6051

Department of Energy

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SEP 30 2005

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DOE-0340-05

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Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF THE FINAL CERTIFICATION REPORT FOR AREA 4A

References:
1) Letter, T. Schneider to W. Taylor, "Approval - Certification Report for Area 4A," dated August 4, 2005
2) Letter, J. Saric to J. Reising, "Area 4A Certification Report," dated August 17, 2005

Enclosed for your approval is the final Certification Report for Area 4A. This report has been revised to note a change in Section 4.2 in reference to data validation and has been approved by both the U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency as noted in the references above. In response to Reference 2, the data collected for certification of Area 4B was verified and validated using the most current EPA guidelines as outlined in Section 11.2 of the Sitewide Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Quality Assurance Project Plan (SCQ). In Appendix D Subpart D.2.3 of the SCQ, it specifies that Fernald Closure Project's (FCP's) validation checklist will be developed from the EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, current revision); which requires that FCP be current with EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, October 2004). Therefore, the only revision from the draft Area 4A Certification Report is updating the citation of the guidance from the 1994 version to reflect the SCQ requirements.

If you have any questions or require additional information, please contact Johnny Reising at (513) 648-3139.

Sincerely,

for William J. Taylor
Director

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CERTIFICATION REPORT FOR AREA 4A

FERNALD CLOSURE PROJECT
FERNALD, OHIO

SEPTEMBER 2005

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

20803-RP-0005
REVISION 0
FINAL

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LIST OF ACRONYMS AND ABBREVIATIONS

ASCOC	area-specific constituent of concern
ASL	analytical support level
BTV	benchmark toxicity value
CDL	Certification Design Letter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	constituent of concern
CRDL	Contract Required Detection Limit
CU	certification unit
D&D	Decontamination and Demolition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FCP	Fernald Closure Project
FPA	Former Production Area
FRL	final remediation level
FTF	Fire Training Facility
GMA	Great Miami Aquifer
HAMDC	highest allowable minimum detectable concentration
HWMU	hazardous waste management unit
MDC	Main Drainage Corridor
MDL	minimum detection level
mg/kg	milligrams per kilogram
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU	Operable Unit
pCi/g	picoCuries per gram
PSP	Project Specific Plan
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SCQ	Sitewide CERCLA Quality Assurance Project Plan
SED	Sitewide Environmental Database
SEP	Sitewide Excavation Plan
STP	Sewage Treatment Plant
TPU	total propagated uncertainty
UCL	upper confidence limit
UST	underground storage tank
V/FCN	Variance/Field Change Notice
V&V	verification and validation
VOC	volatile organic compound
WAC	waste acceptance criteria
yd^3	cubic yards

EXECUTIVE SUMMARY

This Certification Report presents the information and data used by the U.S. Department of Energy (DOE) to determine that soils in Area 4A meet established final remediation levels (FRLs). Area 4A is located in the southeast quadrant of the Former Production Area of the Fernald Closure Project (FCP). Predominant structures formerly located in Area 4 included Plant 4, Plant 5, Plant 6, and Plant 7. Area 4A also includes the footprint of one underground storage tank (UST), UST #14, located in Plant 6, and one high-leachability zone where the FRL for total uranium is 20 milligrams per kilograms.

This Certification Report includes details of the certification sampling, analysis, and validation that took place in Areas 4A. The certification area 4A was reduced due to the location of the Main Drainage Corridor and the field location of the run-on/run-off controls. Figure 1-1 depicts the original layout of Area 4A and Figure 1-2 depicts the area in 4A to be certified.

Consistent with the Sitewide Excavation Plan (DOE 1998), these areas underwent predesign, excavation, and precertification activities, including the use of real-time instrumentation as well as physical sampling and analysis. As a result of these activities, it was determined that no further remediation was necessary prior to certification.

All Area 4A certification units (CUs) were sampled and statistical analysis was conducted where necessary to ensure certification criteria were met. As discussed in the Certification Design Letter and Certification Sampling Project Specific Plan for Area 4A (DOE 2005a and 2005b), the certification criteria are that the average primary area-specific constituent of concern (ASCOC) concentrations within a CU are below-FRLs at a 95 percent upper confidence level (UCL, 90 percent UCL for secondary ASCOCs), and that no certification result is greater than twice the FRL (the hotspot criterion).

CU 6 failed the hotspot criterion with a total uranium result greater than two times the FRL. The hotspot was delineated and excavated, and another sample was collected. Following the re-sample, the pre-excavated data was replaced with the new surface data. Upon completion of final certification statistics, all Area 4A CUs pass the certification criteria.

On the basis of this reported information and supporting project files, DOE has determined that no additional remedial actions are required in this portion of the site. The area will be considered certified when the U.S. Environmental Protection Agency and the Ohio Environmental Protection Agency concur that certification criteria have been met. At that time, DOE intends to proceed with final land use activities as outlined in the Natural Resource Restoration Plan (DOE 2002a).

DOE has restricted access to certified areas in order to maintain their integrity prior to final land use development. FCP procedure EP-0008 has been developed to implement a process to protect certified areas from becoming re-contaminated.

1.0 INTRODUCTION

1.1 PURPOSE

This Certification Report presents the information and data used by the U.S. Department of Energy (DOE) to determine that soils in Area 4A meet established final remediation levels (FRLs). Area 4A, as defined for this certification effort, is located in the southern half of the Former Production Area (FPA) of the Fernald Closure Project (FCP) and consists of the former Plants 4, 5, 6, and 7, roads, perimeter areas, etc. On the basis of this reported information and supporting project files, DOE has determined that no additional remedial actions are required in this portion of the site.

1.2 BACKGROUND

In the Operable Unit (OU) 5 Record of Decision (ROD, DOE 1996a), DOE made a commitment to excavate contaminated soil that exceeds health-based FRLs. The excavated material may be disposed of at the On-Site Disposal Facility (OSDF) or at an off-site disposal facility if it does not meet OSDF waste acceptance criteria (WAC). The OU5 Remedial Investigation Report (RI, DOE 1995a) defined the extent of above-FRL soil contamination and, in general, indicated widespread contamination occurring in approximately 430 acres of the 1,050-acre FCP.

In the OU5 Remedial Action Work Plan (RAWP, DOE 1996b), DOE agreed to prepare a Sitewide Excavation Plan (SEP, DOE 1998) that defined the overall approach to cleaning up soil and at- and below-grade debris in accordance with the OU2 ROD (DOE 1995b), OU3 ROD (DOE 1996c), and OU5 ROD.

In the SEP, the FCP was divided into distinct remedial areas and phases for soil remediation, based on the operable units' remediation schedule. After all necessary remediation is completed within each area/phase, the soil is certified as having attained all clean up goals (i.e., FRLs). The general approach for the removal of contaminated soil and debris in Area 4A followed "Excavation Approach D - Excavation Following D&D in the Former Production Area, STP and FTF," as described in Section 4.4 of the SEP.

1.3 SCOPE AND AREA DESCRIPTION

The scope of this Certification Report includes details of certification sampling, analysis and validation that took place in Area 4A. The Area 4A certification area has been reduced for the scope of this Certification Report due to the location of the Main Drainage Corridor (MDC) and the field location of the run-on/run-off controls, which were based on the current area topography. Figure 1-1 depicts the original layout of Area 4A and Figure 1-2 depicts the area in 4A that is to be certified under this Certification Report.

Area 4A is located in the southeast quadrant of the FPA and is bound by 2nd Street to the north, "E" Street to the east, 1st Street to the south, and "B" Street to the west, as shown on Figure 1-1. Predominant structures formerly located in Area 4A included Plants 4, 5, 6, and 7. Area 4A also includes a high leachability zone where the total uranium FRL is 20 milligrams per kilogram (mg/kg); Underground Storage Tank (UST) #14; and Hazardous Waste Management Unit (HWMU) #36, as shown on Figure 1-3. The entire Area 4A was approximately 17.33 acres. However, due to the MDC, only approximately 10.58 acres will be included in the scope of this Certification Report (Figure 1-2). The Area 4A area perimeter to the north, to the south, to the east, and to the west outside of the run-on control ditches, and HWMU #36 will be included in the scope of the MDC Certification Design Letter (CDL) or another adjacent area.

1.4 OBJECTIVES

The objectives of this Certification Report are:

- Summarize the precertification and remedial activities,
- Describe the analytical methods, data validation processes, data reduction and statistical processes used to support the certification process,
- Present certification sampling results for all certification units (CUs),
- Present the statistical analysis showing that all CUs have passed the certification criteria, including FRL attainment and hotspot criteria, and
- Describe access controls implemented to prevent recontamination.

1.5 REPORT FORMAT

This Certification Report is presented in six sections with supporting documentation and data in the appendices. These sections are as follows:

Section 1.0 Introduction: Purpose, background, area description, scope, and objectives of the report

Section 2.0 Certification Approach: The approach for certification sampling and analysis

Section 3.0 Overview of Field Activities: Historical data evaluation, precertification, area preparation, excavation and changes to work scope

Section 4.0 Analytical Methodologies, Data Validation Processes and Data Reduction

Section 5.0 Certification Evaluation and Conclusions

Section 6.0 Protection of Certified Areas

Appendix A Failing Preliminary Certification Statistics

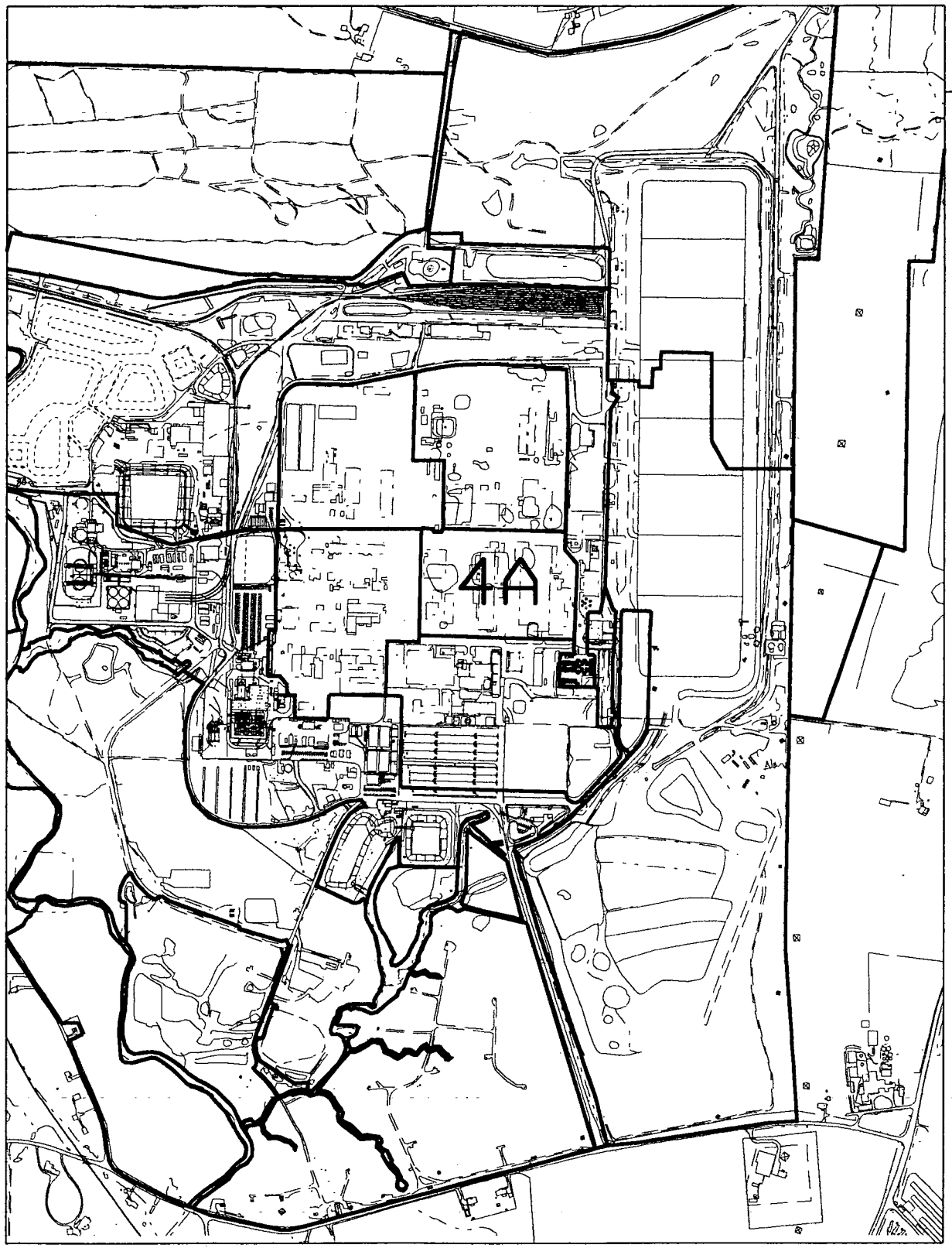
Appendix B Certification Samples, Analytical Results and Final Statistics Tables

Appendix C UST #14 Certification Samples, Analytical Results and Final Statistics Table

Appendix D Variances/Field Change Notices (V/FCNs) for the Area 4A Certification Sampling Project Specific Plan (PSP, DOE 2005b)

1.6 FCP MASTER CERTIFICATION MAP

In order to track certification and characterization for reuse areas at the FCP, DOE updates a controlled map (Figure 1-4) showing the status of the soil remediation areas and phased areas with all Certification Reports. This map has been updated to include certification of Area 4A.



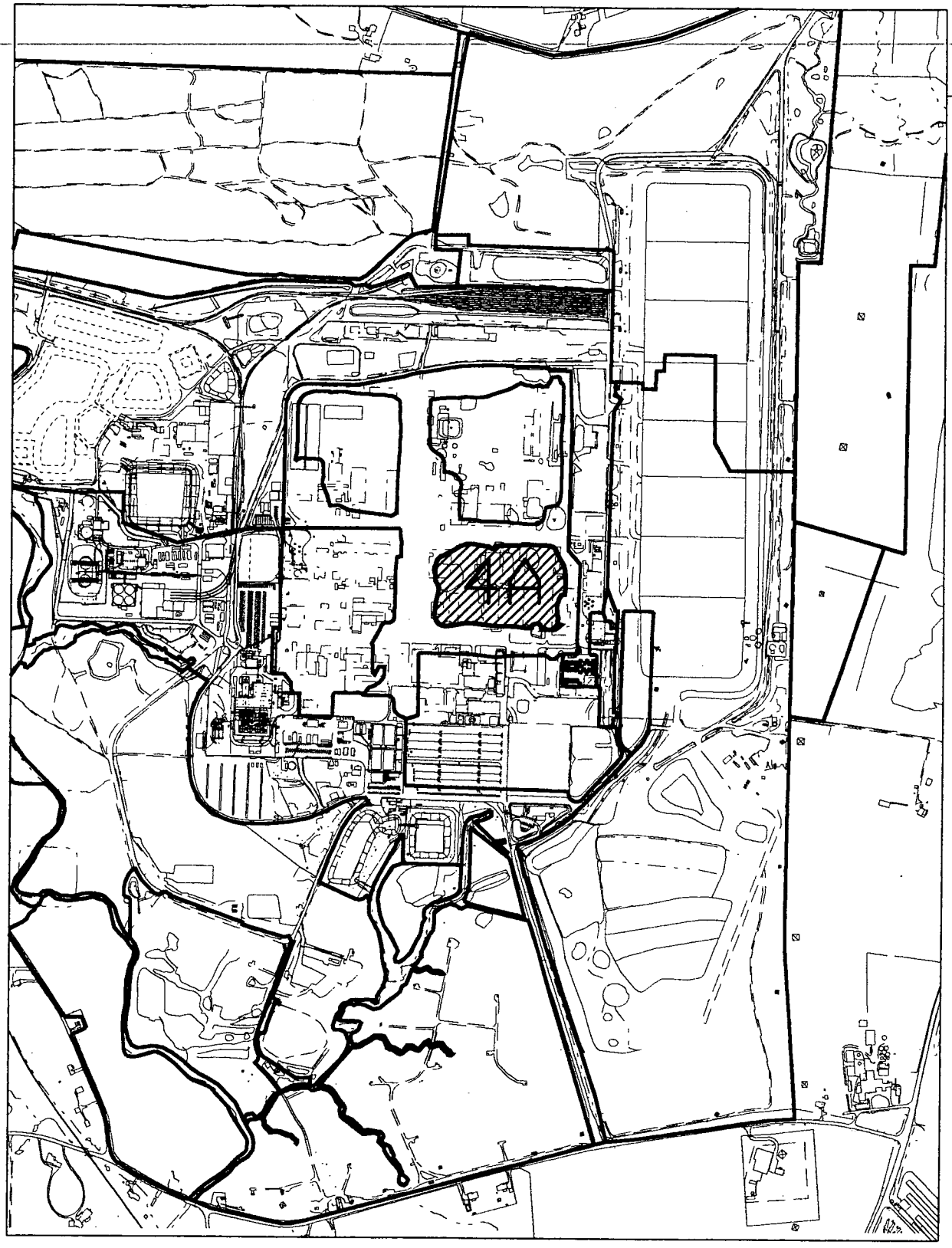
LEGEND:

SCALE

1000 500 0 1000 FEET

FIGURE 1-1. AREA 4A LOCATION MAP

v:\#2fm12\dgn\#4a_001.dgn
STATE PLANAR COORDINATE SYSTEM 1983
31-MAR-2005



LEGEND:

AREA TO BE CERTIFIED

SCALE

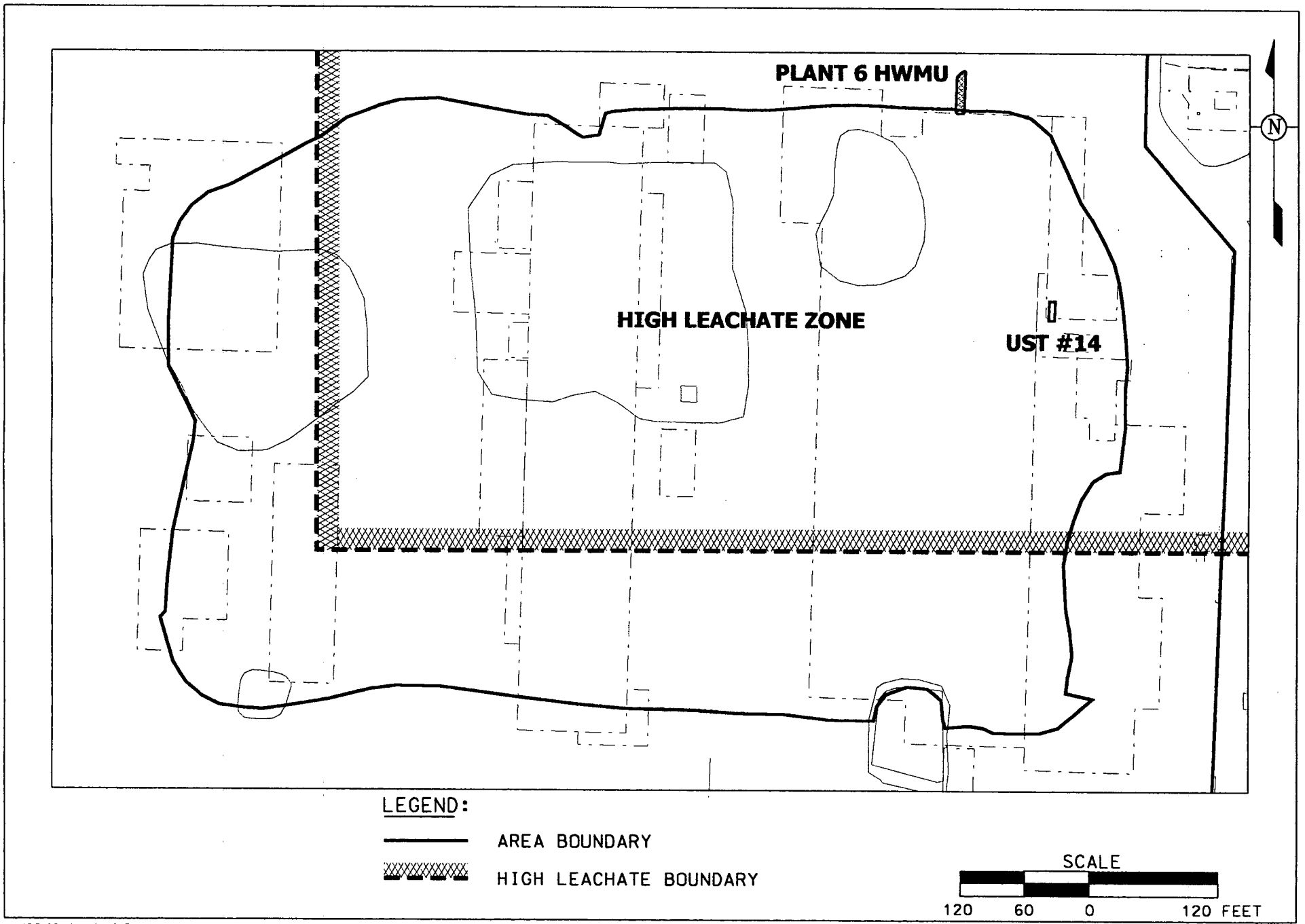
1000 500 0 1000 FEET

FIGURE 1-2. AREA 4A CERTIFICATION AREA BOUNDARY

v:\#2fm12\dgn\#4a_002.dgn

STATE PLANAR COORDINATE SYSTEM 1983

31-MAR-2005



v:\#2fm12\dgn\4a_003.dgn
STATE PLANAR COORDINATE SYSTEM 1983

FIGURE 1-3. AREA 4A HISTORICAL FEATURES

31-MAR-2005

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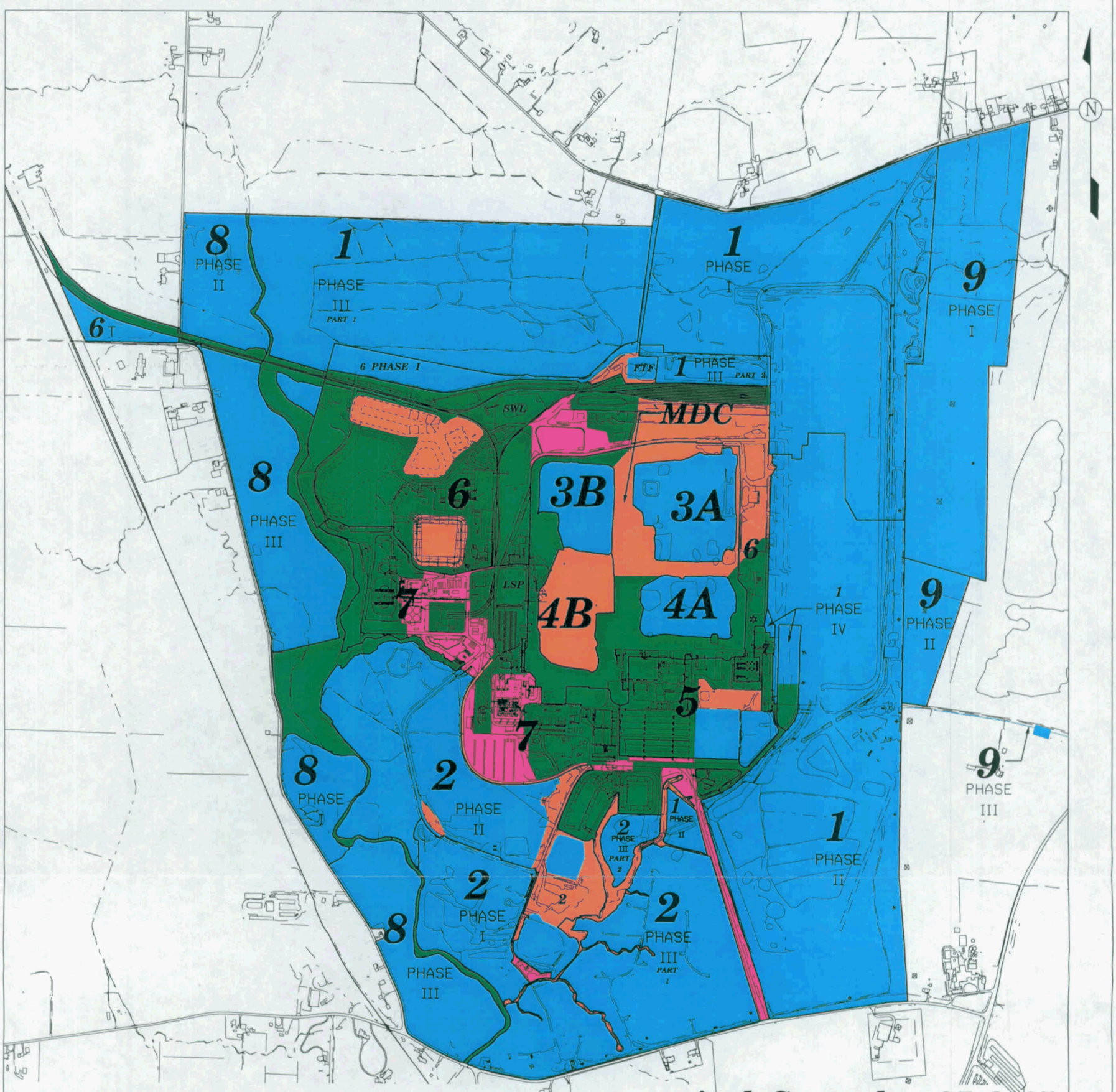

revised September 27, 2005

AREAS	TOTAL ACRES	APPROVED CERT. ACRES	CERT. ACRES IN PROGRESS	REMEDIATION ACRES IN PROGRESS	PREDESIGN ACRES IN PROGRESS	REMAINING ACRES
AREA 1	395.8	394.0	0	1.7	0	0
AREA 2	174.7	162.1	11.8	0	0.8	0
AREA 3A/4A	29.3	29.3	0	0	0	0
AREA 3B/4B	26.2	11.1	15.1	0	0	0
AREA 5	26.9	7.6	2.7	16.7	0	0
AREA 6	140.8	18.8	33.2	82.1	6.8	0
AREA 7	85.1	0	1.2	55.8	28.2	0
AREA 8	98.9	98.9	0	0	0	0
MDC	39.0	0	13.4	25.6	0	0
PR/SSOD/PPDD	32.7	0	7.0	25.8	0	0
TOTAL ON SITE	1049.4	721.8	84.3	207.6	35.7	0
AREA 9	85.6	85.6	0	0	0	0
TOTAL OFF SITE	85.6	85.6	0	0	0	0

* ONSITE AREA9 REMAINING ACRES INCLUDE THE DISSOLVED OXYGEN FACILITY AREA. THE INTERIM LEACHATE LINE CORRIDOR IS INCLUDED IN AREA 6.

AREA 10 INCLUDES PIPELINES RELATED TO GROUNDWATER REMEDIATION AND OTHER UTILITIES NOT SPECIFICALLY LISTED.

SCALE

1100 550 0 1100 FEET

FIGURE 1-4. FCP CONTROLLED CERTIFICATION MAP

v:\5cj31\dgn\bmp\certmap5.dgn

STATE PLANAR COORDINATE SYSTEM 1983

28-SEP-2005

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2.0 CERTIFICATION APPROACH

2.1 CERTIFICATION STRATEGY

This section summarizes the area-specific constituent of concern (ASCOC) selection process and the certification approach, including CU establishment, sampling design, and statistical analysis. The general certification strategy is described in Section 3.4 of the SEP, and the specific strategy for Area 4A is described in the CDL for Area 4A (DOE 2005a).

2.1.1 Area-Specific Constituents of Concern

Total uranium, radium-226, radium-228, thorium-228 and thorium-232 are sitewide primary constituents of concern (COCs) and were retained as ASCOCs for this remediation effort. Secondary ASCOCs for Area 4 are listed in the SEP; however, some COCs were not retained for Area 4A based on the area investigations. Table 2-1 lists the secondary ASCOCs identified in the SEP. Table 2-2 presents justification for retaining or not retaining the ASCOCs and the ecological COCs for each CU in Area 4A.

2.1.2 ASCOC Selection Criteria

The selection process for retaining ASCOCs for a remediation area is driven by applying a set of decision criteria. A soil contaminant is retained as an ASCOC if:

- It is listed as a soil COC in the OU5 ROD and, it is listed as an ASCOC in Table 2-7 of the SEP for the Remediation Area of interest;
- It is listed as a COC for a HWMU or UST that lies within the certification area boundary;
- It can be traced to site use in the remediation area of interest, either through process knowledge or known release of the constituent to the environment;
- Analytical results indicated that a contaminant is present above its FRL, and the above-FRL concentrations are not attributed to false positives or elevated Contract Required Detection Limits (CRDLs);
- Physical characteristics of the contaminant, such as degradation rate or volatility, indicated it is likely to persist in the soil between time of release and remediation; or
- The contaminant is one of the sitewide primary COCs (total uranium, radium-226, radium-228, thorium-238, and thorium-232).

Using the above process, the ASCOCs were refined to those listed in Table 2-7 of the SEP. The list of ASCOCs is also presented in Table 2-1 with their respective FRLs and, if applicable, benchmark toxicity values (BTVs).

Table 2-7 of the SEP also identifies antimony as an ecological COC in Area 4 based on a screening process presented in Appendix C of the SEP. However, antimony was not specifically identified for Area 4A.

2.1.3 ASCOC Selection Process

Each COC on the Remediation Area 4 ASCOC list (Table 2-1) was evaluated for its relevance to Area 4A. Table 2-2 presents the reasoning for either retaining or eliminating the ASCOC. In addition to the assigned COCs for Remediation Area 4, additional COCs with above-FRL concentrations included 1,1-dichloroethene and 1,2-dichloroethene, both which were retained for certification. Table 2-2 of the SEP listed methanol as the COC for UST #14, therefore methanol was also retained for samples collected in support of UST #14 closure.

2.2 CERTIFICATION APPROACH

The certification design for Area 4A followed the general approach outlined in Section 3.4 of the SEP. The design for Area 4A is depicted on Figure 2-1 and the sample locations are depicted in Figure 2-2. The five primary ASCOCs (total uranium, radium-226, radium-228, thorium-228, and thorium-232) were retained in each CU. Additional secondary COCs are identified for specific CUs within the certification area as well as unique COCs for the UST.

Many factors were taken into consideration when determining the boundaries for each CU within Area 4A. These factors included: areas defined as high leachability zones, historical land use, proximity to other areas of the site, residual COC data, and previous existence of USTs and HWMUs. Additionally, since Area 4A falls within the FPA, it is considered to be an impacted area, and was therefore comprised of Group 1 CUs to allow for more concentrated sampling and ensure excavation activities had no effect on the soil.

2.2.1 Area 4A Certification Unit Design

Area 4A consists of nine CUs. Eight CUs are Group 1 CUs that were designed around the high leachability area. As shown of Figure 2-1, CUs 1, 7, and 8 are outside of the high leachability area while CUs 2 through 6 are entirely within the high leachability area.

Due to the presence of UST #14 in Area 4A, the certification effort must include demonstration of soil FRL attainment and UST closure. Per Section 2.2.6 of the SEP:

- Each UST footprint will form a distinct CU
- At least eight samples will be collected from the excavated base and sidewalls for each UST
- Samples will be analyzed for the COCs identified for each particular UST in Table 2-2 of the SEP.

A ninth CU was established for the footprint of UST #14. This CU also fell within the boundary of the high leachability area. The COC for UST #14 is methanol, which does not have an associated soil FRL. However, eight samples were collected for methanol analysis and the Residential Generic Cleanup Number (31.3 mg/kg) was used in place of a FRL. This number is listed on the Closure Plan Review Guidance for Resource Conservation and Recovery Act (RCRA) Facilities (OEPA 2004), written by the Ohio Environmental Protection Agency (OEPA) Division of Hazardous Waste Management. The Residential Generic Cleanup Number was also to be used for statistical analysis if any residual methanol was detected in the samples collected for methanol. In addition to the samples collected for methanol analysis, eight samples were also collected for analysis of the primary radiological COCs (total uranium, radium-226, radium-228, thorium-228, and thorium-232) as well as technetium-99. The eight sample locations for UST #14 are shown on Figure 2-3.

2.2.2 Sample Selection Process

For the eight Group 1 CUs, the selection of certification sampling locations was conducted according to Section 3.4.2 of the SEP. Each CU was first divided into 16 approximately equal sub-CUs. Sample locations were then generated by randomly selecting an easting and northing coordinate within the boundaries of each sub-CU, then testing those locations against the minimum distance criteria for the CU. If the minimum distance criteria were not met, an alternative random location was selected for that sub-CU, and all the locations were re-tested. This process continued, until all 16 random locations met the minimum distance criteria. The sub-CUs and planned certification sampling locations are shown on Figure 2-2. Four of the 16 sample locations (one location from each quadrant of the CU) were designated with a "V," indicating archive sample locations. One sample location in the CU was designated with a "D," indicating a field duplicate sample collection location. Samples were collected for analysis from the 0 to 6-inch interval at 12 of the 16 locations in each CU. The four samples designated as "archive" were not planned to be collected unless they were needed for additional analysis.

The selection of sampling locations for the UST #14 CU was also conducted according to Section 3.4.2 of the SEP however, there were only eight sample locations and no archive or duplicate sample locations were designated. Samples were collected for analysis from the 0 to 6-inch interval at all eight locations as shown on Figure 2-3.

Several breaches of the Great Miami Aquifer (GMA) occurred during excavation of Area 4A. During the excavation and backfill process, samples were collected from either the exposed sand/soil or the clay plugs in accordance with Section 3.5 of the Implementation Plan for Area 3A/4A (DOE 2001). These samples, shown on Figure 2-4, were analyzed and validated consistent with the certification protocols, however it was not necessary to include these samples with their respective CUs during statistical analysis.

Prior to commencement of certification sampling field activities, all certification sample locations were surveyed and field verified to make sure no surface obstacles would prevent collection at the planned location. It was not necessary to move any planned certification sample locations.

2.2.3 Certification Sampling

Samples were collected for analysis from 0 to 6 inches at 12 of the 16 locations in each CU. The four samples designated as "archive" were not collected as they were not needed for additional analysis.

2.2.4 Statistical Analysis

Two criteria must be met for the CU to pass certification. If the data distribution is normal or lognormal, the first criterion compares the 95 percent upper confidence limit (UCL) on the mean of each primary COC to its FRL, or the 90 percent UCL on the mean of each secondary ASCOC. On an individual CU basis, any ASCOC with the 95 percent UCL (for primary ASCOCs) or 90 percent UCL (for secondary ASCOCs) above the FRL results in that CU failing certification. If the data distribution is not normal or lognormal, the appropriate nonparametric approach discussed in Appendix G of the SEP will be used to evaluate the second criterion; the *a posteriori* test will the performed to determine whether the sample size is sufficient for a meaningful conclusion of this comparison. The second criterion is the hotspot criterion, which states that primary or secondary ASCOC results must not exceed two times the FRL. When the given UCL on the mean for ach COC is less that its FRL and the hotspot criterion is met, the CU will be considered certified.

In the event that a CU passes the *a posteriori* test but fails certification, the following two scenarios will be evaluated: 1) localized contamination, and 2) widespread contamination. Details on the evaluation and responses to these possible outcomes are provided in Section 3.4.5 of the SEP.

TABLE 2-1
AREA 4 ASCOC LIST[a]

ASCOC	FRL/*(BTV)*[b]
Radionuclides	
Total Uranium	82 mg/kg
Total Uranium[c]	20 mg/kg
Radium-226	1.7 pCi/g
Radium-228	1.8 pCi/g
Thorium-228	1.7 pCi/g
Thorium-232	1.5 pCi/g
Technetium-99	30.0 pCi/g
Thorium-230	280 pCi/g
Cesium-137	1.4 pCi/g
Chemical	
Aroclor-1254	0.13 mg/kg
Aroclor-1260	0.13 mg/kg
Benzo(a)pyrene	2.0 mg/kg *(1.0 mg/kg)*
Bromodichloromethane	4.0 mg/kg
Dieldrin	0.015 mg/kg
Fluoride	78,000 mg/kg
Tetrachloroethene	3.6 mg/kg
Methanol[d]	31.3 mg/kg
Metals	
Arsenic	12.0 mg/kg
Beryllium	1.5 mg/kg
Lead	400 mg/kg
Ecological	
Antimony	96.0 mg/kg *(10.0 mg/kg)*

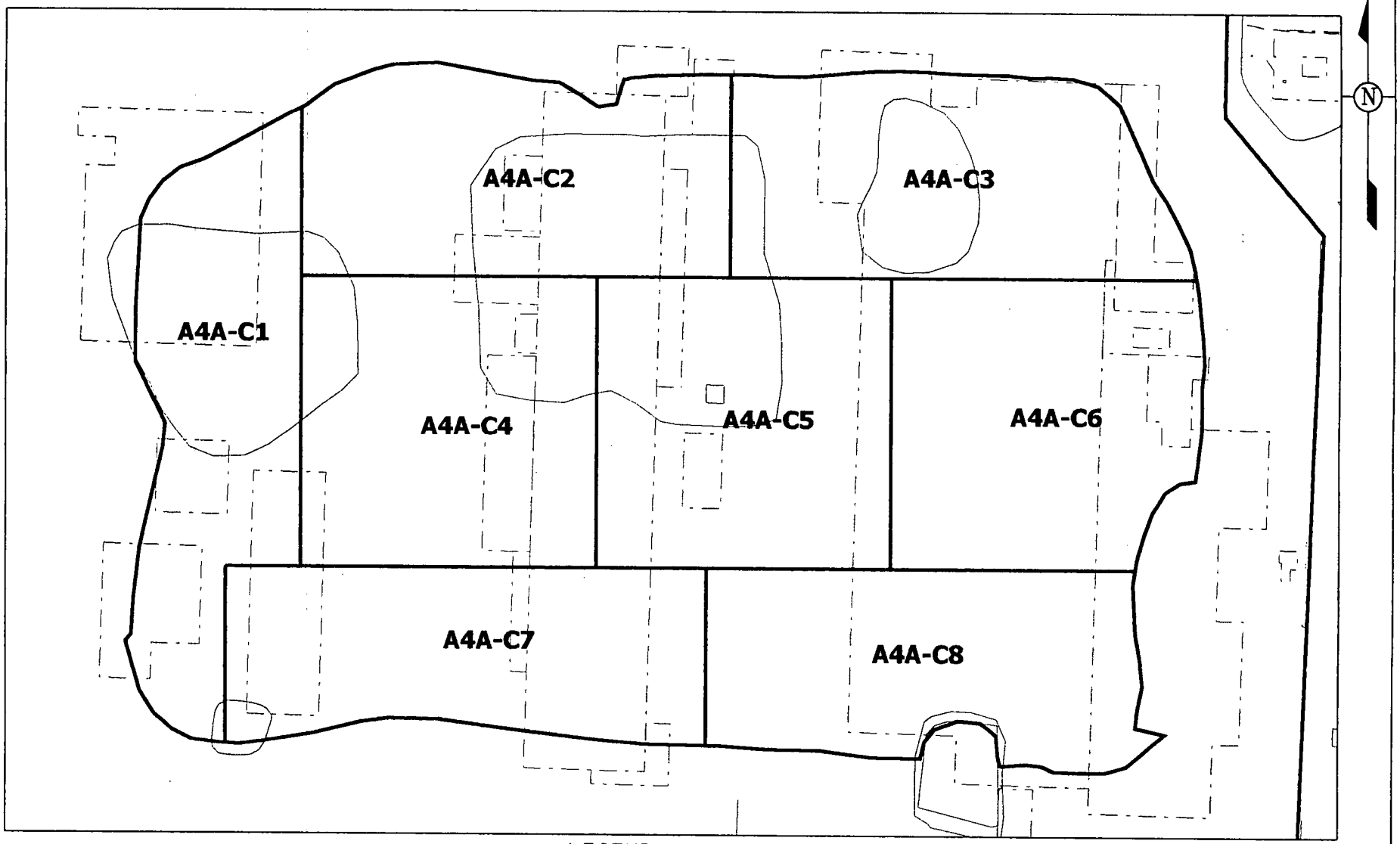
[a]As listed in Table 2-7 of the SEP.
[b]BTV applies to Ecological COCs.
[c]The total uranium FRL is lower in the defined high leachability zones.
[d]Methanol does not have an associated soil FRL. 31.3 mg/kg is listed on Table 1 of the June 2004 Closure Plan Review Guidance for RCRA Facilities, written by the OEPA Division of Hazardous Waste Management.

pCi/g - picoCuries per gram

TABLE 2-2
ASCOC LIST FOR AREA 4A

ASCOC	Retained as ASCOC?	Justification	CU(s)
Radionuclides			
Total Uranium	Yes	Primary Radionuclide	All[a]
Radium-226	Yes	Primary Radionuclide	All
Radium-228	Yes	Primary Radionuclide	All
Thorium-228	Yes	Primary Radionuclide	All
Thorium-232	Yes	Primary Radionuclide	All
Cesium-137	No	Not detected at concentrations above the FRL	None
Plutonium-238	No	Only one above-FRL concentration at 5 to 5.5 feet but captured during above-WAC excavation	None
Strontium-90	No	Only one above-FRL concentration at 1.5 to 2 feet but captured during above-WAC excavation	None
Technetium-99	Yes	Above-FRL and above-WAC concentrations within Area 4A	All
Thorium-230	No	Not detected at concentrations above the FRL	None
Chemical			
Aroclor-1254	No	Not detected at concentrations above the FRL	None
Aroclor-1260	No	Not detected at concentrations above the FRL	None
Benzo(a)pyrene[b]	No	Not detected at concentrations above the FRL	None
Bromodichloromehtane	No	Not detected at concentrations above the FRL	None
Dieldrin	No	Not detected at concentrations above the FRL	None
Fluoride	Yes	Not previously sampled in Area 4A and process knowledge indicates use in Area 4A	1-8
Tetrachloroethene	Yes	Above-FRL concentrations within Area 4A	6
1,1-dichloroethene	Yes	Above-FRL concentrations within Area 4A	6
1,2-dichloroethene	Yes	Above-FRL concentrations within Area 4A	6
Methanol	Yes	UST #14 specific COC	9-UST14
Metals			
Arsenic	Yes	Above-FRL concentrations within Area 3A	5
Beryllium	Yes	Above-FRL concentrations within Area 3A	7
Lead	No	Not detected at concentrations above the FRL	None
Ecological			
Antimony	No	Not detected at concentrations above the FRL or the BTV.	None

[a] CUs 2 through 6 and 9-UST14 fall in the high leachability zones where the uranium FRL = 20 mg/kg



LEGEND:

CU BOUNDARY

SCALE

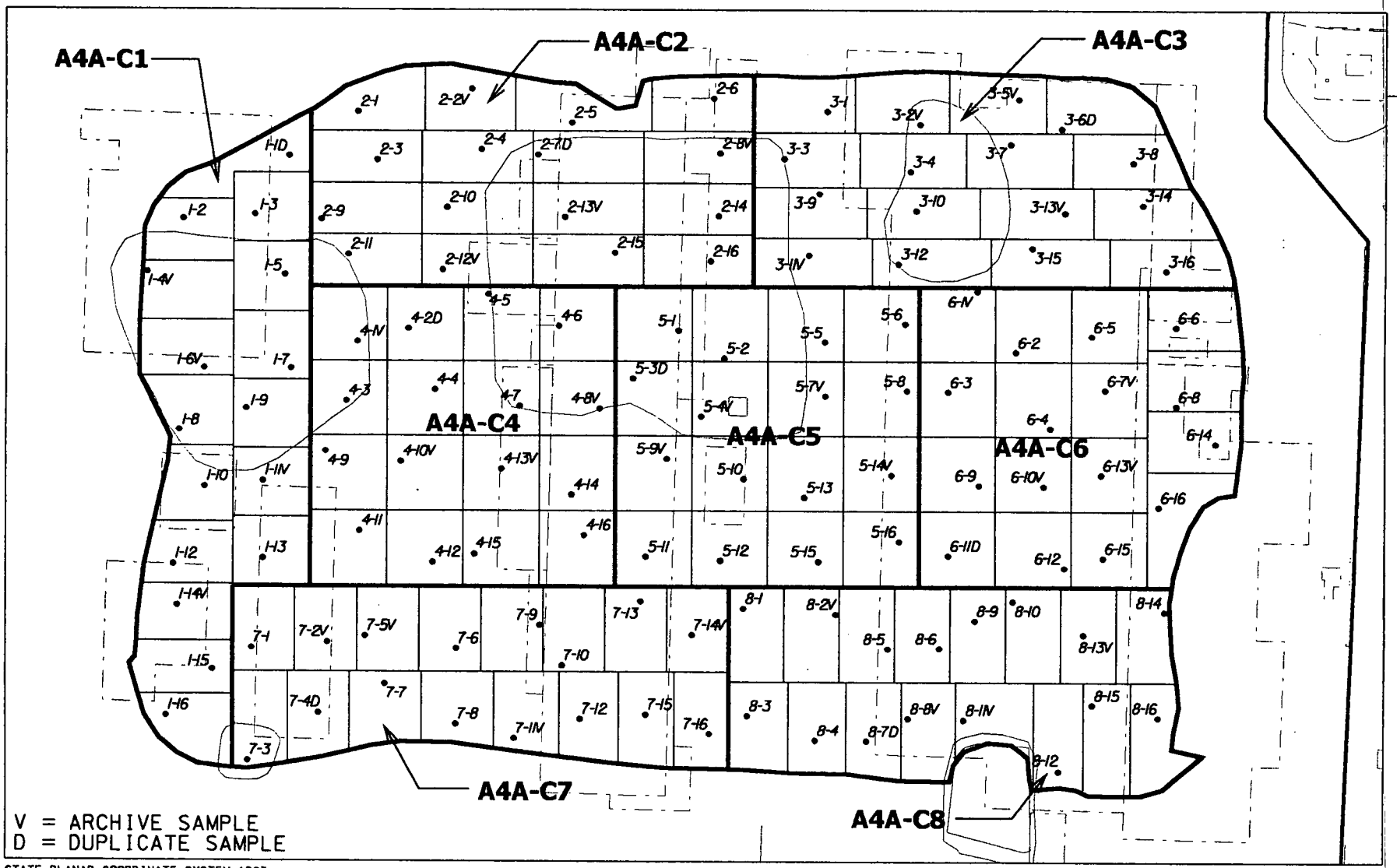
120 60 0 120 FEET

v:\2fm12\dgn\4a_005.dgn
STATE PLANAR COORDINATE SYSTEM 1983

FIGURE 2-1. AREA 4A CU BOUNDARY MAP

09-MAR-2005

6 of 9



LEGEND:

• SAMPLE LOCATION

SCALE

120 60 0 120 FEET

v:\2fm12\dgn\4a_006.dgn

09-MAR-2005

FIGURE 2-2. AREA 4A SUB-CU BOUNDARY AND CERTIFICATION SAMPLING LOCATIONS

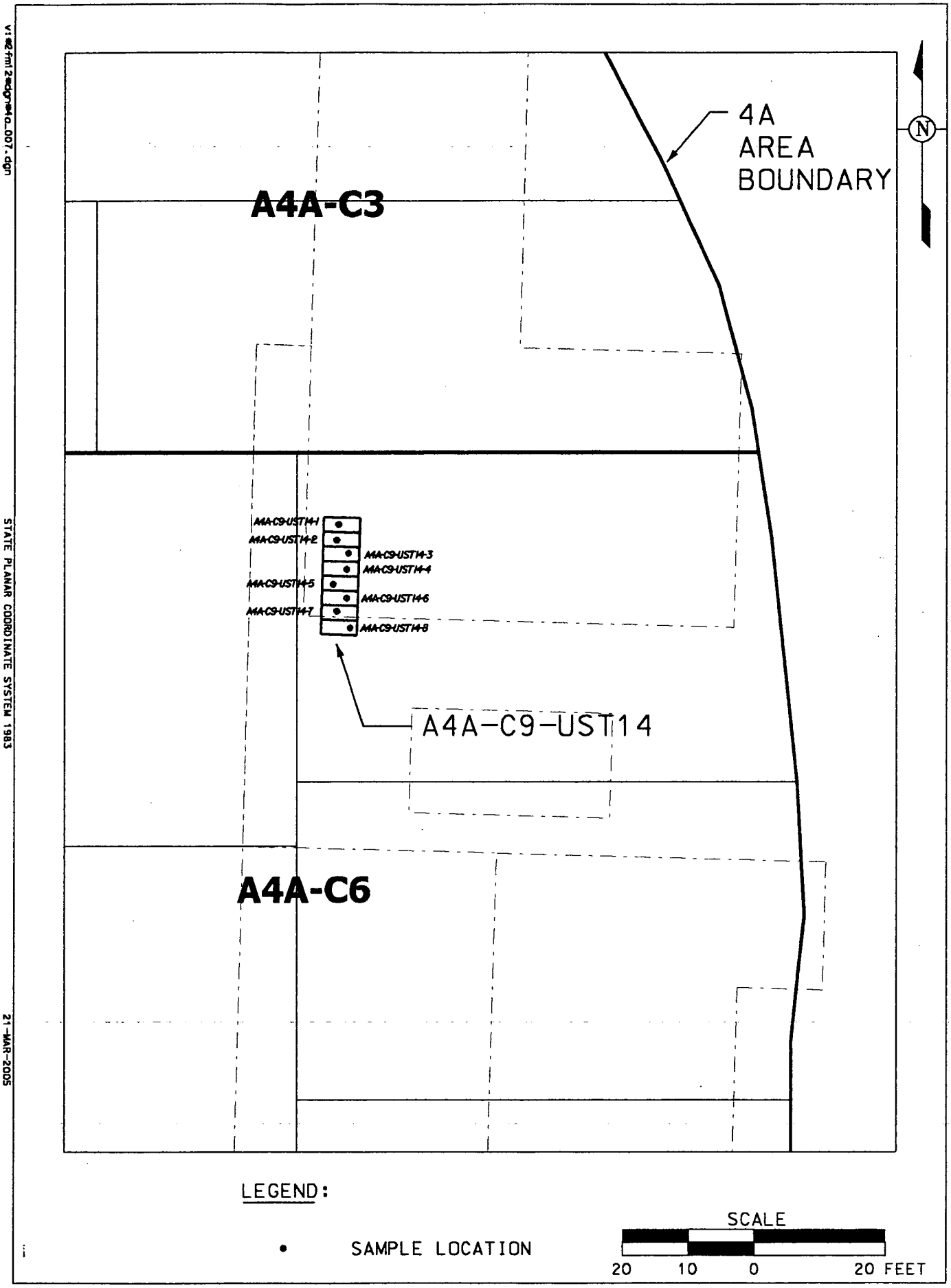
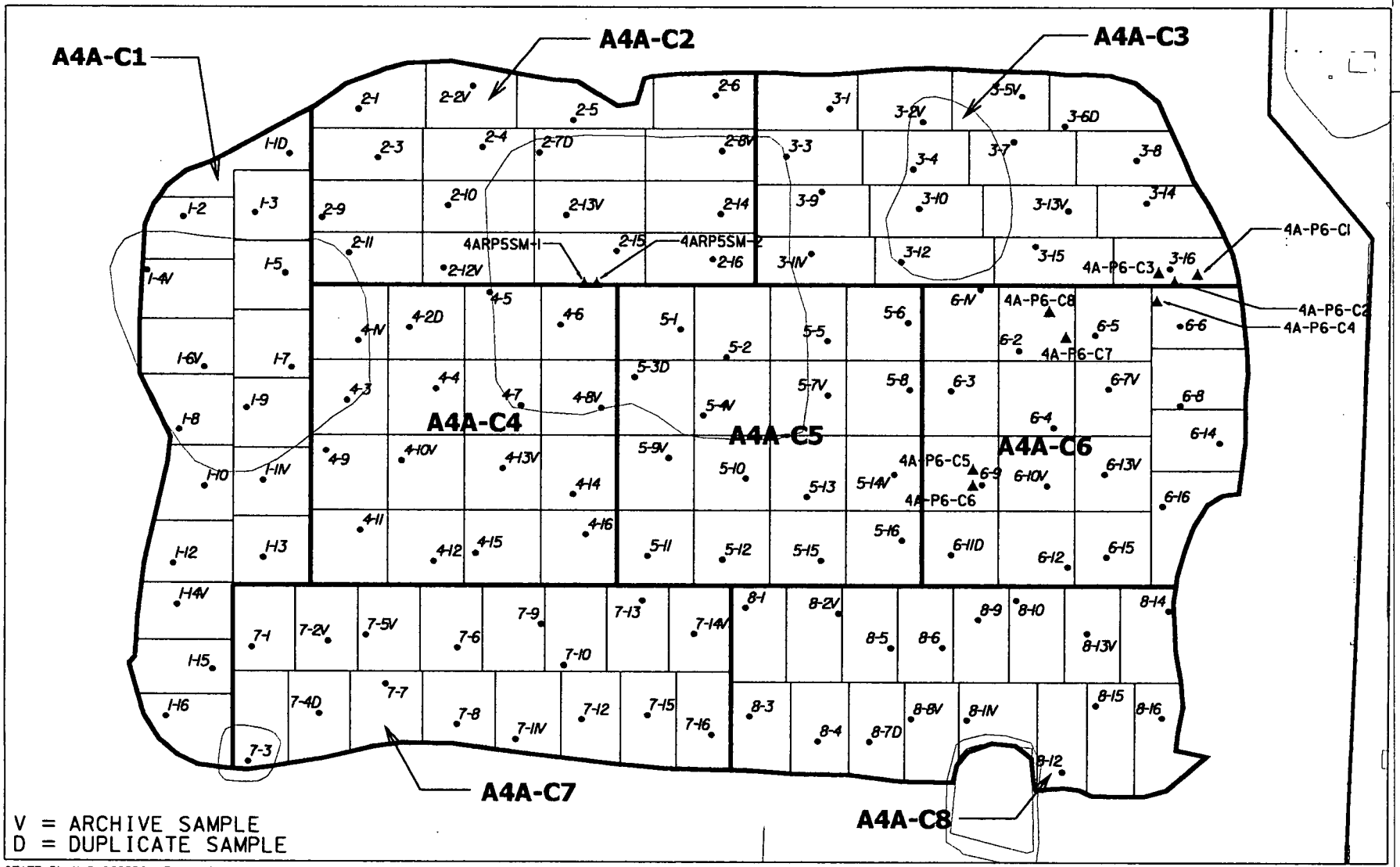


FIGURE 2-3. AREA 4A UST #14 FOOTPRINT SAMPLING LOCATIONS

v:\2fm12\dgn\4a_007.dgn
STATE PLANAR COORDINATE SYSTEM 1983
21-MAR-2005



STATE PLANAR COORDINATE SYSTEM 1983

LEGEND:

• SAMPLE LOCATION

▲ GMA BREACH SAMPLE LOCATION

SCALE

120 60 0 120 FEET

v:\2fm12\dgn\4a_008.dgn

28-JUN-2005

FIGURE 2-4. AREA 4A GMA BREACH SAMPLE LOCATIONS

3.0 OVERVIEW OF FIELD ACTIVITIES

In accordance with the SEP, prior to conducting precertification and certification activities, all soil demonstrated to contain contamination above the associated FRLs or other applicable action levels were evaluated for remedial actions.

In addition to the Predesign Investigations, the OU3 and OU5 RI Reports (DOE 1995c and 1995a) and Feasibility Study Reports (FS, DOE 1995d and 1995e) were used for remedial design of Area 4A. Final grade excavation monitoring/sampling and real-time scanning/sampling data have been collected pursuant to the RI/FS and remedial activities.

Before initiating the certification process, all historical soil data within the Area 4A certification area was pulled from the Sitewide Environmental Database (SED). Based on the results of sampling and scanning activities summarized below, it was determined that no further remedial actions were necessary to remove above-FRL or above-WAC soil.

3.1 AREA PREPARATION AND PRECERTIFICATION

All historical data for Area 4A is presented in the Implementation Plan for Area 3A/4A. This includes data collected during the RI/FS and during two separate predesign investigations: PSP for Area 3A/4A Surface Predesign Investigation (DOE 1999a) and PSP for Area 3A/4A Subsurface Predesign Investigation (DOE 1999b). Data were also collected during the remediation/excavation activities for excavation control and following the remediation/excavation activities for precertification per the PSP for Area 3A/4A Excavation Characterization and Precertification (DOE 2002b).

Below is a brief discussion of the remediation/excavation activities in Area 4A that follow this order: above-WAC areas, UST area, and breaching the sand lens of the GMA.

There were four designed above-WAC areas in Area 4A; each was located within Plant 6. East Plant 6 was above-WAC for tetrachloroethene, technetium-99, and uranium. North Central Plant 6, South Plant 6, and Northeast Plant 6 were above-WAC for technetium-99 and uranium. All of the above-WAC material was removed during the remediation/excavation activities in Area 4A. During remediation/excavation activities in Area 4A the above-WAC area in Plant 6 was expanded laterally and vertically due to the presence of visible product material. Additional excavation was performed until all of the product material was removed. Once all of the above-WAC material was removed from these areas, the excavation proceeded to remove the remaining above-FRL material.

UST #14, located in eastern Plant 6, was approved abandoned (closed) in place in March 1995, as stated in Table 2-2 of the SEP as well as the Closeout Report for UST #14 (DOE 1995f). During excavation activities within Area 4A, UST #14 was removed. Additional information about UST #14 can be found in Section 2 of the SEP and Sections 3 and 4 of the CDL for Area 4A.

During removal of hydraulic casings in Plant 5, two excavation locations came within 5 feet of the sands and gravels of the GMA. Excavation in east Plant 6 as well as the Plant 6 sump also came within 5 feet of the sands and gravels of the GMA. While excavating a hotspot that was discovered during precertification activities, one additional location in Plant 6 came within 5 feet of the sands and gravels of the GMA (see Section 2.1.2 for further discussion of precertification activities). Prior to backfilling the areas that came within 5 feet of the sands and gravels of the GMA, sampling was performed per the PSP for Area 3A/4A Excavation Characterization and Precertification. Further discussion on sampling of these areas is located in Section 4.1.3 of the CDL for Area 4A.

The final above-WAC soil volume removed from Area 4A was 37,004 (bank) cubic yards (yd^3). The final above-FRL soil and concrete volume removed from Area 4A was 188,726 (bank) yd^3.

Precertification activities were conducted to evaluate residual radiological contamination patterns as specified in the Area 3A/4A Excavation Characterization and Precertification PSP. During Phase 1 of precertification, four total uranium hotspots were detected that were greater than three times the FRL (20 mg/kg) in the east portion of Area 4A. The hotspots were delineated and excavated. Following excavation of the areas, Phase 3 measurements were performed to confirm that the excavations removed the contamination. With the successful removal of the hotspots, all areas in Area 4A passed the requirements of precertification.

3.2 CHANGES TO SCOPE OF WORK

The scope of work for Area 4A Certification Sampling required one change, which was documented with a V/FCN and discussed in the following paragraph.

CU 6 failed the hotspot criterion for total uranium with a result greater than two times the FRL. The area was delineated and excavated to remove the contamination. Following the excavation, an additional sample was collected from the same location. This change in work was documented in V/FCN 20803-PSP-0003-01, which is included in Appendix D, and is further discussed in Section 5.

4.0 ANALYTICAL METHODOLOGIES, DATA VALIDATION PROCESSES, AND DATA REDUCTION

4.1 ANALYTICAL METHODOLOGIES

All samples collected were sent off-site for analysis. The laboratories complied with Sitewide Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Quality Assurance Project Plant (SCQ) requirements (DOE 2003). The SCQ is the source for analytical methodologies (Appendix G), data verification and validation, and analytical quality assurance/quality control requirements.

Laboratory analysis of certification samples was conducted using approved analytical methods, as discussed in Appendix H of the SEP. The minimum detection level (MDL) was set at 10 percent of the FRL and analyses were conducted to Analytical Support Level (ASL) D or E, where the MDL of 10 percent of the FRL is above the SCQ ASL detection level, but the analyses meet all other SCQ ASL D criteria. ASL D data packages were provided for all of the analytical data. All data were validated. Once data were validated as required, results were entered into the FCP SED. Final certification results are provided in Appendix B, and a summary of the analytical methods follows:

4.1.1 Chemical Methods

Fluoride

Samples submitted for fluoride analysis were analyzed by ion chromatography.

Metals

Samples submitted for arsenic and beryllium analysis were analyzed by inductively coupled plasma-mass spectrometry.

Methanol

Samples submitted for methanol analysis were analyzed by gas chromatography/flame ionization detector.

Volatile Organic Compounds (VOCs)

Samples submitted for VOC analyses were analyzed by gas chromatography/mass spectrometry.

4.1.2 Radiochemical Methods

The radiochemical analytical methods depended on the specific nuclides of interest. Performance-based specification criteria included highest allowable minimum detectable concentration (HAMDC) percent overall tracer/chemical recovery, percent matrix spike recovery, method blank concentration, percent recovery of laboratory control sample, and relative error ratio for duplicate samples for each analyte. The on-site laboratory was required to meet these specifications using the methodologies described below.

Total Uranium

Samples were analyzed for unaium-238 using gamma spectroscopy, and the results were used to calculate the total uranium value. The calculation used was as follows:

Total uranium (mg/kg) = (2.998544) x uranium-238 gamma spectrometry result (pCi/g)

The validation qualifier assigned to the total uranium value was the same as the uranium-238 qualifier.

Radium-226

Samples were analyzed by gamma spectrometry, and radium-226 was quantified by measuring gamma rays emitted by members of its decay chain. This method does not require chemical separation, but the samples must be allowed a 20-day progeny in-growth period before counting. The off-site laboratory used the same gamma ray emission lines and error weighted average methodology to calculate all of the Area 4A certification results.

Radium-228

Following gamma spectrometry analysis, radium-228 was also quantified by measuring gamma rays emitted by members of its decay chain. The off-site laboratory used the same gamma ray emission lines and error weighted average methodology to calculate all Area 4A certification results.

Isotopic Thorium

Isotopic thorium (thorium-228 and thorium-232) was also quantified by measuring gamma rays emitted by members of its decay chain by gamma spectrometry. The off-site laboratory used the same gamma ray emission lines and error weighted average methodology to calculate all Area 4A certification results.

Technetium-99

Techentium-99 was quantified by using a liquid scintillation counter.

4.2 DATA VERIFICATION AND VALIDATION

This section discusses the data verification and validation (V&V) process used to examine the quality of field and laboratory results. Data were qualified to indicate the level of data usability, or level of confidence in the reported analytical results following Section 11.2 and Appendix D of the SCQ.

Specific parameters associated with the data were evaluated during V&V to determine whether or not the data quality objectives were met. Five principal Quality Assurance parameters (i.e., precision, accuracy, completeness, comparability, and representativeness) were addressed during V&V. Field sampling and

handling, laboratory analysis and reporting, and non-conformances and discrepancies in the data were examined to ensure compliance with appropriate and applicable procedures.

The V&V process evaluated the following parameters:

- Specific field forms for sample collection and handling
- Chain of Custody forms
- Completeness of laboratory data deliverable.

The data validation process examined the analytical data to determine the validation qualifier of the results. General areas examined that apply to all the chemical data include the following:

- Holding Times
- Instrument calibrations
- Calculation of results
- Matrix spike/matrix spike duplicate recoveries
- Laboratory/field duplicate precision
- Field/Laboratory Blank contamination
- Dry weight correction for solid samples
- Correct detection limits reported
- Laboratory control sample recoveries and compliance with established limits.

Parameters unique to the evaluation of radiochemical analyses include:

- Calibration data for specific energies
- Background checks
- Relative Error ratios
- Detector efficiencies
- Background count correction.

For this project, all the radiological data were reviewed and validated for all criteria noted above. Per project requirements, a minimum of 10 percent of the certification data were validated to Level D. This validation included the same review process as for Level B, but included a systematic review of the raw data and recalculations

Following V&V, qualifier codes were applied to specific data points, reflecting the level of confidence assigned to the particular datum. These codes included:

- No qualification; the positive result or detection limit is confident as reported

J Positive result is estimated or imprecise; data point is usable for decision-making purposes. Positive results less than the contract required reporting limit are also qualified in this manner

R Positive result or detection limit is considered unreliable; data point should not be used for decision-making purposes

U Undetected result at the stated limit of detection

UJ Undetected result; detection limit is considered estimated or imprecise; the data point is usable for decision-making purposes

N Positive result is tentatively identified - that is, there is some question regarding the actual identification and quantification of the result. Compound reported is best professional judgement of the interpretation of the supporting data, such as mass spectra. Caution must be exercised with the use of these data

NV Not Validated. The results for this sample were not validated

Z This result, or detection limit in this analysis is not the best one to use; another analysis (e.g., the dilution or re-analysis) contains a more confident and usable result.

The V&V of this data set did not identify any problems. All results were either not qualified, qualified as estimated (J) and/or non-detects (U). No results were qualified as rejected (R).

4.3 DATA REDUCTION

Each sample used to support the Area 4A certification decision was entered in the SED with the following information:

Field Information

- Sample Identification Number - A unique number assigned to each discrete sample point
- Coordinate Information - Northing and Easting locations.

Using the information as summarized above, the following actions were taken for data reduction of each CU data set.

1. All of the data for each CU were queried from SED. All of the data were used even if the CU had more than the minimum required data points.

2. The data from the validation fields were used for statistical calculations.

3. Data with a qualifier of R or Z was not used in the statistical calculations.

4. The higher of the two duplicate results was used in the statistical calculations.

5. One half on the non-detect (U or UJ) values were used in the statistical calculations.

Laboratory Information

For each sample result the following information is entered:

- Laboratory Result - The reported analytical value from the laboratory
- Laboratory Qualifier - The qualifier reported from the lab. For radiological parameters non-detect values are assigned a U qualifier
- Total Propagated Uncertainty (TPU) - The TPU is an estimate of the overall uncertainty associated with a measured or calculated result that has been derived from an evaluation of all factors that can influence a result, including both systematic and random sources of uncertainty. For both *in situ* and laboratory-based radioactivity measurements, factors such as the random nature of the radioactive decay process (i.e., counting uncertainty), the mass or volume of the "sample" being analyzed, the variation in radiation detection efficiency with the energy of the emitted radiation and the density and chemical composition of the sample, uncertainty in nuclear decay parameters used to convert counts to activity, and attenuation of the radiation must be considered to properly asses the overall uncertainty of the measured result.
- Units - The units in which the Laboratory Result is reported.

Validation Information

- Validation Result - The result based on the validation process. During the validation process, sample results may be adjusted. If the laboratory result is less than the associated minimum detectable concentration, the validation result becomes the minimum detectable concentration value.
- Validation TPU - The TPU based on the validation process (applicable to radiological parameters only). The data Validation Section evaluates the reported TPU as described in the SCQ in Section 11.2 and Appendix D to assess the impact on the data quality and will qualify the data as estimated if the uncertainty is excessive.
- Validation Qualifier - The qualifier assigned as a result of the data validation process.
- Validation Units - The units in which the Validation Result is reported.

5.0 CERTIFICATION EVALUATION AND CONCLUSIONS

Certification success or failure was based on sample data from each CU against criteria discussed in Section 2.2.4. Subsequent to any evaluation of preliminary data, full statistical analysis and evaluation was performed on all validated data. Final certification data are presented in Appendix B.

5.1 CERTIFICATION RESULTS AND EVALUATION

The following is a summary of the analytical results and statistical analyses of the data for each CU in Area 4A:

A4A-C1

CU A4A-C1 passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C2

A4A-C2 is in a high leachability zone in which the total uranium FRL is lower (20 mg/kg). This CU passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C3

A4A-C3 is in a high leachability zone in which the total uranium FRL is lower (20 mg/kg). This CU passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C4

A4A-C4 is in a high leachability zone in which the total uranium FRL is lower (20 mg/kg). This CU passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C5

A4A-C5 is in a high leachability zone in which the total uranium FRL is lower (20 mg/kg). This CU passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C6

A4A-C6 is in a high leachability zone in which the total uranium FRL is lower (20 mg/kg). The total uranium result at sample location A4A-C6-12 was 59.9 mg/kg, which is greater than two times the total

uranium FRL; therefore the CU failed the hot spot criterion. The failing preliminary certification statistics are presented in Appendix A. The sample location was delineated (Figure 5-1) and excavated to remove the contamination. Following a real-time scan of the area (Figure 5-2), another sample was collected from the same location under V/FCN 20803-PSP-0003-01. The new sample was below the total uranium FRL with a result of 5.14 mg/kg. Other than the total uranium issue, the remainder of the constituents for A4A-C6 passed all certification requirements. All final certification data are presented in Appendix B.

A4A-C7

CU A4A-C7 passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C8

CU A4A-C8 passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix B.

A4A-C9-UST14

As discussed in Section 2 of the SEP and Section 4 of the CDL for Area 4A, UST #14 is in Area 4A and is being closed under the scope of this certification. The excavated footprint of UST #14 is defined as a distinct CU, A4A-C9-UST14, and the constituents for this CU are identified in Section 2 of this report. This CU passed all of the certification criteria as discussed in Section 2.2.4. Final certification data are presented in Appendix C.

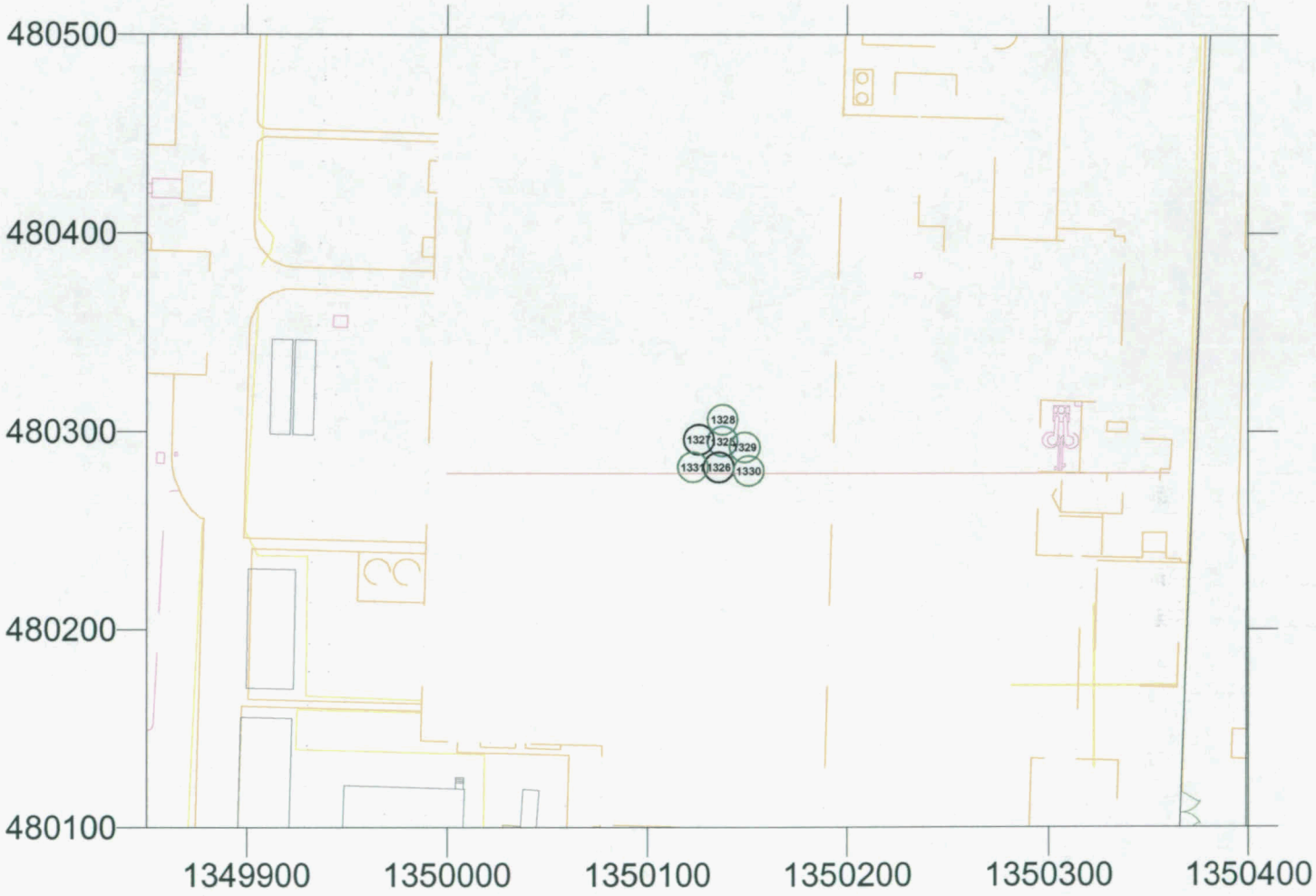
5.2 AREA 4A CERTIFICATION CONCLUSIONS

Based on the certification analytical results, precertification data, and statistical analysis, DOE has determined that the remedial objectives in the OU5 ROD have been achieved for Area 4A and UST #14, and no further remedial actions are required. This portion of the FCP will be released for restoration and final land use upon U.S. Environmental Protection Agency (EPA) and OEPA concurrence.

Figure 5-1. Area 4A, CU6 Hotspot Delineation Moisture Corrected Total Uranium

Field of View to Scale
HPGe DET#: 40227
Measurement Date: 05/23/05; 05/25/05

N



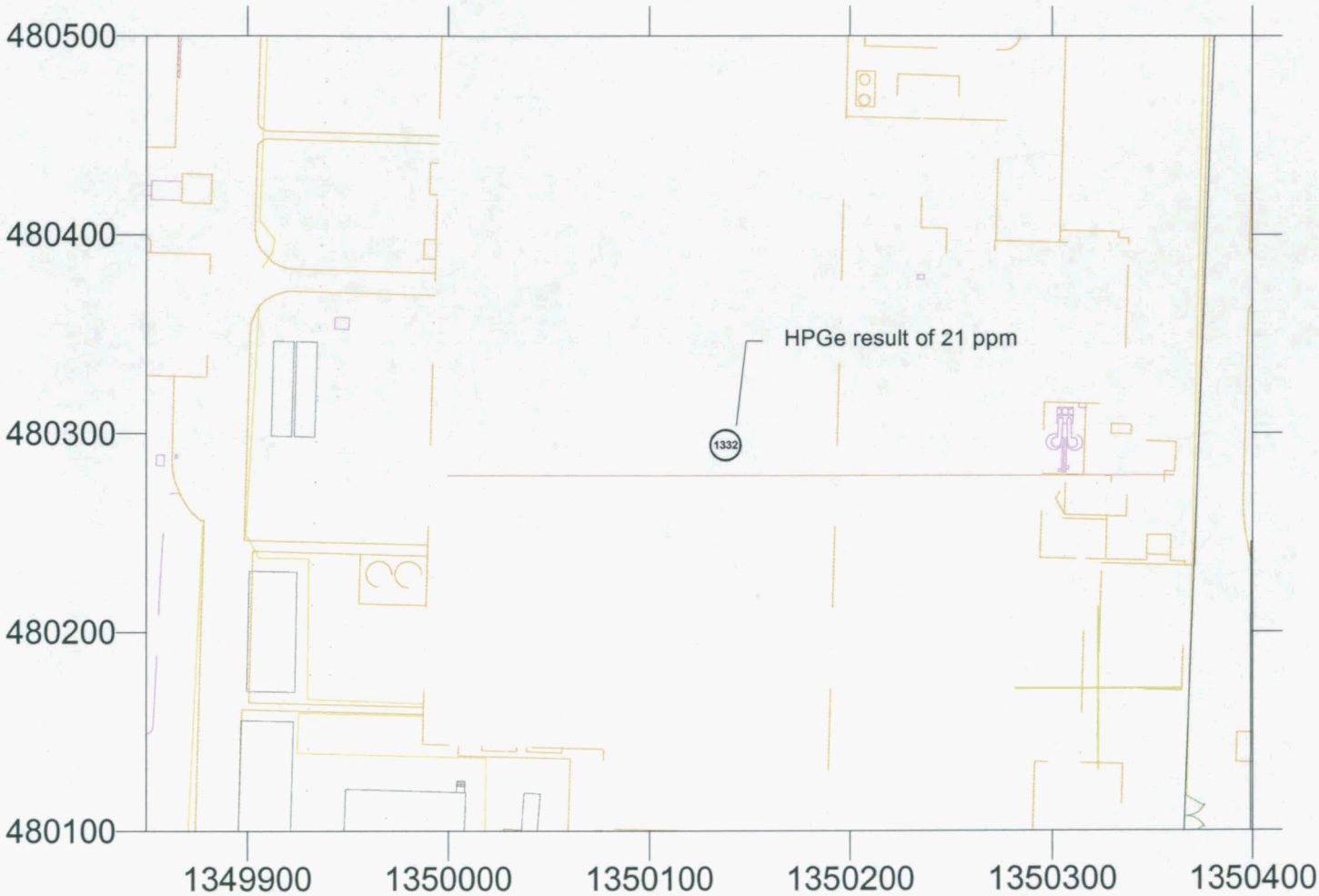
HPGe @ 31 cm
Total U (ppm)
FRL = 20 ppm

- 0 to 20
- 20 to 40
- 40 to 60
- 60 to 928
- 928 to 9999

RTIMP DWG Title: A4A_P2HS_HL_TU_05-25-2005.srf
Project Name: Gen Char for Site Soil Remediation
Project #: 20300-PSP-0011
Prepared By: Joe Nikstenas/77839
Date Prepared: 05/26/05
Support Data: A4A_P2HS_HL_40227_31cm.xls

Figure 5-2. Area 4A, CU6 Hotspot Removal Confirmation Moisture Corrected Total Uranium

Field of View to Scale
HPGe DET#: 30699
Measurement Date: 06/08/05



HPGe @ 31cm
Total U (ppm)
- 0 to 20
- 20 to 40
- 40 to 60

RTIMP DWG Title: A4A_P3HS_HL_TU_06-08-2005.srf
Project Name: Gen Char for Site Soil Remediation
Project #: 20300-PSP-0011
Prepared By: A. Veach/80515
Date Prepared: 06/09/05
Support Data:A4A_P3HS_HL_30699_31cm_06-08-2005.xls

6.0 PROTECTION OF CERTIFIED AREAS

DOE has restricted access to certified areas in order to maintain their integrity prior to transfer for final land use. FCP Procedure EP-0008 has been developed to implement a process to protect certified areas from becoming re-contaminated.

The procedure is summarized as follows:

- At the beginning of certification sampling activities for a remediation area, the perimeter of the "certified" area will be clearly delineated
- Signs will be posted upon the temporary perimeter limiting access to authorized individuals or projects
- To gain access to conduct work in a "certified" area, the person or project desiring access will submit a request to the Compliance section of the Environmental Closure Project
- Any equipment to be used within the "certified" area must have been cleaned in accordance with FCP certified area access
- Employees/operators should be briefed on the entry and exit requirements for a "certified" area
- Additional restrictions apply to certified areas that have been restored. The Environmental Closure Project Restoration Management Group will approve request for access in writing prior to entry.

After DOE, EPA and OEPA agree that an area is certified, the area will be released for final land use. At that time, best management practices and administrative controls will be used to protect the area from contamination, and other controls will be implemented as needed.

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APPENDIX A

FAILING PRELIMINARY CERTIFICATION STATISTICS

APPENDIX A
FAILING PRELIMINARY CERTIFICATION STATISTICS

Boring ID	Uranium, Total
A4A-C6-11	3.69 J
A4A-C6-11-D	2.48 UJ
A4A-C6-12	59.9 J
A4A-C6-14	4.69 J
A4A-C6-15	6.52 J
A4A-C6-16	36.4 J
A4A-C6-2	3.11 J
A4A-C6-3	7.35 J
A4A-C6-4	4.85 J
A4A-C6-5	8.56 J
A4A-C6-6	4.46 J
A4A-C6-8	6.9 J
A4A-C6-9	3.57 J
Limit	20
Units	mg/kg
Conf. Level	95%
Max. Result	59.9 J
Max. >= Limit	Yes
W-statistic Prob. #	< 0.01% (LN)
Test Procedure	Wilcoxon
Sample Size	12
Nondetects	0
% Nondetects	0.0%
Est. Mean*	5.69
UCL	- -
Prob. > Limit	8.81%
Pass / Fail	FAIL

a posteriori Sample	41
Size calculation	Fail

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption. The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B

CERTIFICATION SAMPLES, ANALYTICAL RESULTS AND FINAL STATISTICS TABLES

APPENDIX B
STATISTICAL ABBREVIATIONS AND SYMBOLS

The procedure used to determine if the data are to be assumed to be either normally distributed or lognormally distributed is outlined in Section G.2.3 of Appendix G to the SEP. The second paragraph under "Step 3: Perform the Shapiro-Wilk Test to evaluate if the data are normally or lognormally distributed" states that "If the Shapiro-Wilk Test indicates both normal and lognormal distributions fit the data, the distribution with the highest p-value will be used in the Student's t-Test (Section G.2.2.2) to make the certification decision." Therefore, the distribution testing procedure is not a matter of transforming the data and then testing for lognormality only when the normality assumption fails as the comment seems to imply. The method is to test both normality and lognormality and select the distribution that "best" fits the data as defined by the test yielding the higher p-value above a minimum acceptable value. The minimum acceptable p-value for acceptance of a distribution was set at 0.05.

Abbreviations:

W-Statistic Probability - Shapiro-Wilk probability of the "better" fit - either normal or lognormal (note: a value less than 0.05 indicates that neither normality nor lognormality could be accepted, but the highest p-value is still shown.)

t-Test (N) - indicates that the normal distribution is best fit to data with a p-value greater than or equal to 0.05.

t-Test (LN) - indicates that the lognormal distribution is best fit to data with a p-value greater than or equal to 0.05.

Sign Test - the Sign test was used because one of the following situations occurred:

1. there were greater than 50 percent non-detects,
2. between 15 and 50 percent non-detects and data not symmetrically distributed,
3. less than 15 percent non-detects, but fails Shapiro-Wilk test for both normality and lognormality and data not symmetrically distributed.

Wilcoxon SR - the Wilcoxon Signed Rank procedure was used because of one of the following situations:

1. between 15 and 50 percent non-detects and data symmetrically distributed,
2. less than 15 percent non-detects, but fails Shapiro-Wilk test for both normality and lognormality and data symmetrically distributed.

Note: Data was considered to be "symmetrically distributed" if the Standardized Skewness had an Absolute Value of less than or equal to 2.00 (i.e., between -2.00 and 2.00).

Number of NDs - number of non-detects.

@ - maximum result was below the FRL indicating that no statistical result needed to be reported.

APPENDIX B
A4A-CU1

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Fluoride
A4A-C1-1	0.707 J	0.814 -	0.821 -	0.814 -	2.55 UJ	0.806 U	1.46 J
A4A-C1-1-D	0.835 J	0.769 -	0.79 -	0.769 -	4.87 J	0.822 U	1.74 J
A4A-C1-2	0.823 J	0.738 -	0.735 -	0.738 -	29.4 J	0.798 U	1.82 J
A4A-C1-3	0.755 J	0.758 -	0.751 -	0.758 -	6.67 J	0.806 U	2.08 J
A4A-C1-5	0.87 J	0.996 -	1 -	0.996 -	9.02 J	0.804 U	1.52 J
A4A-C1-7	1.09 J	1.04 -	1.08 -	1.04 -	10 J	0.86 U	1.74 J
A4A-C1-8	1.33 J	1.28 -	1.24 -	1.28 -	5.45 J	0.873 U	1.55 J
A4A-C1-9	1.01 J	0.977 -	0.958 -	0.977 -	9.77 J	0.844 U	2.59 J
A4A-C1-10	1.17 J	1.14 -	1.1 -	1.14 -	12.7 J	0.882 U	2 J
A4A-C1-12	1.31 J	1.14 -	1.15 -	1.14 -	3.13 J	0.87 U	1.83 J
A4A-C1-13	1.3 J	1.13 -	1.14 -	1.13 -	10.1 J	0.879 U	1.86 J
A4A-C1-15	1.33 J	1.24 -	1.26 -	1.24 -	3.92 UJ	0.893 U	4.26 J
A4A-C1-16	1.21 J	1.07 -	1.08 -	1.07 -	10.2 J	0.889 U	1.8 J
Limit	1.7	1.8	1.7	1.5	82	30	78000
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%
Max. Result	1.33 J	1.28 -	1.26 -	1.28 -	29.4 J	0.893 U	4.26 J
Max. >= Limit	No	No	No	No	No	No	No
W-statistic Prob. #	- -	- -	- -	- -	- -	- -	- -
Test Procedure	- -	- -	- -	- -	- -	- -	- -
Sample Size	12	12	12	12	12	12	12
Nondetects	0	0	0	0	1	12	0
% Nondetects	0%	0%	0%	0%	8%	100%	0%
Est. Mean*	- -	- -	- -	- -	- -	- -	- -
UCL	- -	- -	- -	- -	- -	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	- -	- -	- -	- -	- -	- -	- -
a posteriori Sample	- -	- -	- -	- -	- -	- -	- -
Size calculation	- -	- -	- -	- -	- -	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption. The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B
A4A-CU2

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Fluoride
A4A-C2-1	0.979 J	0.832 -	0.822 -	0.832 -	7.35 J	0.995 U	2.38 J
A4A-C2-3	0.763 J	0.662 -	0.665 -	0.662 -	2.95 J	0.962 U	3.43 J
A4A-C2-4	0.799 J	0.728 -	0.73 -	0.728 -	4.28 J	0.98 U	1.72 J
A4A-C2-5	0.701 J	0.648 -	0.641 -	0.648 -	2.54 J	0.935 U	1.76 J
A4A-C2-6	0.892 J	0.636 -	0.622 -	0.636 -	10.7 J	0.951 U	3.64 J
A4A-C2-7	0.836 J	0.78 -	0.785 -	0.78 -	1.82 U	0.963 U	1.42 J
A4A-C2-7-D	0.855 J	0.733 -	0.737 -	0.733 -	3.62 J	0.984 U	1.3 J
A4A-C2-9	0.961 J	0.747 -	0.759 -	0.747 -	5.66 J	0.931 U	6.6 J
A4A-C2-10	0.871 J	0.825 -	0.826 -	0.825 -	8.04 J	1.03 U	1.72 J
A4A-C2-11	0.858 J	0.71 -	0.74 -	0.71 -	3.86 J	0.871 U	1.71 J
A4A-C2-14	0.859 J	0.676 -	0.695 -	0.676 -	6.06 J	0.948 U	1.24 J
A4A-C2-15	0.85 J	0.822 -	0.816 -	0.822 -	6.01 J	1.15 U	1.37 J
A4A-C2-16	0.75 J	0.579 -	0.601 -	0.579 -	6.34 J	1.07 U	1.4 J
Limit	1.7	1.8	1.7	1.5	20	30	78000
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%
Max. Result	0.979 J	0.832 -	0.826 -	0.832 -	10.7 J	1.15 U	6.6 J
Max. >= Limit	No	No	No	No	No	No	No
W-statistic Prob. #	- -	- -	- -	- -	- -	- -	- -
Test Procedure	- -	- -	- -	- -	- -	- -	- -
Sample Size	12	12	12	12	12	12	12
Nondetects	0	0	0	0	0	12	0
% Nondetects	0%	0%	0%	0%	0%	100%	0%
Est. Mean*	- -	- -	- -	- -	- -	- -	- -
UCL	- -	- -	- -	- -	- -	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	- -	- -	- -	- -	- -	- -	- -
a posteriori Sample	- -	- -	- -	- -	- -	- -	- -
Size calculation	- -	- -	- -	- -	- -	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption. The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B
A4A-CU3

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Fluoride
A4A-C3-1	0.922 -	0.756 J	0.876 J	0.756 J	10.6 J	0.821 U	4.63 J
A4A-C3-3	0.862 -	0.71 J	0.711 J	0.71 J	4.41 J	0.823 U	1.43 J
A4A-C3-4	0.917 -	0.678 J	0.673 J	0.678 J	5.04 J	0.816 U	1.85 J
A4A-C3-6	0.944 -	0.664 J	0.655 J	0.664 J	5.65 J	0.827 U	1.63 J
A4A-C3-6-D	0.895 -	0.819 J	0.934 J	0.819 J	7.62 J	0.826 U	2.05 J
A4A-C3-7	0.883 -	0.692 J	0.704 J	0.692 J	3.49 J	0.816 U	1.89 J
A4A-C3-8	1.01 -	0.688 J	0.691 J	0.688 J	6.04 J	0.828 U	1.25 J
A4A-C3-9	1.04 -	0.865 J	0.967 J	0.865 J	6.92 J	0.814 U	1.39 J
A4A-C3-10	0.946 -	0.687 J	0.679 J	0.687 J	6.04 J	0.813 U	2.32 J
A4A-C3-12	1 -	0.625 J	0.61 J	0.625 J	3.28 J	0.823 U	1.72 J
A4A-C3-14	0.985 -	0.887 J	0.965 J	0.887 J	8.44 J	0.823 U	4.01 J
A4A-C3-15	0.963 -	0.748 J	0.747 J	0.748 J	25.2 J	0.809 U	1.66 J
A4A-C3-16	0.933 -	0.542 J	0.529 J	0.542 J	2.84 J	0.806 U	0.337 U
Limit	1.7	1.8	1.7	1.5	20	30	78000
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%
Max. Result	1.04 -	0.887 J	0.967 J	0.887 J	25.2	0.828 U	4.63 J
Max. >= Limit	No	No	No	No	Yes	No	No
W-statistic Prob. #	- -	- -	- -	- -	42.5% (LN)	- -	- -
Test Procedure	- -	- -	- -	- -	Lognormal	- -	- -
Sample Size	12	12	12	12	12	12	12
Nondetects	0	0	0	0	0	12	1
% Nondetects	0%	0%	0%	0%	0%	100%	8%
Est. Mean*	- -	- -	- -	- -	7.39	- -	- -
UCL	- -	- -	- -	- -	11.1	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	- -	- -	- -	- -	pass	- -	- -
a posteriori Sample	- -	- -	- -	- -	3	- -	- -
Size calculation	- -	- -	- -	- -	Pass	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption. The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B
A4A-CU4

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Fluoride
A4A-C4-2	1.42 J	1.2 J	1.21 J	1.2 J	18.3 -	0.877 U	7.49 J
A4A-C4-2-D	1.28 J	0.908 J	0.933 J	0.908 J	16.4 -	0.851 U	7.75 J
A4A-C4-3	1.2 J	1.07 J	1.09 J	1.07 J	20.3 -	1.54 -	4.99 J
A4A-C4-4	1.06 J	0.907 J	0.969 J	0.907 J	7.06 J	0.815 U	7.55 J
A4A-C4-5	1.08 J	0.858 J	0.906 J	0.858 J	3.86 UJ	0.819 U	5.19 J
A4A-C4-6	0.721 J	0.552 -	0.551 -	0.552 -	3.28 J	1.06 U	1.53 J
A4A-C4-7	0.964 J	0.631 J	0.659 J	0.631 J	3.62 UJ	0.84 U	2.52 J
A4A-C4-9	1.65 J	1.47 J	1.47 J	1.47 J	4.42 UJ	0.919 U	2.99 J
A4A-C4-11	1.44 J	0.896 J	0.876 J	0.896 J	19.8 -	0.828 U	4.71 J
A4A-C4-12	1.28 J	0.73 J	0.748 J	0.73 J	11.9 -	0.814 U	4.04 J
A4A-C4-14	0.957 J	0.712 J	0.816 J	0.712 J	8.15 J	0.808 U	6.73 J
A4A-C4-15	1 J	0.652 J	0.609 J	0.652 J	4.56 J	0.804 U	5.09 J
A4A-C4-16	0.977 J	0.619 J	0.658 J	0.619 J	4.08 UJ	0.801 U	4.94 J
Limit	1.7	1.8	1.7	1.5	20	30	78000
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%
Max. Result	1.65 J	1.47 J	1.47 J	1.47 J	20.3	1.54 -	7.75 J
Max. >= Limit	No	No	No	No	Yes	No	No
W-statistic Prob. #	- -	- -	- -	- -	10.0% (LN)	- -	- -
Test Procedure	- -	- -	- -	- -	Wilcoxon	- -	- -
Sample Size	12	12	12	12	12	12	12
Nondetects	0	0	0	0	4	11	0
% Nondetects	0%	0%	0%	0%	33%	92%	0%
Est. Mean*	- -	- -	- -	- -	5.81	- -	- -
UCL	- -	- -	- -	- -	18.3	- -	- -
Prob. > Limit	- -	- -	- -	- -	0.0007	- -	- -
Pass / Fail	- -	- -	- -	- -	pass	- -	- -
a posteriori Sample	- -	- -	- -	- -	5	- -	- -
Size calculation	- -	- -	- -	- -	Pass	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption.
The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B
A4A-CU5

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Arsenic	Fluoride
A4A-C5-1	0.851 J	0.668 -	0.661 -	0.668 -	2.52 J	1 U	5 -	1.43 J
A4A-C5-2	0.869 J	0.689 -	0.715 -	0.689 -	3.72 J	1.04 U	4.1 -	2.73 J
A4A-C5-3	0.696 -	0.733 -	0.724 -	0.733 -	2.54 UJ	0.813 U	3.64 -	2.06 J
A4A-C5-3-D	0.709 -	0.76 -	0.752 -	0.76 -	2.57 UJ	0.806 U	3.19 -	2.07 J
A4A-C5-5	0.794 -	0.728 -	0.7 -	0.728 -	2.57 UJ	0.823 U	4.16 -	2.21 J
A4A-C5-6	0.845 -	0.767 -	0.756 -	0.767 -	4.18 J	0.821 U	3.5 -	2.11 J
A4A-C5-8	0.749 -	0.694 -	0.708 -	0.694 -	6.56 -	0.814 U	4.3 -	2.92 J
A4A-C5-10	0.8 -	0.794 -	0.819 -	0.794 -	10.2 -	0.799 U	5.03 -	2.9 J
A4A-C5-11	0.842 -	0.781 -	0.788 -	0.781 -	6.72 -	0.795 U	5.5 -	3 J
A4A-C5-12	0.823 -	0.759 -	0.734 -	0.759 -	13.7 -	0.807 U	5.14 -	4.34 J
A4A-C5-13	0.955 -	0.898 -	0.914 -	0.898 -	4.6 J	0.816 U	1.85 -	2.8 J
A4A-C5-15	0.666 -	0.523 -	0.539 -	0.523 -	2.2 UJ	0.779 U	4.61 -	2.31 J
A4A-C5-16	0.683 -	0.818 -	0.82 -	0.818 -	14.2 -	0.821 U	4.22 -	1.72 J
Limit	1.7	1.8	1.7	1.5	20	30	12	78000
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%	90%
Max. Result	0.955 -	0.898 -	0.914 -	0.898 -	14.2 -	1.04 U	5.5 -	4.34 J
Max. >= Limit	No	No	No	No	No	No	No	No
W-statistic Prob. #	- -	- -	- -	- -	- -	- -	- -	- -
Test Procedure	- -	- -	- -	- -	- -	- -	- -	- -
Sample Size	12	12	12	12	12	12	12	12
Nondetects	0	0	0	0	3	12	0	0
% Nondetects	0%	0%	0%	0%	25%	100%	0%	0%
Est. Mean*	- -	- -	- -	- -	- -	- -	- -	- -
UCL	- -	- -	- -	- -	- -	- -	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	- -	- -	- -	- -	- -	- -	- -	- -
a posteriori Sample	- -	- -	- -	- -	- -	- -	- -	- -
Size calculation	- -	- -	- -	- -	- -	- -	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption.
The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B
A4A-CU6

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Fluoride	1,1-Dichloroethene	1,2-Dichloroethene (Total)	Tetrachloroethene
A4A-C6-2	1.02 -	0.89 -	0.95 -	0.89 -	3.11 J	0.785 U	1.68 J	0.0008 J	0.0009 U	0.0009 U
A4A-C6-3	0.878 -	0.71 -	0.712 -	0.71 -	7.35 J	0.759 U	2.27 J	0.0043 -	0.0009 U	0.0009 U
A4A-C6-4	0.922 -	0.744 -	0.761 -	0.744 -	4.85 J	0.769 U	1.69 J	0.0022 -	0.001 U	0.001 U
A4A-C6-5	0.879 -	0.699 -	0.678 -	0.699 -	8.56 J	0.788 -	1.64 J	0.001 -	0.0009 U	0.0009 U
A4A-C6-6	0.881 -	0.632 -	0.719 -	0.632 -	4.46 J	0.77 U	1.27 J	0.0048 -	0.0008 U	0.0008 U
A4A-C6-8	0.923 -	0.647 -	0.681 -	0.647 -	6.9 J	0.756 U	1.56 J	0.001 U	0.001 U	0.001 U
A4A-C6-9	0.973 -	0.72 -	0.682 -	0.72 -	3.57 J	0.948 -	1.77 J	0.0012 -	0.001 U	0.001 U
A4A-C6-11	0.822 -	0.811 -	0.801 -	0.811 -	3.69 J	0.759 U	1.48 J	0.0047 -	0.0009 U	0.0009 U
A4A-C6-11-D	0.823 -	0.763 -	0.752 -	0.763 -	2.48 UJ	0.881 U	0.282 U	0.0041 -	0.0008 U	0.0008 U
A4A-C6-12	1.05 -	0.953 -	0.925 -	0.953 -	na	1.03 -	1.77 J	0.0048 -	0.0009 U	0.0009 U
A4A-C6-12A**	na	na	na	na	5.14 J	na	na	na	na	na
A4A-C6-14	0.913 -	0.682 -	0.685 -	0.682 -	4.69 J	0.75 U	1.43 J	0.0012 -	0.0009 U	0.0009 U
A4A-C6-15	0.867 -	0.639 -	0.641 -	0.639 -	6.52 J	0.752 U	2.55 J	0.0014 -	0.001 U	0.001 U
A4A-C6-16	0.942 -	0.884 -	0.913 -	0.884 -	36.4 J	0.79 -	1.45 J	0.0058 -	0.001 U	0.001 U
Limit	1.7	1.8	1.7	1.5	20	30	78000	0.410	0.160	3.6
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%	90%	90%	90%
Max. Result	1.05 -	0.953 -	0.95 -	0.953 -	36.4 J	1.03 -	2.55 J	0.0058 -	0.001 U	0.001 U
Max. >= Limit	No	No	No	No	Yes	No	No	No	No	No
W-statistic Prob. #	--	--	--	--	< 0.01% (LN)	--	--	--	--	--
Test Procedure	--	--	--	--	Wilcoxon	--	--	--	--	--
Sample Size	12	12	12	12	12	12	12	12	12	12
Nondetects	0	0	0	0	0	8	0	1	12	12
% Nondetects	0%	0%	0%	0%	0%	67%	0%	8%	100%	100%
Est. Mean*	--	--	--	--	4.995	--	--	--	--	--
UCL	--	--	--	--	7.35	--	--	--	--	--
Prob. > Limit	--	--	--	--	0.0105	--	--	--	--	--
Pass / Fail	--	--	--	--	pass	--	--	--	--	--
a posteriori Sample	--	--	--	--	6	--	--	--	--	--
Size calculation	--	--	--	--	Pass	--	--	--	--	--

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption.
The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

** - Resample

APPENDIX B
A4A-CU7

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Beryllium	Fluoride
A4A-C7-1	1.25 J	1.27 -	1.23 -	1.27 -	11.3 J	0.843 U	0.749 -	4.74 J
A4A-C7-3	1.26 J	1.11 -	1.08 -	1.11 -	8.82 J	0.857 U	0.616 -	2.84 J
A4A-C7-4	1.29 J	1.23 -	1.18 -	1.23 -	3.61 UJ	0.864 U	0.743 -	2.52 J
A4A-C7-4-D	1.08 J	1.1 -	1.11 -	1.1 -	6.07 J	0.852 U	0.67 -	1.63 J
A4A-C7-6	1.76 J	1.33 -	1.27 -	1.33 -	3.32 J	0.883 U	0.524 -	2.57 J
A4A-C7-7	1.12 J	0.994 -	1.02 -	0.994 -	3.17 UJ	0.81 U	0.708 -	2.55 J
A4A-C7-8	1.27 J	1.3 -	1.28 -	1.3 -	7.22 J	0.857 U	0.773 -	1.74 J
A4A-C7-9	0.881 J	0.806 -	0.808 -	0.806 -	5.64 J	0.798 U	0.485 -	1.63 J
A4A-C7-10	0.764 J	0.792 -	0.791 -	0.792 -	6.89 J	0.813 U	0.482 -	1.17 J
A4A-C7-12	1.02 J	0.932 -	0.926 -	0.932 -	12.8 J	0.824 U	0.662 -	2.49 J
A4A-C7-13	0.818 J	0.773 -	0.821 -	0.773 -	3.07 UJ	0.81 U	0.536 -	2.78 J
A4A-C7-15	1.01 J	0.895 -	0.905 -	0.895 -	10.1 J	0.82 U	0.572 -	2.59 J
A4A-C7-16	0.957 J	0.877 -	0.848 -	0.877 -	13.1 J	0.818 U	0.703 -	2.54 J
Limit	1.7	1.8	1.7	1.5	82	30	1.5	78000
Units	mg/kg	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%	90%
Max. Result	1.76 J	1.33 -	1.28 -	1.33 -	13.1 J	0.883 U	0.773 -	4.74 J
Max. >= Limit	Yes	No	No	No	No	No	No	No
W-statistic Prob. #	71.0% (LN)	- -	- -	- -	- -	- -	- -	- -
Test Procedure	Lognormal	- -	- -	- -	- -	- -	- -	- -
Sample Size	12	12	12	12	12	12	12	12
Nondetects	0	0	0	0	0	12	0	0
% Nondetects	0%	0%	0%	0%	0%	100%	0%	0%
Est. Mean*	1.12	- -	- -	- -	- -	- -	- -	- -
UCL	1.28	- -	- -	- -	- -	- -	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	pass	- -	- -	- -	- -	- -	- -	- -
a posteriori Sample	4	- -	- -	- -	- -	- -	- -	- -
Size calculation	Pass	- -	- -	- -	- -	- -	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption.
The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX B
A4A-CU8

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Fluoride
A4A-C8-1	0.946 -	0.859 -	0.874 -	0.859 -	2.98 J	0.777 U	5.38 J
A4A-C8-3	1.17 -	0.922 -	0.896 -	0.922 -	11.9 -	0.82 U	5.94 J
A4A-C8-4	0.929 -	0.84 -	0.879 -	0.84 -	8.94 -	0.784 U	5.47 J
A4A-C8-5	0.945 -	0.917 -	0.927 -	0.917 -	7 -	0.836 U	3.35 J
A4A-C8-6	0.893 -	0.775 -	0.775 -	0.775 -	2.38 U	0.801 U	3.75 J
A4A-C8-7	0.843 -	0.8 -	0.76 -	0.8 -	8.12 -	0.797 U	4.98 J
A4A-C8-7-D	0.793 -	0.837 -	0.852 -	0.837 -	5.61 -	0.789 U	4.84 J
A4A-C8-9	0.863 -	0.86 -	0.83 -	0.86 -	4.77 J	0.806 -	5.47 J
A4A-C8-10	0.705 -	0.611 -	0.603 -	0.611 -	5.67 -	0.791 U	4.17 J
A4A-C8-12	0.717 -	0.639 -	0.632 -	0.639 -	3.42 J	0.762 U	4.27 J
A4A-C8-14	0.836 -	0.735 -	0.76 -	0.735 -	20.1 -	0.796 U	4.46 J
A4A-C8-15	0.775 -	0.805 -	0.817 -	0.805 -	6.44 -	0.788 U	3.38 J
A4A-C8-16	0.871 -	0.769 -	0.778 -	0.769 -	16.8 -	0.916 -	4.9 J
Limit	1.7	1.8	1.7	1.5	82	30	78000
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%
Max. Result	1.17 -	0.922 -	0.927 -	0.922 -	20.1 -	0.916 -	5.94 J
Max. >= Limit	No	No	No	No	No	No	No
W-statistic Prob. #	- -	- -	- -	- -	- -	- -	- -
Test Procedure	- -	- -	- -	- -	- -	- -	- -
Sample Size	12	12	12	12	12	12	12
Nondetects	0	0	0	0	1	10	0
% Nondetects	0%	0%	0%	0%	8%	83%	0%
Est. Mean*	- -	- -	- -	- -	- -	- -	- -
UCL	- -	- -	- -	- -	- -	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	- -	- -	- -	- -	- -	- -	- -
a posteriori Sample	- -	- -	- -	- -	- -	- -	- -
Size calculation	- -	- -	- -	- -	- -	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption.
The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

APPENDIX C

UST #14 CERTIFICATION SAMPLES, ANALYTICAL RESULTS AND FINAL STATISTICS TABLES

APPENDIX C
HWMU #14 CERTIFICATION SAMPLES, ANALYTICAL RESULTS AND FINAL STATISTICS TABLE

Boring ID	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Technetium-99	Methanol
A4A-C9-UST14-1	0.808 -	0.702 -	0.675 -	0.702 -	2.45 UJ	0.759 U	5.2 U
A4A-C9-UST14-2	0.823 -	0.716 -	0.699 -	0.716 -	4.53 J	0.768 U	5 U
A4A-C9-UST14-3	0.837 -	0.694 -	0.657 -	0.694 -	4.07 J	0.758 U	2.8 U
A4A-C9-UST14-4	0.909 -	0.717 -	0.703 -	0.717 -	2.43 UJ	0.747 U	2.1 U
A4A-C9-UST14-5	0.883 -	0.697 -	0.74 -	0.697 -	4.06 J	0.822 U	5.5 U
A4A-C9-UST14-6	0.91 -	0.664 -	0.646 -	0.664 -	2.67 UJ	0.827 U	1.1 U
A4A-C9-UST14-7	0.898 -	0.713 -	0.692 -	0.713 -	2.29 UJ	0.798 U	4.6 U
A4A-C9-UST14-8	0.834 -	0.642 -	0.647 -	0.642 -	2.55 UJ	0.798 U	2.2 U
Limit	1.7	1.8	1.7	1.5	20	30	31.3
Units	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	pCi/g	mg/kg
Conf. Level	95%	95%	95%	95%	95%	90%	90%
Max. Result	0.91 -	0.717 -	0.74 -	0.717 -	4.53 J	0.827 U	5.5 U
Max. >= Limit	No	No	No	No	No	No	No
W-statistic Prob. #	- -	- -	- -	- -	- -	- -	- -
Test Procedure	- -	- -	- -	- -	- -	- -	- -
Sample Size	8	8	8	8	8	8	8
Nondetects	0	0	0	0	5	8	8
% Nondetects	0%	0%	0%	0%	63%	100%	100%
Est. Mean*	- -	- -	- -	- -	- -	- -	- -
UCL	- -	- -	- -	- -	- -	- -	- -
Prob. > Limit	- -	- -	- -	- -	- -	- -	- -
Pass / Fail	- -	- -	- -	- -	- -	- -	- -
a posteriori Sample	- -	- -	- -	- -	- -	- -	- -
Size calculation	- -	- -	- -	- -	- -	- -	- -

Note: *Est. Mean = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
The maximum value of the two duplicates was used in all statistical equations.
#: This is the highest reported probability of the Shapiro-Wilk W-statistic for tests for the validity of the normality assumption.
The test is performed on the raw data (untransformed) data (N) and the log-transformed data (LN) to test for lognormality.

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APPENDIX D

VARIANCE/FIELD CHANGE NOTICES FOR THE AREA 4A CERTIFICATION SAMPLING PSP

VARIANCE/FIELD CHANGE NOTICE LOG FOR THE PROJECT SPECIFIC PLAN FOR AREA 4A CERTIFICATION SAMPLING

Variance No.	Variance Date	Variance Description	Significant? (Y or N)	Date Signed	Date Distributed	EPA/OEPA Approval
20803-PSP-0003-01	6/8/05	Documents the collection of one physical sample following the removal of a hotspot identified in CU6 during certification efforts in Area 4A.	Y	6-9-05	6-23-05	6-13-05

VARIANCE / FIELD CHANGE NOTICE	Significant? (Yes or No): **YES**	**V/F: 20803-PSP-0003-01**
WBS NO.: PROJECT/DOCUMENT/ECDC #20803-PSP-0003 REV 0		**Page: 1 of 3** 6051
PROJECT TITLE: Project Specific Plan for Area 4A Certification Sampling		**Date: 6/9/05**

VARIANCE / FIELD CHANGE NOTICE (Include justification):

This V/FCN documents the collection of one total uranium (TAL G) sample in Area 4A from CU 6. One sample from sub-CU 6-12 will be collected, following excavation of an above-FRL sample location. The sample will be collected from the original sample location in this sub-CU where the area was excavated, as shown on Figure 1.

The sample ID for the sample to be collected is A4A-C6-12A^1-R,

Where:
A4A = Area 4A
C6 = CU 6
12 = Sample Location within the CU
A = additional sample at this location
1 = depth interval (i.e. 0-0.5 feet)
R = radiological analysis

See Attachment 1 for the TAL and the Sampling and Analytical Requirement.

Surveying required: Yes. Surveyors should survey this location.
Field QC samples required: No
Field data validation: Yes
Analytical data validation: Yes - VSL D
Off-site data package requirements (if applicable): ASL D
The highest total uranium result for the area is 59.9 mg/kg from boring A4A-C6-12.

Justification:
Area 4A, CU 6 is located within the high leachability area where the total uranium FRL is 20 mg/kg. The total uranium result at sample location A4A-C6-12 is 59.9 mg/kg, which is greater than two times the total uranium FRL, therefore the CU has failed the hot spot criterion. The above FRL sample location was delineated and excavated to remove the contamination. Following excavation, it is necessary to sample the location again and the result of the additional sample taken under this V/FCN will replace the above FRL uranium sample result (now excavated) in the statistical analysis. Per Section 3.4 of the PSP, the changes to the PSP will be documented with a V/FCN.

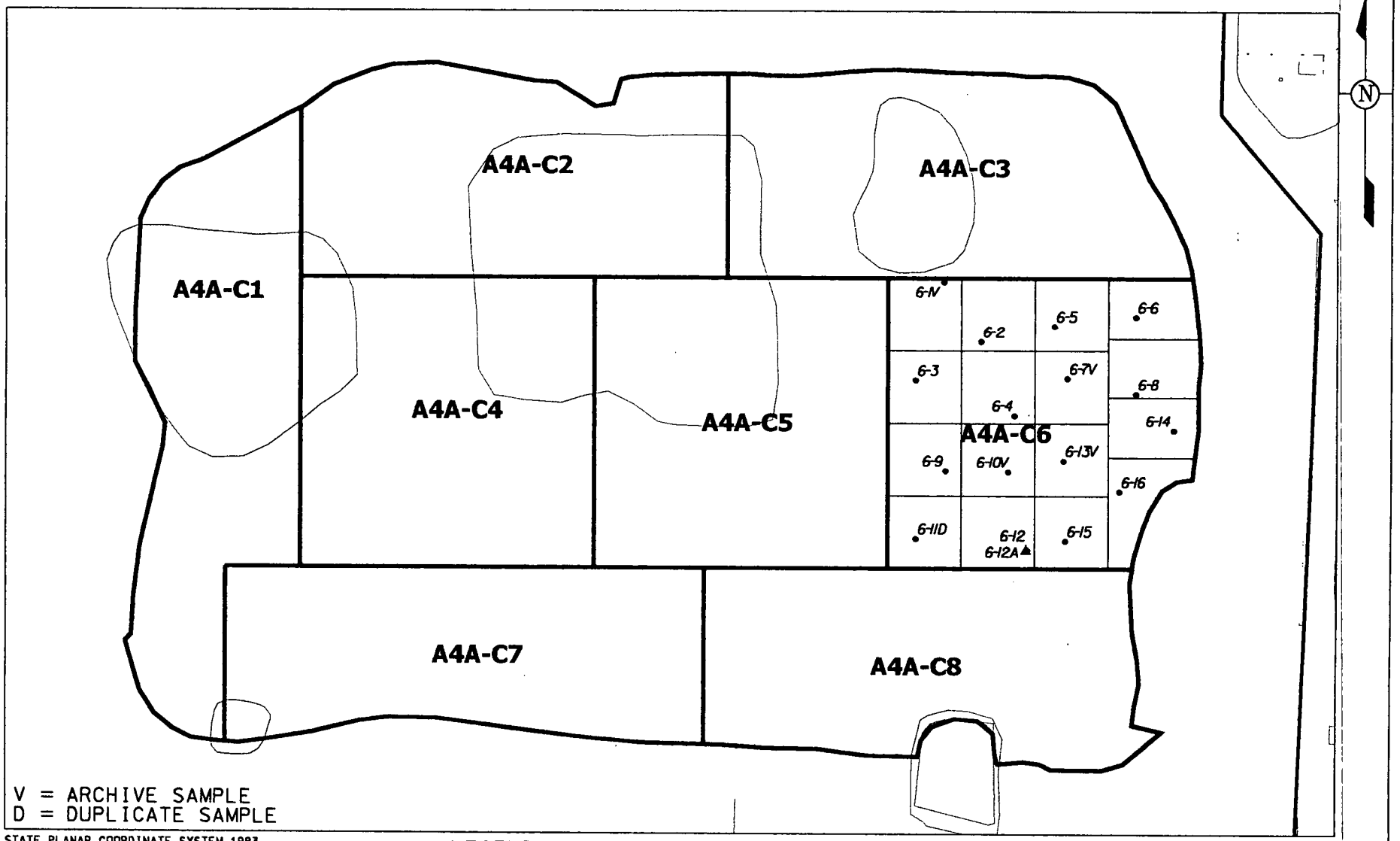
REQUESTED BY: Denise Arico Date: 6/9/05

X IF REQD	VARIANCE/FCN APPROVAL	DATE	X IF REQD	VARIANCE/FCN APPROVAL	DATE
X	QUALITY ASSURANCE: R. Frisko Dan Wessel	6-9-05	X	PROJECT MANAGER: J.D. Chiou	6/9/05
	DATA QUALITY MANAGEMENT		X	CHARACTERIZATION MANAGER: F. Miller	6/9/05
X	ANALYTICAL CUSTOMER SUPPORT: Amy Meyer	6/15/05		RTIMP Manager	
	WAO		X	Sampling Manager: T. Buhrlage T. Buhrlage	6/10/05

VARIANCE/FCN APPROVED [X]YES [ ]NO REVISION REQUIRED: [ ]YES [x]NO

DISTRIBUTION

PROJECT MANAGER:	DOCUMENT CONTROL: Jeannie Rosser	OTHER:
QUALITY ASSURANCE:	CHARACTERIZATION MANAGER: Frank Miller	OTHER:
FIELD MANAGER:	OTHER:	OTHER:



V = ARCHIVE SAMPLE
D = DUPLICATE SAMPLE

STATE PLANAR COORDINATE SYSTEM 1983

LEGEND:

• PREVIOUSLY SAMPLED LOCATION

▲ PROPOSED SAMPLE LOCATION

SCALE

120 60 0 120 FEET

DRAFT

v:\2fm12\dgn\4a_009.dgn

09-JUN-2005

FIGURE 1.

CU	Location	Depth (feet)	Sample ID	TAL	Northing	Easting
6	6-12A	0-0.5	A4A-C6-12A^1-R	G	480294.58	1350138.87

TAL 20803-PSP-0003 G

Component	MDL
Total Uranium	2 mg/kg

SAMPLING AND ANALYTICAL REQUIREMENTS

Analyte	Sample Matrix	Lab	ASL	TAT	Preservative	Holding Time	Container	Sample Volume/Mass
TAL G	Solid	Offsite	D	3 day	None	12 months	Appropriate Plastic or Glass	300 g (900 g)*

*At the direction of the Field Sampling Lead, triple the specified volume must be collected for all samples at one location in order for the contract laboratory to perform the required quality control analysis.
The samples shall be idnetifed on the Chain of Custody/Request for Analysis forms as "designated for laboratory QC".

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Southwest District

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Bob Taft, Governor
Bruce Johnson, Lt. Governor
Joseph P. Koncelik, Director

6051

MEMO

TO: J.D. Chiou

FROM: Donna Bohannon

DATE: June 13, 2005

SUBJECT: V/FCN 20803-PSP-0003-01 for PSP for Area 4A Certification Sampling

This V/FCN documents the collection of one certification sample after excavation of a hotspot from CU6 in Area 4A. Ohio EPA approves of this V/FCN.