	53-01031	0.17-0.50	Clay Liner	—	35.5	—	—	—	70.9
0253-95-0225	53-01032	0.04-0.75	Clay Liner	—	—	—	—	—	—
0253-95-0229	53-01033	0.08-0.33	Clay Liner	—	28.1	—	—	—	50.3
0253-95-0232	53-01034	0.17-0.33	Clay Liner	—	29.5	—	—	—	52.9
0253-95-0128	53-01324	0.33-0.83	Clay Liner	0.774	68.7	33.9	0.111	—	55.5

Table A-3
Detected Radionuclide Data in Sludge(pCi/g)

Sample ID	Location ID	Depth(ft)	Medium	Cobalt-60	Europium-152	Plutonium-238	Plutonium-239	Sodium-22	Strontium-90	Tritium
Soil Background Value				—	—	0.023	0.054	—	1.31	0.766
AAB9956	53-01001	0.00-0.50	Sludge	1400	—	0.03	0.06	1.1	—	26.13
AAB9957	53-01002	0.00-0.50	Sludge	2160	—	—	—	—	—	36.03
AAB9958	53-01003	0.00-0.50	Sludge	232	—	—	—	—	—	11.74
AAB9959	53-01004	0.00-0.50	Sludge	57.2	—	—	—	—	—	4.59
AAB9960	53-01005	0.00-0.50	Sludge	2260	—	—	—	2.14	2.15	66.21(J)
AAB9961	53-01006	0.00-0.50	Sludge	1200	—	—	—	—	—	17.6(J)
AAB9962	53-01007	0.00-0.50	Sludge	110	—	—	—	—	—	8.96(J)
AAB9963	53-01008	0.00-0.50	Sludge	141	—	—	—	—	—	5.27(J)
AAB9964	53-01009	0.00-0.50	Sludge	461	—	—	—	0.712	—	6.32(J)
AAB9967	53-01010	0.00-0.50	Sludge	4740	—	—	—	—	—	64.93
AAB9968	53-01011	0.00-0.50	Sludge	1124.17	—	—	—	—	—	38.51
AAB9969	53-01012	0.00-0.50	Sludge	597	—	—	—	—	—	2.71
AAB9970	53-01013	0.00-0.50	Sludge	35.8	0.455	—	—	—	—	2.38
AAB9971	53-01014	0.00-0.50	Sludge	1020	—	—	—	—	—	34.74
AAB9972	53-01015	0.00-0.50	Sludge	4230	—	—	—	—	—	36.1
AAB9973	53-01016	0.00-0.50	Sludge	75.2	—	—	—	—	—	2.39
AAB9974	53-01017	0.00-0.50	Sludge	102	—	—	—	—	—	2.97
AAB9977	53-01018	0.00-0.50	Sludge	268	—	—	—	—	—	168.14
AAB9978	53-01019	0.00-0.50	Sludge	62	—	—	—	—	—	39.8
AAB9979	53-01020	0.00-0.50	Sludge	707	—	—	—	—	2.26	404.57
AAB9980	53-01021	0.00-0.50	Sludge	708	4.95	—	—	1.59	2.69	288.26
AAB9981	53-01022	0.00-0.50	Sludge	430	—	—	—	—	—	216.18
AAB9982	53-01023	0.00-0.50	Sludge	104	0.914	—	—	0.47	—	27.83
AAB9983	53-01024	0.00-0.50	Sludge	52.8	—	—	—	—	—	68.38

Sample ID	Location ID	Depth(ft)	Medium	Cobalt-60	Europium-152	Plutonium-238	Plutonium-239	Sodium-22	Strontium-90	Tritium
Soil Background Value	[redacted]			—	—	0.023	0.054	—	1.31	0.766
AAB9984	53-01025	0.00-0.50	Sludge	713	5.68	—	—	2.4	3.86	304.97(J)
AAB9985	53-01026	0.00-0.50	Sludge	54.1	0.807	—	—	—	—	17.45(J)
AAB9989	53-01027	0.00-0.50	Sludge	277	—	—	—	—	—	157(J)
AAB9990	53-01028	0.00-0.50	Sludge	188	1.66	—	—	—	—	78.23(J)
AAB9991	53-01029	0.00-0.50	Sludge	87.2	0.942	—	—	—	—	32.3(J)
AAB9992	53-01030	0.00-0.50	Sludge	129	1.69	—	—	—	—	47.55(J)
AAB9993	53-01031	0.00-0.50	Sludge	1070	—	—	—	—	1.81	286.35(J)
AAB9994	53-01032	0.00-0.50	Sludge	46	1.05	—	—	—	—	17.15(J)
AAB9995	53-01033	0.00-0.50	Sludge	79.4	1.29	—	—	—	—	33.81(J)
AAB9996	53-01034	0.00-0.50	Sludge	283	2.77	—	—	0.571	—	78.55(J)

Table A-4
Detected Radionuclide Data in Clay Liner(pCi/g)

Sample ID	Location ID	Depth(ft)	Media	Cesium-134	Cobalt-60	Strontium-90	Tritium
Soil Background Value	[redacted]			—	—	1.31	0.766
0253-95-0102	53-01001	0.33-0.83	Clay Liner	6.31	36.3	2.11	1.09
0253-95-0105	53-01002	0.33-1.00	Clay Liner	2.59	13.9	—	0.74
0253-95-0108	53-01003	0.33-0.83	Clay Liner	1.94	6.51	—	0.51
0253-95-0112	53-01004	0.33-0.83	Clay Liner	3.7	6.41	—	0.40
0253-95-0115	53-01005	0.33-0.75	Clay Liner	4.66	21.6	—	0.31
0253-95-0118	53-01006	0.33-0.67	Clay Liner	6.9	25.7	—	0.98
0253-95-0121	53-01007	0.33-0.83	Clay Liner	2.62	7.33	—	0.85
0253-95-0125	53-01008	0.33-0.83	Clay Liner	7.45	11	—	0.46
0253-95-0131	53-01010	0.33-0.83	Clay Liner	9.54	9.8	—	1.31
0253-95-0134	53-01011	0.33-0.83	Clay Liner	9.41	13.1	—	1.29
0253-95-0137	53-01012	0.33-0.83	Clay Liner	10.3	25.3	—	1.15
0253-95-0141	53-01013	0.33-0.83	Clay Liner	—	0.196	—	1.18
0253-95-0144	53-01014	0.33-0.83	Clay Liner	7.54	15.4	—	1.57
0253-95-0147	53-01015	0.33-0.83	Clay Liner	6.29	11.2	—	1.24
0253-95-0150	53-01016	0.33-0.83	Clay Liner	5.81	16.4	—	1.87
0253-95-0153	53-01017	0.33-0.83	Clay Liner	3.33	10.1	—	2.16
0253-95-0176	53-01018	0.04-0.33	Clay Liner	11.3	2.5	—	3.30
0253-95-0180	53-01019	0.04-0.33	Clay Liner	3.08	0.445	—	3.77
0253-95-0183	53-01020	0.08-0.83	Clay Liner	4.24	—	—	3.27
0253-95-0186	53-01021	0.08-0.42	Clay Liner	4.1	1.92	—	2.26
0253-95-0189	53-01022	0.04-0.50	Clay Liner	17.6	6.06	—	1.74
0253-95-0192	53-01023	0.04-0.50	Clay Liner	9.74	2.33	—	3.34
0253-95-0195	53-01024	0.04-0.33	Clay Liner	4.4	0.775	1.86	3.19
0253-95-0198	53-01025	0.33-0.83	Clay Liner	7.76	1.4	1.15	2.12
0253-95-0207	53-01026	0.25-0.58	Clay Liner	5.11	0.699	—	3.82

Sample ID	Location ID	Depth(ft)	Media	Cesium-134	Cobalt-60	Strontium-90	Tritium
Soil Background Value				—	—	1.31	0.765
0253-95-0210	53-01027	0.33-0.83	Clay Liner	5.93	1.56	—	1.36
0253-95-0213	53-01028	0.04-0.33	Clay Liner	17.7	4.97	—	2.65
0253-95-0216	53-01029	0.04-0.38	Clay Liner	22.6	6.23	—	2.92
0253-95-0219	53-01030	0.08-0.33	Clay Liner	22.6	2.42	—	4.61
0253-95-0222	53-01031	0.17-0.50	Clay Liner	13	2.47	—	2.37
0253-95-0225	53-01032	0.04-0.75	Clay Liner	9.68	1.79	—	3.59
0253-95-0229	53-01033	0.08-0.33	Clay Liner	9.47	1.67	—	4.77
0253-95-0232	53-01034	0.17-0.33	Clay Liner	8.85	1.25	—	4.23
0253-95-0128	53-01324	0.33-0.83	Clay Liner	2.89	42.3	—	0.90

Table A-5
Detected Organic Chemicals in Sludge (mg/kg)

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[alpha-]	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	Butanone[2-]	DDE[4,4'-]	DDT[4,4'-]	Endosulfan I	Endrin	Methylene Chloride	Toluene	Trichloroethene
0253-95-0101	53-01001	0.00-0.33	Sludge	0.417	2.74(J)	-	-	-	59.3	-	0.601(J)	-	-	0.6 (J)	-	0.0124	-
0253-95-0104	53-01002	0.00-0.33	Sludge	1.43	2.32(J)	1.56(J)	-	-	40.6	-	-	-	0.166(J)	-	-	-	-
0253-95-0107	53-01003	0.00-0.33	Sludge	1.58	-	-	-	-	-	0.0759	0.0836(J)	-	-	-	-	-	-
0253-95-0111	53-01004	0.00-0.33	Sludge	1.33	0.835(J)	0.63(J)	-	-	17.3(J)	0.0481(J)	-	-	-	-	-	-	-
0253-95-0114	53-01005	0.00-0.33	Sludge	0.597	1.86(J)	1.21(J)	-	-	40(J)	-	-	-	-	-	-	-	-
0253-95-0117	53-01006	0.00-0.33	Sludge	0.438	3.82(J)	2.66(J)	0.116(J)	-	94.9	-	-	-	0.232(J)	-	-	-	-
0253-95-0120	53-01007	0.00-0.33	Sludge	1.85	1.23(J)	0.758(J)	0.0514(J)	-	17.2(J)	0.0302(J)	-	-	0.0833(J)	-	-	-	-
0253-95-0123	53-01008	0.00-0.33	Sludge	0.983	0.938(J)	0.588(J)	-	-	17.1(J)	0.0302(J)	-	-	-	-	-	-	-
0253-95-0127	53-01009	0.00-0.33	Sludge	0.0644(J)	-	-	-	-	1.95(J)	-	-	-	-	-	-	-	-
0253-95-0130	53-01010	0.00-0.33	Sludge	0.583	2.26(J)	-	-	-	40.4(J)	-	0.0871(J)	0.251(J)	-	-	-	-	-
0253-95-0133	53-01011	0.00-0.33	Sludge	-	2.44(J)	-	-	-	49.3(J)	-	0.0891(J)	0.254(J)	-	-	-	-	-
0253-95-0136	53-01012	0.00-0.33	Sludge	-	0.884(J)	-	-	-	35(J)	-	0.296(J)	-	-	-	-	-	-
0253-95-0140	53-01013	0.00-0.33	Sludge	0.0892(J)	0.99(J)	-	-	-	25(J)	0.0332(J)	-	-	-	-	-	-	-
0253-95-0143	53-01014	0.00-0.33	Sludge	-	2.16(J)	-	-	-	33.9(J)	-	0.607(J)	-	-	0.608 (J)	-	-	-
0253-95-0146	53-01015	0.00-0.33	Sludge	-	2.34(J)	-	-	-	32(J)	-	-	-	-	0.601 (J)	-	-	-
0253-95-0149	53-01016	0.00-0.33	Sludge	0.0778(J)	0.598(J)	-	-	-	-	-	-	-	-	-	0.0251(J)	-	-
0253-95-0152	53-01017	0.00-0.33	Sludge	-	0.451(J)	-	-	-	-	-	0.29(J)	-	-	-	-	-	-
0253-95-0175	53-01018	0.00-0.08	Sludge	0.105(J)	1.06(J)	-	-	-	-	0.0296(J)	-	-	-	-	0.0405(J)	-	-
0253-95-0178	53-01019	0.00-0.08	Sludge	0.202	0.522(J)	-	-	-	-	0.0927	-	-	-	-	0.0344(J)	-	-
0253-95-0182	53-01020	0.00-0.17	Sludge	0.131	3.89(J)	-	-	-	-	0.0304(J)	-	-	0.195(J)	-	0.0362(J)	-	-

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[alpha-]	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	Butanone[2-]	DDE[4,4'-]	DDT[4,4'-]	Endosulfan I	Endrin	Methylene Chloride	Toluene	Trichloroethene
0253-95-0185	53-01021	0.00-0.33	Sludge	0.102	2.87(J)	-	0.0533(J)	-	-	0.0252(J)	-	-	0.143(J)	-	0.0367(J)	-	-
0253-95-0188	53-01022	0.00-0.08	Sludge	0.233	0.679(J)	-	0.0619(J)	-	-	0.0618	-	-	-	-	0.0344(J)	-	-
0253-95-0191	53-01023	0.00-0.08	Sludge	0.183	0.282(J)	-	-	-	-	0.0582	-	-	-	-	0.0253(J)	-	-
0253-95-0194	53-01024	0.00-0.08	Sludge	0.154	0.496(J)	-	-	-	-	0.0341(J)	-	-	-	-	-	-	-
0253-95-0197	53-01025	0.00-0.25	Sludge	0.108	1.82(J)	-	-	-	-	0.0212(J)	-	-	-	-	-	-	-
0253-95-0206	53-01026	0.00-0.50	Sludge	-	1.26(J)	-	0.0531(J)	-	-	-	-	-	-	-	-	-	-
0253-95-0209	53-01027	0.00-0.08	Sludge	0.0863(J)	-	-	-	-	-	-	-	-	0.152(J)	-	0.0251(J)	-	-
0253-95-0212	53-01028	0.00-0.08	Sludge	-	0.375(J)	-	-	-	-	0.241	-	-	-	-	0.0632	0.0133 (J)	-
0253-95-0215	53-01029	0.00-0.08	Sludge	0.545(J)	0.422(J)	-	-	-	-	0.0564(J)	-	-	-	-	0.0398(J)	-	-
0253-95-0218	53-01030	0.00-0.17	Sludge	0.333	-	-	-	-	-	-	-	-	-	-	0.0589	-	-
0253-95-0221	53-01031	0.00-0.17	Sludge	0.804	3.43(J)	-	-	-	-	0.0229(J)	0.107(J)	0.389(J)	0.101(J)	-	0.0632	-	-
0253-95-0224	53-01032	0.00-0.06	Sludge	0.6	0.358(J)	-	-	-	-	0.132	-	-	-	-	0.049(J)	0.0126(J)	-
0253-95-0228	53-01033	0.00-0.08	Sludge	0.676	0.747(J)	-	-	-	-	0.0384(J)	-	-	-	-	0.0612	-	-
0253-95-0231	53-01034	0.00-0.17	Sludge	0.664	0.903(J)	-	-	-	-	0.115	-	-	-	-	0.0613	-	-
RE53-99-0022	53-01568	0.00-0.33	Sludge	-	5.2	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0025	53-01569	0.00-0.33	Sludge	-	5.6	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0028	53-01570	0.00-0.33	Sludge	-	0.058	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0063	53-01572	0.00-0.33	Sludge	-	9	3.9	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0037	53-01573	0.00-0.33	Sludge	-	0.04	0.037	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0042	53-01574	0.00-0.33	Sludge	-	0.038	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0057	53-01575	0.00-0.33	Sludge	-	1	0.36	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0060	53-01576	0.00-0.33	Sludge	-	9	3.9	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0045	53-01579	0.00-0.33	Sludge	-	8.3	2.5	-	-	-	-	-	-	-	-	-	-	-

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[alpha-]	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	Butanone[2-]	DDE[4,4'-]	DDT[4,4'-]	Endosulfan I	Endrin	Methylene Chloride	Toluene	Trichloroethene
RE53-99-0048	53-01580	0.00-0.33	Sludge	-	0.12	0.056	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0051	53-01581	0.00-0.33	Sludge	-	0.11	0.056	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0078	53-01582	0.00-0.33	Sludge	-	25	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0074	53-01583	0.00-0.33	Sludge	-	13	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0070	53-01584	0.00-0.33	Sludge	-	1.3	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0066	53-01585	0.00-0.33	Sludge	-	0.55	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0067	53-01585	0.00-0.33	Sludge	-	0.54	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0090	53-01586	0.00-0.33	Sludge	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0087	53-01587	0.00-0.33	Sludge	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0093	53-01588	0.00-0.33	Sludge	-	1.5	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0084	53-01589	0.00-0.33	Sludge	-	0.82	0.4	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0081	53-01590	0.00-0.33	Sludge	-	0.74	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0105	53-01591	0.00-0.33	Sludge	-	-	0.65	-	0.0098 (J+)	-	-	-	-	-	-	-	-	-
RE53-99-0102	53-01592	0.00-0.33	Sludge	-	0.35	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0159	53-01592	0.00-0.00	Sludge	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00029 (J)
RE53-99-0099	53-01593	0.00-0.33	Sludge	-	1.4	0.56	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0158	53-01593	0.00-0.00	Sludge	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00027 (J)
RE53-99-0096	53-01594	0.00-0.33	Sludge	-	8	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0187	53-01595	0.00-0.33	Sludge	-	0.053	0.037(J)	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0190	53-01596	0.00-0.33	Sludge	-	11	3.5	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0111	53-01597	0.00-0.33	Sludge	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[alpha-]	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	Butanone[2-]	DDE[4,4'-]	DDT[4,4'-]	Endosulfan I	Endrin	Methylene Chloride	Toluene	Trichloroethene
RE53-99-0108	53-01598	0.00-0.33	Sludge	-	2.6	-	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0054	53-01599	0.00-0.33	Sludge	-	0.86	0.71	-	-	-	-	-	-	-	-	-	-	-

Table A-6
Detected Organic Chemicals in the Clay Liner(mg/kg)

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	DDD[4,4'-]	DDT[4,4'-]	Dieldrin	Endosulfan I	Endrin	Heptachlor	Methylene Chloride	Toluene
0253-95-0102	53-01001	0.33-0.83	Clay Liner	0.00334(J)	-	-	-	-	-	-	-	-	-	-	0.00269(J)	-
0253-95-0108	53-01003	0.33-0.83	Clay Liner	0.0313	-	-	-	-	-	-	-	-	-	-	-	-
0253-95-0112	53-01004	0.33-0.83	Clay Liner	0.0483	-	-	-	-	-	-	-	-	-	-	-	-
0253-95-0115	53-01005	0.33-0.75	Clay Liner	-	0.202(J)	-	-	-	-	-	0.0196 (J)	0.0215 (J)	-	-	0.00553	-
0253-95-0118	53-01006	0.33-0.67	Clay Liner	0.0777	-	-	-	-	-	-	-	-	-	-	-	-
0253-95-0121	53-01007	0.33-0.83	Clay Liner	-	-	-	-	-	-	-	-	-	-	-	0.00286(J)	-
0253-95-0125	53-01008	0.33-0.83	Clay Liner	-	-	-	-	0.171(J)	-	-	-	-	-	-	-	-
0253-95-0131	53-01010	0.33-0.83	Clay Liner	0.0328	-	-	-	0.234(J)	-	-	0.0193 (J)	-	-	-	0.00288(J)	-
0253-95-0134	53-01011	0.33-0.83	Clay Liner	0.00686(J)	-	-	-	0.385	-	-	-	-	-	-	0.00422(J)	-
0253-95-0137	53-01012	0.33-0.83	Clay Liner	0.0539	-	-	-	0.246(J)	-	-	-	-	-	-	-	-
0253-95-0141	53-01013	0.33-0.83	Clay Liner	0.0165	-	-	0.000757 (J)	-	-	-	-	-	-	-	0.00418(J)	-
0253-95-0144	53-01014	0.33-0.83	Clay Liner	0.0279(J)	-	-	-	0.215(J)	-	-	-	-	-	-	0.00486(J)	-
0253-95-0147	53-01015	0.33-0.83	Clay Liner	0.079	-	-	-	0.223(J)	-	-	-	-	-	-	0.00391(J)	-
0253-95-0150	53-01016	0.33-0.83	Clay Liner	0.0254	-	-	-	-	-	-	-	-	-	-	-	0.00124 (J)
0253-95-0153	53-01017	0.33-0.83	Clay Liner	0.00354(J)	-	-	-	-	-	-	-	-	-	-	-	-
0253-95-0183	53-01020	0.08-0.83	Clay Liner	0.00984(J)	-	-	-	-	-	-	-	-	-	-	-	-
0253-95-0186	53-01021	0.08-0.42	Clay Liner	0.0298	-	-	-	-	-	-	-	-	-	-	-	-
0253-95-0189	53-01022	0.04-0.50	Clay Liner	-	0.0696(J)	-	-	-	-	-	0.0322 (J)	-	0.0329 (J)	-	-	-

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	DDD[4,4'-]	DDT[4,4'-]	Dieldrin	Endosulfan I	Endrin	Heptachlor	Methylene Chloride	Toluene
0253-95-0207	53-01026	0.25-0.58	Clay Liner	0.00622(J)	-	-	-	-	-	-	-	-	0.0512 (J)	-	-	-
0253-95-0213	53-01028	0.04-0.33	Clay Liner	-	-	0.0679	-	-	-	-	-	-	0.00567(J)	-	-	-
0253-95-0216	53-01029	0.04-0.38	Clay Liner	-	-	0.301(J)	-	-	-	-	-	-	0.0236 (J)	-	-	-
0253-95-0222	53-01031	0.17-0.50	Clay Liner	-	-	0.144(J)	-	-	-	-	-	-	0.0116 (J)	-	-	-
0253-95-0225	53-01032	0.04-0.75	Clay Liner	-	-	0.205(J)	-	-	0.0607 (J)	0.0675(J)	-	-	-	-	-	-
0253-95-0229	53-01033	0.08-0.33	Clay Liner	-	-	0.0844(J)	-	-	-	-	-	-	0.0109 (J)	-	-	-
0253-95-0232	53-01034	0.17-0.33	Clay Liner	-	-	0.143(J)	-	-	-	0.0203(J)	-	-	0.0118 (J)	-	-	-
0253-95-0128	53-01324	0.33-0.83	Clay Liner	-	0.618(J)	-	-	0.324(J)	-	-	0.027 (J)	0.0354(J)	0.0251 (J)	-	-	-
RE53-99-0029	53-01570	0.33-0.67	Clay Liner	-	-	-	-	-	-	-	-	-	-	0.0019	-	-
RE53-99-0046	53-01579	0.33-0.67	Clay Liner	-	0.046	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0079	53-01582	0.33-0.67	Clay Liner	-	0.086	0.092	-	-	-	-	-	-	-	-	-	-
RE53-99-0075	53-01583	0.33-0.67	Clay Liner	-	0.042	0.043	-	-	-	-	-	-	-	-	-	-
RE53-99-0078	53-01583	0.33-0.67	Clay Liner	-	0.077	0.048	-	-	-	-	-	-	-	-	-	-
RE53-99-0085	53-01589	0.33-0.67	Clay Liner	-	0.038	0.067	-	-	-	-	-	-	-	-	-	-
RE53-99-0082	53-01590	0.33-0.67	Clay Liner	-	0.073	0.071	-	-	-	-	-	-	-	-	-	-
RE53-99-0103	53-01592	0.33-0.67	Clay Liner	-	0.024	-	-	-	-	-	-	-	-	-	-	-
RE53-99-0100	53-01593	0.33-0.67	Clay Liner	-	0.11	0.11	-	-	-	-	-	-	-	-	-	-
RE53-99-0097	53-01594	0.33-0.67	Clay Liner	-	-	0.06	-	-	-	-	-	-	-	-	-	-
RE53-99-0188	53-01596	0.33-0.67	Clay Liner	-	10	-	-	-	-	-	-	-	-	-	-	-

Sample ID	Location ID	Depth(ft)	Media	Acetone	Aroclor-1254	Aroclor-1260	BHC[gamma-]	Bis(2-ethylhexyl)phthalate	DDD[4,4'-]	DDT[4,4'-]	Dieldrin	Endosulfan I	Endrin	Heptachlor	Methylene Chloride	Toluene
RE53-99-0191	53-01596	0.33-0.67	Clay Liner	-	0.053	0.075	-	-	-	-	-	-	-	-	-	-
RE53-99-0112	53-01597	0.33-0.67	Clay Liner	-	0.097	0.089	-	-	-	-	-	-	-	-	-	-
RE53-99-0055	53-01599	0.33-0.67	Clay Liner	-	0.07	-	-	-	-	-	-	-	-	-	-	-

Appendix B

Maximum Detected Concentrations for COPCs

Table B-1
Maximum Detected Values (mg/kg) for Carcinogens in the Northwest Impoundment

Analyte	Sludge	Clay Liner
Aroclor-1254	9.0	0.62
Aroclor-1260	3.9	NA*
BHC[alpha-]	0.12	NA
BHC[gamma-]	NA	0.00076
Bis(2-ethylhexyl) phthalate	94.9	0.39
Chromium, total	31.7	16.1
DDE[4,4'-]	0.61	NA
DDT[4,4'-]	0.25	NA
Dieldrin	NA	0.027
Heptachlor	NA	0.0019
Methylene chloride	0.025	0.0055

* NA = Not analyzed.

Table B-2
Maximum Detected Values (mg/kg) for Carcinogens in the Northeast Impoundment

Analyte	Sludge	Clay Liner
Aroclor-1254	25	10
Aroclor-1260	3.5	0.30
Benzene	0.00027	NA*
BHC[alpha-]	0.062	NA
BHC[gamma-]	0.0098	0.00065
Bis(2-ethylhexyl)phthalate	16.1	10
Chromium, total	16.1	10
DDD[4,4'-]	NA	0.051
DDE[4,4'-]	0.11	NA
DDT[4,4'-]	0.39	0.068
Dieldrin	NA	0.032
Methylene chloride	0.063	NA
Trichloroethene	0.00029	NA

*NA= Not analyzed.

Table B-3
Maximum Detected Values(mg/kg) for Noncarcinogens in the Northwest Impoundment

Analyte	Sludge	Clay Liner
Acetone	1.9	0.079
Antimony	0.7	0.26
Aroclor-1254	9.0	0.62
Butanone[2-]	0.08	NA*
Cadmium	3.3	0.77
Copper	569	88.7
Endosulfan I	0.23	0.035
Endrin	0.61	0.025
Lead	77.0	33.9
Mercury	2.9	0.11
Nickel	17.1	10.5
Selenium	1.9	0.47
Silver	19.7	0.29
Thallium	0.66	0.32
Toluene	0.01	0.0012
Zinc	838	131

*NA = Not analyzed.

Table B-4
Maximum Detected Values (mg/kg) for Noncarcinogens in the Northeast Impoundment

Analyte	Sludge	Clay Liner
Acetone	0.8	0.03
Antimony	3.0	0.28
Aroclor-1254	25	10
Butanone[2-]	0.24	NA*
Cadmium	1.7	0.45
Copper	1070	44.8
Cyanide, total	500	NA
Endosulfan I	0.2	NA
Endrin	NA	0.051
Lead	135	19.4
Mercury	2.0	0.043
Nickel	8.1	5.6
Selenium	2.2	0.41
Silver	6.3	NA
Thallium	0.92	2.1
Toluene	0.013	NA
Zinc	325	78.8

* NA = Not analyzed.

Table B-5
Maximum Detected Values (pCi/g) Radionuclides in the Northwest Impoundment

Analyte	Sludge	Clay Liner
Cesium-134	NA	10.3
Cobalt-60	4740	42.3
Europium-152	0.46	NA*
Plutonium-238	0.03	NA
Plutonium-239	0.06	NA
Sodium-22	2.1	NA
Strontium-90	2.2	2.1
Tritium	4.8	0.13

* NA = Not analyzed.

Table B-6
Maximum Detected Values(pCi/g) for Radionuclides in the Northeast Impoundment

Analyte	Sludge	Clay Liner
Cesium-134	NA*	22.6
Cobalt-60	1070	6.2
Europium-152	5.7	NA
Plutonium-239	0.04	NA
Sodium-22	2.4	NA
Strontium-90	3.9	1.9
Tritium	405	4.8

* NA = Not analyzed.

Appendix C

Risk Calculations for COPCs in Each Medium

Table C-1
Calculated Cancer Risk for Carcinogens in Northwest Impoundment
Using the Maximum Concentration for Each Medium

Analyte	Sludge Residential Risk	Sludge Industrial Risk	Clay Liner Residential Risk	Clay Liner Industrial Risk
Aroclor-1254	4.09E-05	9.68E-06	2.81E-06	6.65E-07
Aroclor-1260	1.77E-05	4.19E-06	NA*	NA
BHC[alpha-]	1.29E-06	2.58E-07	NA	NA
BHC[gamma-]	NA	NA	1.72E-09	3.44E-10
Bis(2-ethylhexyl) phthalate	2.71E-06	6.33E-07	1.10E-08	2.57E-09
Chromium, total	1.51E-07	5.66E-08	7.67E-08	2.88E-08
DDE[4,4'-]	3.57E-07	6.90E-08	NA	NA
DDT[4,4'-]	1.49E-07	2.89E-08	NA	NA
Dieldrin	NA	NA	9.00E-07	2.08E-07
Heptachlor	NA	NA	1.73E-08	3.96E-09
Methylene chloride	2.82E-09	1.00E-09	6.21E-10	2.21E-10
Total Excess Cancer Risk	8.0E-05	2.0-05	1.0E-05	2.0E-06

* NA = Not analyzed.

Table C-2
Calculated Cancer Risk for Carcinogens in Northeast Impoundment
Using the Maximum Concentration for Each Medium

Analyte	Sludge Residential Risk	Sludge Industrial Risk	Clay Liner Residential Risk	Clay Liner Industrial Risk
Aroclor-1254	1.14E-04	2.69E-05	4.55E-05	1.08E-05
Aroclor-1260	1.59E-05	3.76E-06	1.37E-06	3.24E-07
Benzene	4.22E-10	1.50E-10	NA*	NA
BHC[alpha-]	6.88E-07	1.38E-07	NA	NA
BHC[gamma-]	2.23E-08	4.45E-09	1.48E-09	2.95E-10
Bis(2-ethylhexyl)phthalate	4.60E-07	1.07E-07	2.85E-07	6.66E-08
Chromium, total	7.67E-08	2.88E-08	4.76E-08	1.78E-08
DDD[4,4'-]	NA	NA	2.11E-08	4.23E-09
DDE[4,4'-]	6.29E-08	1.22E-08	NA	NA
DDT[4,4'-]	2.29E-07	4.42E-08	3.97E-08	7.67E-09
Dieldrin	NA	NA	1.07E-06	2.48E-07
Methylene chloride	7.10E-09	2.53E-09	NA	NA
Trichloroethene	1.81E-10	3.82E-11	NA	NA
Total Excess Cancer Risk	3.0E-05	7.0E-06	1.0E-05	3.0E-06

* NA = Not analyzed.

Table C-3
Calculated HQs for Noncarcinogens in the Northwest Impoundment Using the Maximum Concentration for Each Medium

Analyte	Sludge Residential Risk	Sludge Industrial Risk	Clay Liner Residential Risk	Clay Liner Industrial Risk
Acetone	0.00	0.00	0.00	0.00
Antimony	0.02	0.00	0.01	0.00
Aroclor-1254	8.2	0.69	0.56	0.05
Butanone[2-]	0.00	0.00	NA*	NA
Cadmium	0.08	0.01	0.01	0.00
Copper	0.20	0.01	0.03	0.00
Endosulfan I	0.00	0.00	0.00	0.00
Endrin	0.03	0.00	0.00	0.00
Lead	0.19	0.04	0.08	0.02
Mercury	0.13	0.01	0.00	0.00
Nickel	0.01	0.00	0.01	0.00
Selenium	0.00	0.00	0.00	0.00
Silver	0.05	0.00	0.00	0.00
Thallium	0.11	0.01	0.05	0.00
Toluene	0.00	0.00	0.00	0.00
Zinc	0.04	0.01	0.01	0.00
HI	9.6	0.95	1.3	0.26

*NA = Not analyzed.

Table C-4
Calculated HQs for Noncarcinogens in the Northeast Impoundment Using the Maximum Concentration for Each Medium

Analyte	Sludge Residential Risk	Sludge Industrial Risk	Clay Liner Residential Risk	Clay Liner Industrial Risk
Acetone	0.001	0.000	0.000	0.000
Antimony	0.101	0.006	0.009	0.001
Aroclor-1254	22.7	1.9	9.1	0.77
Butanone[2-]	0.000	0.000	NA[a]	NA
Cadmium	0.024	0.003	0.006	0.001
Copper	0.38	0.023	0.016	0.001
Cyanide, total	0.42	0.033	NA	NA
Endosulfan I	0.001	0.000	NA	NA
Endrin	0.000	0.000	0.003	0.000
Lead	0.34	0.068	0.049	0.010
Mercury	0.088	0.005	0.002	0.000
Nickel	0.005	0.000	0.004	0.000
Selenium	0.006	0.000	0.001	0.000
Silver	0.016	0.001	0.000	0.000
Thallium	0.15	0.009	0.35	0.021
Toluene	0.000	0.000	NA	NA
Zinc	0.014	0.003	0.003	0.001
HI	**25**	**2.3**	**10.1**	**0.98**

[a] NA = Not analyzed.

Table C-5
Calculated Dose (mrem/yr) for Radionuclides in the Northwest Impoundment Using the Maximum Concentrations for Each Medium

Analyte	Sludge Residential Dose	Sludge Industrial Dose	Clay Liner Residential Dose	Clay Liner Industrial Dose
Cesium-134	NA[a]	NA	44.8	6.2
Cobalt-60	39500	5413	353	48.3
Europium-152	1.7	0.23	ND[b]	ND
Plutonium-238	0.01	0.00	ND	ND
Plutonium-239	0.01	0.00	ND	ND
Sodium-22	14.3	1.9	ND	ND
Strontium-90	3.8	0.01	3.7	0.01
Tritium	0.75	0.10	0.02	0.00
Total Dose	**39538**	**5416**	**405**	**54.7**

[a] NA = Not analyzed; cesium-134 was not sampled in the sludge layer.

[b] ND = Not detected.

Table C-6
Calculated Dose (mrem/yr) for Radionuclides in the Northeast Impoundment Using the Maximum Concentration for Each Medium

Analyte	Sludge Residential Dose	Sludge Industrial Dose	Clay Liner Residential Dose	Clay Liner Industrial Dose
Cesium-134	NA*	NA	98.3	13.7
Cesium-137	NA	NA	NA	NA
Cobalt-60	8917	1222	51.9	7.1
Europium-152	21.0	2.9	NA	NA
Plutonium-238	0.00	0.00	NA	NA
Plutonium-239	0.01	0.00	NA	NA
Sodium-22	16.0	2.2	NA	NA
Strontium-90	6.8	0.01	3.3	0.01
Tritium	4.6	0.58	0.05	0.01
Total Dose	8966	1228	154	20.8

* NA = Not analyzed.