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CERTIFICATION REPORT FOR AREA 1, PHASE I SEDIMENT TRAPS 2 AND 3

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

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U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

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LIST OF ACRONYMS AND ABBREVIATIONS

A1PI	Area 1, Phase I
ASCOC	area specific constituent of concern
ASL	analytical support level
CDL	Certification Design Letter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	constituent of concern
CRDL	contract required detection limit
CU	certification unit
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FRL	final remediation level
GIS	Geographical Information System
HAMDC	highest allowable minimum detectable concentration
HPGe	high purity germanium detector
LCS	laboratory control sample
MDC	minimum detectable concentration
μg/kg	milligrams per kilogram
OU	Operable Unit
OSDF	On-Site Disposal Facility
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
ppm	parts per million
PSP	Project Specific Plan
QA/QC	Quality Assurance/Quality Control
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RTRAK	Radiation Tracking System
ROD	Record of Decision
SED	Sitewide Environmental Database
SEP	Sitewide Excavation Plan
SCQ	Sitewide CERCLA Quality Assurance Project Plan
TPU	total propagated uncertainty
UCL	upper confidence level
V&V	verification and validation
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

This certification report presents the information and data used by the U.S. Department of Energy (DOE) to determine that existing soil concentrations do not exceed the final remediation levels (FRLs) in Area 1, Phase I (A1PI) Sediment Traps 2 and 3 at the Fernald Environmental Management Project (FEMP). On the basis of this reported information and supporting project files, DOE has determined that no remedial actions are required in this area of the site; therefore, this area can be considered "certified." Upon approval from the regulatory agencies, DOE intends to proceed with development of a wetland mitigation area.

Each Sediment Trap was divided into three certification units (CUs) for a total of six CUs, as discussed in the Certification Design Letter (CDL) for A1PI Sediment Traps 2 and 3. Certification sampling was conducted in each CU to verify that the certification criteria were achieved. These criteria state that: 1) the mean concentrations or activities of the primary area-specific constituents of concern (ASCOCs) within a CU are less than the final remediation levels (FRLs) at the 95 percent upper confidence level (UCL) (90% for secondary ASCOCs); and 2) no certification result can exceed two-times the FRL (i.e., the "hot spot" criterion). If either of these criteria is not met, then further investigation and possible excavation is required. If both of these criteria are met for a CU, than it can be released for final land use. A1PI Sediment Traps 2 and 3 will be considered certified when the U.S. and Ohio Environmental Protection Agencies (EPA) agree that the certification criteria have been met within all six A1PI CUs.

Based on historical data, no above-FRL contamination was present within the A1PI Sediment Traps; as a result, certification began without conducting remedial activities. The certification samples were analyzed at laboratories on the FEMP Approved Laboratories List per the Sitewide CERCLA Quality Assurance Project Plan (SCQ). All these samples were analyzed and reported at the required analytical support level (ASL). Analytical data packages included sample results with associated quality assurance/quality control (QA/QC) data and all applicable raw data. The data were also subjected to the required validation and verification process, which did not identify any significant quality concerns.

All CUs achieved the certification criteria. The determination of passing or failing certification was based on a review of certification sample analytical results from each CU against the certification

criteria. Statistical analysis was not necessary to determine if a ASCOC passed certification for a particular CU in most cases, since only one result (including all ASCOCs, all CUs) exceeded the associated FRL. When the statistical analyses were run, all CUs passed final certification relative to the average constituent of concern concentration and the "hot spot" determination on the first round of certification, and no additional corrective actions were necessary.

DOE has restricted access to certified areas in order to maintain their integrity prior to final land use development. A FEMP procedure (EP-0008) has been developed to implement a process to protect certified areas from becoming recontaminated. Upon approval of this report by the EPAs, development of the wetland mitigation area will begin.

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 existing soil contamination does not exceed the FRLs within Area 1 Phase I (A1PI) Sediment Traps (ST) 2 and 3. As identified in the A1PI Sediment Traps 2 and 3 Certification Design Letter (CDL, DOE 1998a), this soil is being certified in order to proceed with future land use activities. On the basis of this reported information, DOE considers remedial goals achieved.

1.2 BACKGROUND

In the Operable Unit (OU) 5 Record of Decision (ROD) (DOE 1996a), DOE committed to excavating contaminated soil that exceeds health-based final remediation levels (FRLs), with final disposition of the excavated material in the On-Site Disposal Facility (OSDF) or at an off-site disposal facility if OSDF waste acceptance criteria (WAC) are exceeded. The OU5 Remedial Investigation Report (DOE 1995) defined the extent of above-FRL soil contamination and, in general, indicated widespread contamination in approximately 430 acres of the 1050-acre Fernald Environmental Management Project (FEMP). Approximately 1.8 million cubic yards of contaminated soil are anticipated to be excavated and placed within the OSDF.

In the OU5 Remedial Action Work Plan (RAWP) (DOE 1996b), DOE committed to preparing a Sitewide Excavation Plan (SEP) to define the overall approach to implementing the soil and at- and below-grade debris cleanup obligations identified in the OU2, OU3, and OU5 RODs. Subsequently, the FEMP has been divided into distinct remedial areas and phases for soil remediation, based on the OU remediation schedule. The Area 1, Phase I (A1PI) Certification Report was approved by the regulatory agencies in June 1998; however, it did not include Sediment Traps 2 and 3, which are addressed in this Certification Report.

1.3 AREA DESCRIPTION

The subject area includes two A1PI sediment traps located in the northeast corner of the Fernald Environmental Management Project (FEMP) site, to the east of the North Access Road. The two traps (A1PI-ST-2 and A1PI-ST-3), as shown in Figure 1-1 were constructed in Summer 1996 for storm water control during A1PI remedial activities. As part of the A1PI design, six inches of soil were removed

from the surface of A1PI prior to certification. However, these sediment traps were constructed before the A1PI excavation, and the soil that was removed to form the sediment trap area was placed along the trap edges to form the berms.

A1PI-ST-2, the northern sediment trap, is approximately 1.02 acres in size, with the berm located on the eastern side. The berm contains approximately 30,060 cubic feet of soil. A1PI-ST-3, the southern sediment trap, is approximately 0.4 acres in size, with a berm surrounding the trap. The soil volume of this berm is approximately 30,766 cubic feet.

1.4 SCOPE

The scope of this report includes the certification of the A1PI Sediment Traps 2 and 3, as described above. The certification design follows the general approach outlined in Section 3.4 of the Siewide Excavation Plan (SEP; DOE 1998b). The areas requiring certification for both A1PI-ST-2 and A1PI-ST-3 include the sediment trap areas, the berms, and the soil beneath the berms. Therefore, three CUs were established within each sediment trap, one to cover the sediment trap area, one to cover the berm, and one to cover the soil beneath the berm (established directly beneath the CU that covers the berm).

1.5 OBJECTIVES

The objectives of this Certification Report are:

- Describe the precertification activities
- Describe the analytical methods, data validation processes, data reduction and statistical processes used to support the certification process
- Present certification sampling results for the 6 CUs being certified
- Present the statistical analysis showing that all 6 CUs have passed the certification criteria, including FRL attainment and hot spot criteria, as discussed in Section 2.0
- Describe access controls implemented to prevent recontamination.

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1.6 REPORT FORMAT

This certification report is presented in five 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 to sampling and analysis used for certification
Section 3.0	Overview of Field Activities: 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	CU Maps and Statistics Tables

1.7 FEMP CERTIFICATION MASTER MAP

In order to track certification and characterization for reuse areas at the FEMP, DOE will include a controlled map showing the status of the soil remediation areas and phased areas with all Certification Reports and CDLs. This map is included in this Certification Report as Figure 1-3, and has been updated to reflect the status of the approvals of Area 1 Phase I, Area 8 Phase I, and Area 1 Phase II Sector 1, 2a and the Conveyance Ditch.

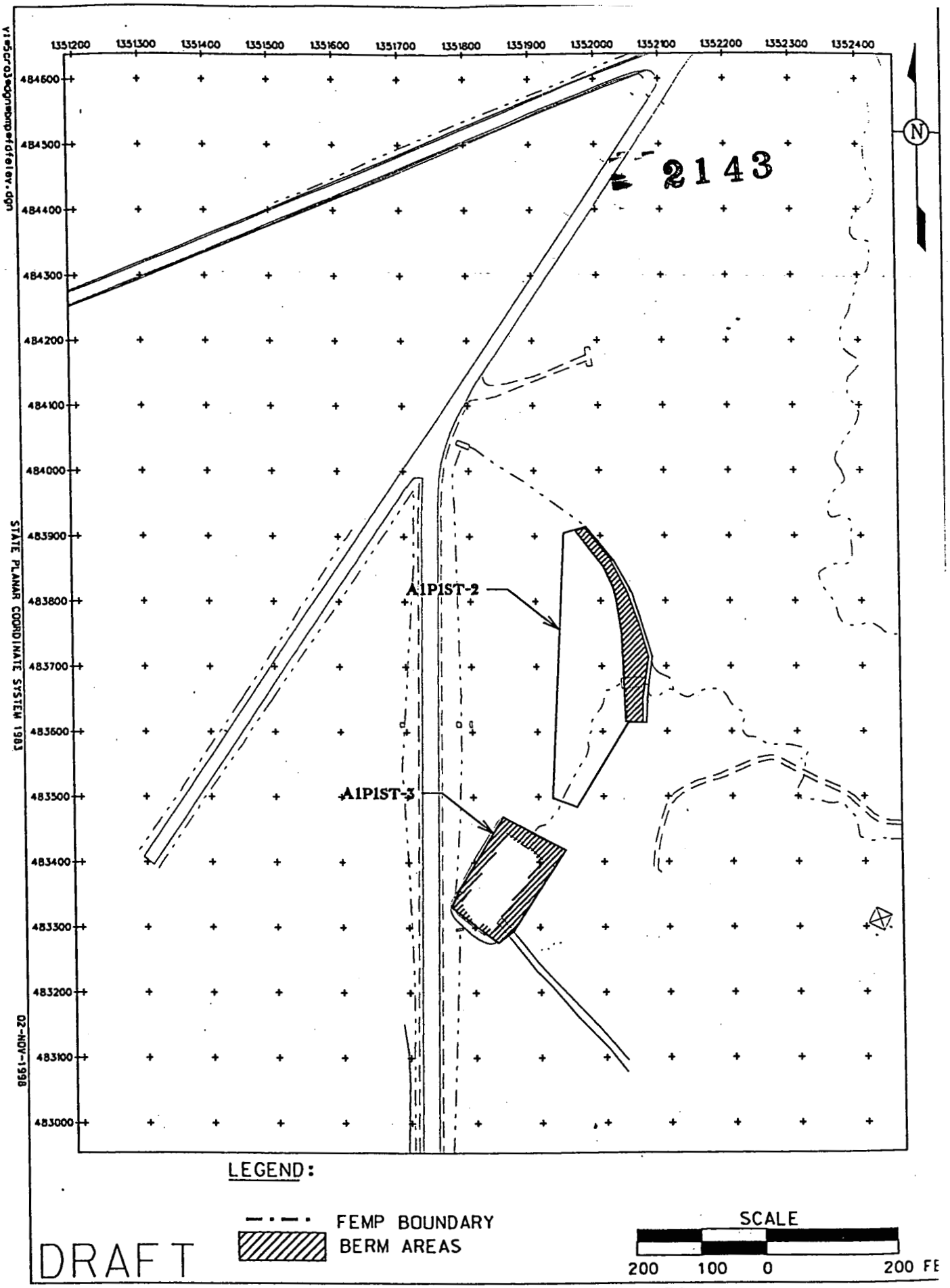

FIGURE 1-1. A1P1 SEDIMENT TRAPS

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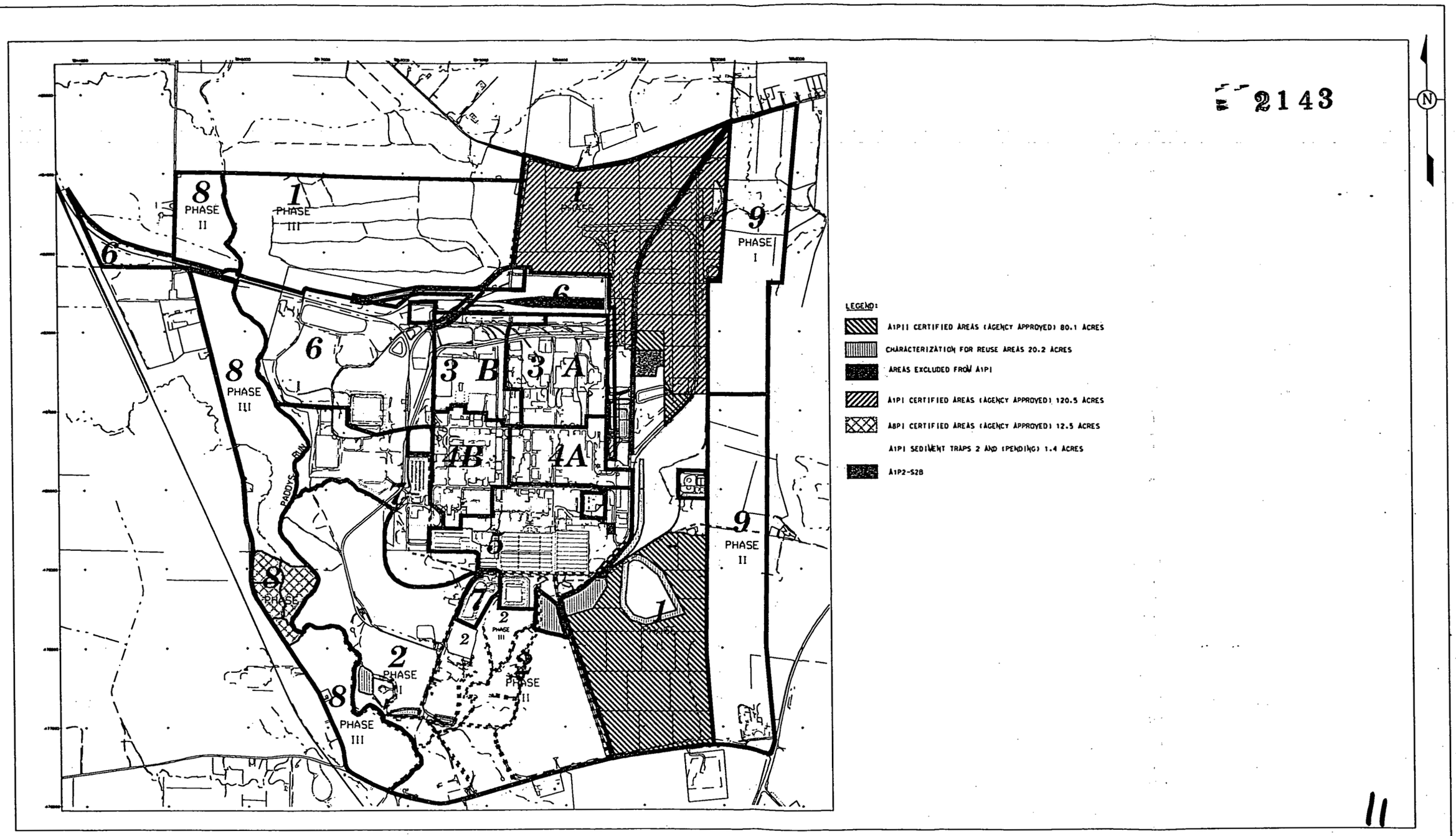

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FIGURE 1. FEMP CONTROLLED CERTIFICATION MASTER MAP

2.0 CERTIFICATION APPROACH

2.1 CERTIFICATION STRATEGY

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This section summarizes the area specific constituents of concern (ASCOCs) selection process and the certification approach, including CU establishment, sampling design, and statistical analysis. The general purpose of certification sampling is to verify that the mean concentrations or activities of primary ASCOCs remaining in the soil of a CU following remedial activities are less than the FRLs at the 95 percent upper confidence level (UCL), and at the 90 percent UCL for secondary ASCOCs. The certification process also includes the hot spot criterion, which states that if any of the certification samples exceeds two-times the FRL, further action is required as discussed in Section 2.2.5. If the mean residual ASCOC concentrations or activities are below the FRLs within the respective confidence bounds, and the hot spot criterion is met, then the remedial objectives have been achieved for the CU. It can then be released for regrading, reseeding and final land use. The general certification strategy is described in Section 3.4 of the draft final SEP (DOE 1998b), and the A1PI-specific strategy is described in the CDL for A1PI (DOE 1998a).

2.1.1 ASCOC for A1PI Sediment Traps 2 and 3

Since the ASCOC selection process for A1PI included the A1PI-ST-2 and A1PI-ST-3 areas, these areas will be certified using the A1PI ASCOC list, with the exception of thorium-230 and cesium-137, and aroclor 1260. While these analytes were part of the A1PI ASCOC list, further review of historical data shows no concentrations above the FRL for thorium-230, cesium-137 or aroclor 1260 in the subject areas. The rationale for not analyzing thorium-230 and cesium-137 is discussed in the CDL (Revision 0); the rationale for not analyzing aroclor 1260 is discussed in the revised CDL (Revision 1), submitted July 24, 1998. Furthermore, these analytes passed all the certification criteria in all A1PI CUs.

TABLE 2-1

ASCOC LIST 2143

Primary ASCOCs	FRL	SECONDARY ASCOCs	FRL
Total Uranium	82 mg/kg	Arsenic	12.0 mg/kg
Thorium-232	1.5 pCi/g	Beryllium	1.5 mg/kg
Radium-226	1.7 pCi/g		
Radium-228	1.8 pCi/g		

2.2 CERTIFICATION APPROACH

2.2.1 Certification Design

The certification design follows the general approach outlined in Section 3.4 of the SEP (DOE 1998b). The areas requiring certification for both A1PI-ST-2 and A1PI-ST-3 include the sediment trap areas, the berms, and the soil beneath the berms. Therefore, three CUs were established within each sediment trap, one to cover the sediment trap area, one to cover the berm, and one to cover the soil beneath the berm (established directly beneath the CU that covers the berm). Figure 3 shows the CU design for both sediment basins to be certified under the scope of this CDL.

Since the berm CUs are directly over the CUs representing the area beneath the berms, one set of sample locations were be established for both CUs. During sample collection, the berm certification samples were taken at the 0 to 6-inch interval, while the certification samples for the CUs below the berms were collected from the top 0 to 6-inch of native soil beneath the berms. The depth of the native soil was confirmed by a field geologist, historical (pre-excavation) elevation data, and Geoprobe sampling. The sample locations for all the CUs within the scope of this CDL are also shown in Figure 2-1.

Per the SEP, 16 discrete soil samples were collected from random locations as discussed above. Each sample will be collected from the 0 to 6-inch soil interval at the designated and surveyed sample point. Three randomly selected samples from each quadrant of a CU (12 total) were submitted for analysis for the appropriate ASCOCs, while the remaining four were archived.

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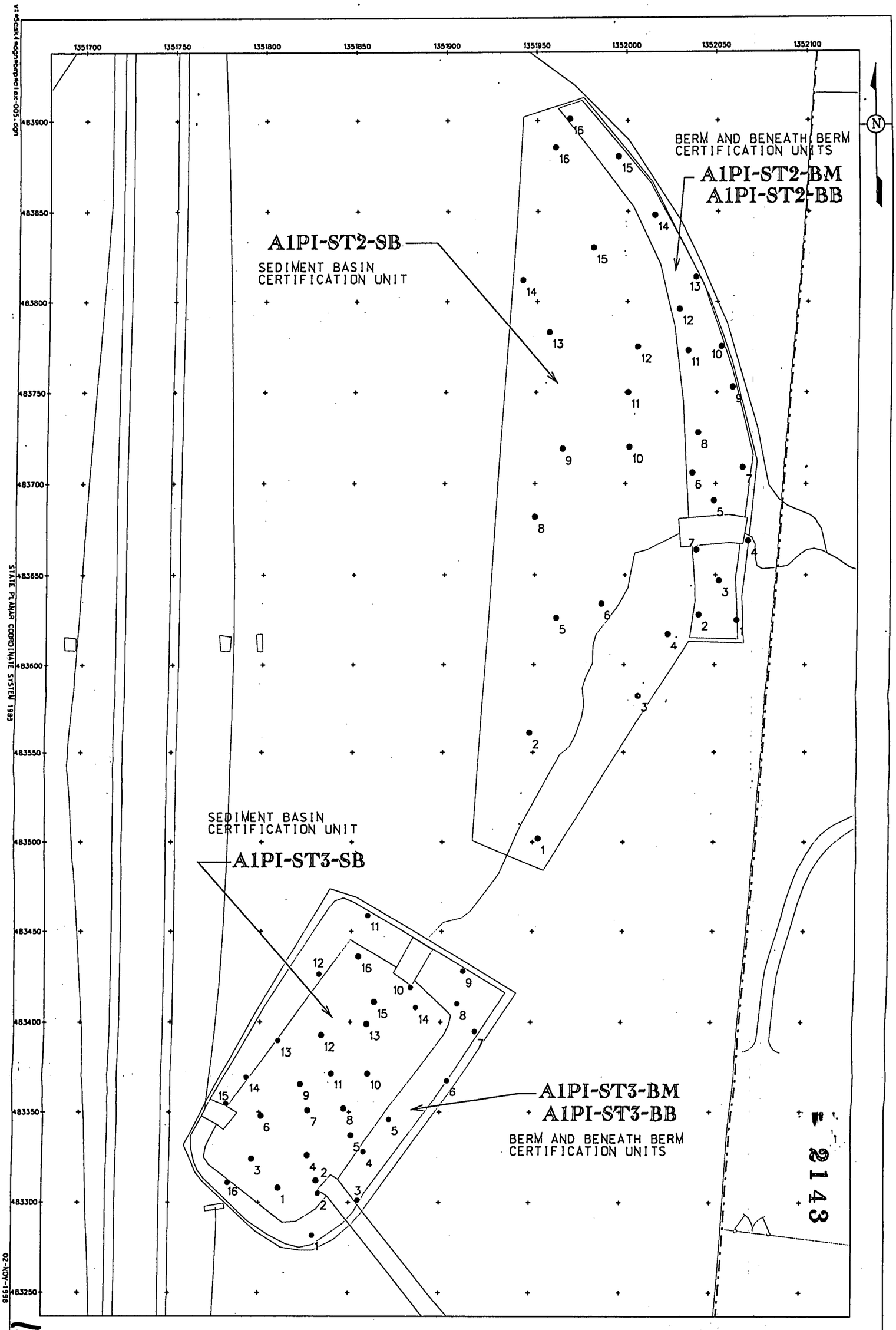
2.2.3 Statistical Analysis

The statistical analysis of certification samples is discussed in the revised Appendix G of the SEP. The revised Appendix G will be included in the final SEP, which will be submitted to the EPAs in Summer 1998. Statistical analysis of certification results is not necessary to determine if an ASCOC passed certification in a CU if all of the results for that ASCOC in that CU were below the FRL. If any sample result does exceed the associated FRL, then statistical analyses will be performed and two criteria must be met for the CU to pass certification. If the data distribution is normal or lognormal, the first criterion is to compare the 95 percent UCL on the mean of each primary ASCOC to its FRL, resulting in the pass/fail decision on each individual CU. If the data distribution was not normal or lognormal, the appropriate nonparametric approach, discussed in the revised Appendix G of the SEP, was used to evaluate the 95 percent UCL on the mean. The second criterion is related to the hot spot criterion, which states that if a certification sample for a primary radiological ASCOC exceeds two-times the FRL, then further action is necessary as shown on Figure 3-11 of the draft final SEP (DOE 1998b). Specifically, if the contamination is not widespread in the CU and is limited to an individual sample location, the high purity germanium detector (HPGe) will be used to delineate the area as described in Section 3.3.3 of the Real-Time User's Manual (DOE 1998c). If the area is less than 10 square meters (m^2) then the acceptable concentration is three times the FRL. If the area is larger than 10 m^2, then the acceptable concentration is two times the FRL. When the given UCL on the mean for each COC is less than its FRL, and the hot spot criterion is met, the CU has met both criteria and will be considered certified.



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LEGEND:

• SAMPLE LOCATION

—·—·— FEMP BOUNDARY

SCALE

50 25 0 50 FEET

FIGURE 2-1. CU DESIGN AND SAMPLE LOCATIONS

3.0 OVERVIEW OF FIELD ACTIVITIES

3.1 AREA PREPARATION

Based on historical data, no soil required remedial activities prior to certification sampling. Historical and precertification data are discussed in detail in the CDL (DOE 1998a).

3.2 CHANGES TO SCOPE OF WORK

The scope of work for A1PI certification sampling was documented in the final CDL (DOE 1998a), and there were no changes during field implementation. Final certification sampling locations and CU boundaries remained as identified, and all analyses were carried out as planned. The only notable change was the deletion of aroclor 1260 from the ASCOC list, as discussed in the revised CDL submitted on July 24, 1998.

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4.0 ANALYTICAL METHODOLOGIES, DATA VALIDATION PROCESSES AND DATA REDUCTION

4.1 ANALYTICAL METHODOLOGIES

A1PI samples were analyzed at FEMP on site laboratory, which is on the FEMP Approved Laboratories List per the Sitewide CERCLA Quality Assurance Project Plan (SCQ). To be on the FEMP Approved Laboratories List, a laboratory must comply with SCQ requirements and be audited within one year of sample analysis. The SCQ is also the source for analytical methodologies (Appendix G), data validation and verification, and analytical and field QA/QC requirements.

For all the certification data, ASL D analytical requirements were selected per Appendix G of the SCQ. The laboratory reported an ASL D data package, which includes all the raw data. For the total uranium data, the detection limit was set at 10 percent of the FRL (8.2 μg/kg), which is higher than the detection limit documented in Appendix G. Similarly, the detection limit was set at approximately 10 percent of the FRL (1.5 pCi/g) for thorium-228 and thorium-232, which is also higher than the detection limit documented in Appendix G. Therefore, by definition, the ASL detection limit for uranium, thorium-228 and thorium-232 is ASL E, although all other ASL D requirements are met for these analyses. The analytical data packages provided by the contract laboratory included sample results with associated QA/QC data and all applicable raw data.

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 percent recovery for duplicate samples for each analyte. Laboratories were required to meet these specifications using the methodologies described below.

Total Uranium

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

$$\text{Total uranium (mg/kg)} = (2.998544) \times \text{uranium-238 gamma spectrometry result (pCi/g)}$$

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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 level of confidence 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 (LCS) 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
- Tracer yields
- 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 ten percent of the certification data were validated to validation level D. This validation included the same review process as for ASL B, but included a systematic review of the raw data and recalculations. In exceedence of the project requirement for 10 percent validation, two of the four analytical releases (i.e., all data from CUs 01 and 02) were validated to level D, while all remaining data were verified for completeness but were not validated.

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 this 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.

Review of the data set in the Revision A November, 1998 Certification Report by the regulatory agencies noted a significant amount of "J" qualifers. Further review of the reasons for the qualification showed that for radium-226, radium-228, thorium-228, and thorium-232 the primary reason for the "J" qualification was due to duplicate precision from the internal laboratory duplicate and the field duplicate. The data validation criterion is based on the calculation of the relative error ratio (RER) which is calculated by dividing the absolute value of the difference between duplicates by the square root of the sum of the squared total propagated uncertainties (TPU). The RER is a statistical-based criterion; it is equivalent to the statistical comparison of two means. If the RER is greater than 2, all of the data in the batch associated with that duplicate are qualified as estimated (J). This acceptance criterion is defined in the SCQ.

Upon further review of the data in question by data validation, it was found that counting uncertainty (CU) rather than the TPU in calculating the RER for gamma spectrometry data. Because the CU is smaller than the TPU, the RER calculated in this way will be erroneously high, so consequently some duplicates that actually meet the RER criterion appeared to fail.

A related issue is that field duplicates have been evaluated using the same RER criterion. When a field duplicate failed the criterion, the entire batch was J-qualified. This conflicts with the Data Validation Plan included in Appendix D of the SCQ. Appendix D, Section 12.12.2 D states that "If the RER is greater than 2.0, the results of the field duplicate and its associated sample ONLY are to be qualified as estimated (J)." Other samples in the batch should not be qualified on the basis of the field duplicate RER.

For total uranium the data was qualified because the elevated TPUs. If the TPU is greater than 50% of the sample activity the result is qualified as "J". Since the TPU values do not differ significantly from counting uncertainty values, when the sample concentration is low the TPUs are high relative to the sample result. Since the reported total uranium results are far below the FRL no further action is necessary.

Since the data was qualified incorrectly, the data set has been revised to reflect the correct application of the data validation criteria and the correct data set is presented in Appendix A.

4.3 DATA REDUCTION

Each sample used to support the certification decision was entered in the FEMP Sitewide Environmental Database (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
- Certification Unit - Each sample is assigned to a CU based on location.

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) - This value represents the uncertainty associated with the reported result. TPU includes the counting error, as well as uncertainty from other laboratory measurements and data reduction. (Applicable to radiological parameters only)

- 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 (MDC) , the validation result becomes the MDC value

- Validation TPU - The TPU based on the validation process

- Validation Qualifier - The qualifier assigned as a result of the data validation process

- Validation Units - The units in which the Validation Result is reported.

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

1. All the data for each CU were queried from the SED. All 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 highest of the two duplicate results was used in the statistical calculations

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

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5.0 CERTIFICATION EVALUATION AND CONCLUSIONS

5.1 CERTIFICATION RESULTS AND EVALUATION

All CUs for A1PI passed the certification criteria. Certification success or failure was based on a review of certification sample data from each CU against criteria discussed in Section 2.2.5. All CUs passed final certification relative to the average COC concentration and the 2 x FRL "hot spot" criterion. All CUs passed on the first round of certification, and no additional corrective actions were necessary. Final certification data are presented in Appendix A. A review of the certification results reveals only one FRL exceedence, an arsenic result of 12.8 mg/kg exceeded the FRL of 12.0 mg/kg at location A1P1-ST3-BB-03.

5.2 A1PI CERTIFICATION CONCLUSIONS

All of the CUs have passed certification statistical analyses relative to the determination of average residual soil concentrations within applicable confidence bounds of all the ASCOCs, and relative to the 2x FRL "hot spot" criterion. Based on these results, DOE has determined that the remedial objectives in the OU5 ROD have been achieved in A1PI, and no remedial actions are required. The subject areas will be released for final land use.

6.0 PROTECTION OF CERTIFIED AREAS

DOE has restricted access to certified areas in order to maintain their integrity prior to transferral for final land use. FEMP procedure EP-0008 has been developed to implement a process to protect certified areas from becoming recontaminated.

The procedure is summarized as follows:

- At the initiation of certification sampling activities for a remediation area, temporary fencing will be installed to delineate the perimeter of the "certified" area
- Signs will be posted upon the temporary perimeter fencing to require access approval for entry into the "certified" area
- To gain access to the "certified" area, the individual(s) or project desiring admittance will submit a written request to the responsible project manager
- Any equipment to be used within the "certified" area must have been clean in accordance with FEMP certified area access procedure subsequent to any use in a uncertified areas; or for any work, before entry into a "certified" area
- FEMP management team representatives must instruct general employees/operators on the entry and exit requirements for a "certified" area.

After DOE certifies the remediated area, it will be transferred 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

CERTIFICATION SAMPLES, ANALYTICAL RESULTS AND STATISTICS TABLES

CU: A1P1-ST2-BB

Station Number	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Arsenic	Beryllium
A1P1-ST2-BB-01	1.36 -	1.35 -	1.33 -	1.35 -	2.84 U	8.00 -	0.98 U
A1P1-ST2-BB-02	1.12 -	1.13 -	1.11 -	1.13 -	5.73 J	5.90 U	0.70 U
A1P1-ST2-BB-02D	1.05 -	1.11 -	1.08 -	1.11 -	7.76 -	4.00 U	0.60 U
A1P1-ST2-BB-03	1.09 J	1.07 -	1.08 -	1.07 -	3.57 J	6.40 -	0.80 U
A1P1-ST2-BB-05	1.26 -	1.20 -	1.18 -	1.20 -	5.45 J	6.80 -	0.83 U
A1P1-ST2-BB-06	1.13 -	1.15 -	1.15 -	1.15 -	2.78 U	2.90 U	0.55 U
A1P1-ST2-BB-07	1.11 -	1.20 -	1.21 -	1.20 -	5.62 J	5.60 U	0.71 U
A1P1-ST2-BB-09	0.99 -	1.00 -	0.96 -	1.00 -	4.02 J	3.50 U	0.61 U
A1P1-ST2-BB-10	1.07 -	0.85 -	0.84 -	0.85 -	2.87 U	4.50 U	0.65 U
A1P1-ST2-BB-11	1.06 -	1.09 -	1.03 -	1.09 -	2.81 U	7.80 -	1.00 U
A1P1-ST2-BB-13	0.99 -	0.99 -	0.96 -	0.99 -	2.92 U	6.10 -	0.67 U
A1P1-ST2-BB-14	0.94 -	1.06 -	1.03 -	1.06 -	4.65 J	4.30 U	0.75 U
A1P1-ST2-BB-15	0.87 -	1.17 -	1.12 -	1.17 -	4.31 J	4.10 U	0.65 U
FRL	1.70	1.80	1.70	1.50	82.00	12.00	1.50
Units	pCi/g	pCi/g	pCi/g	pCi/g	ug/g	mg/kg	mg/kg
Confidence Level	95%	95%	95%	95%	95%	90%	90%
Max Result	1.36 @	1.35 @	1.33 @	1.35 @	7.76 @	8.00 @	1.0 U @
Standardized Skewness	--	--	--	--	--	--	--
W-Statistic Probability *	--	--	--	--	--	--	--
Test Procedure	--	--	--	--	--	--	--
Sample Size	12	12	12	12	12	12	12
Estimated Mean**	1.08	1.10	1.08	1.10	3.80	2.88	0.35
UCL of the Mean	--	--	--	--	--	--	--
Non-Parametric Prob.	--	--	--	--	--	--	--
Est. Mean - Pass / Fail	--	--	--	--	--	--	--
2x Rule - Pass / Fail	--	--	--	--	--	--	--
a posteriori Sample Size Calculation	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass

Note: Estimated Mean** = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
Results reported below the MDC were corrected to: "<MDC value> UJ"
The maximum value of the two duplicates was used in all statistical equations.
W-Statistic Probability* = 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.
@ - Maximum result below the FRL, Certification Statistics not calculated - Analyte passes certification.

CU: A1P1-ST2-BM

Station Number	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Arsenic	Beryllium
A1P1-ST2-BM-01	1.40 -	1.20 -	1.20 -	1.20 -	8.20 -	5.30 -	0.44 -
A1P1-ST2-BM-02	1.40 -	1.20 -	1.20 -	1.20 -	8.00 -	4.20 UJ	0.21 J
A1P1-ST2-BM-02D	1.50 J	1.20 J	1.20 J	1.20 J	7.10 J	3.40 UJ	0.43 J
A1P1-ST2-BM-03	1.30 -	1.10 -	1.10 -	1.10 -	4.60 -	4.20 UJ	0.40 -
A1P1-ST2-BM-05	1.40 -	1.20 -	1.20 -	1.20 -	4.60 -	4.60 UJ	0.55 -
A1P1-ST2-BM-06	1.30 -	1.10 -	1.10 -	1.10 -	4.20 -	4.10 UJ	0.49 -
A1P1-ST2-BM-07	1.28 -	1.10 -	1.10 -	1.10 -	4.20 -	2.60 UJ	0.46 -
A1P1-ST2-BM-09	1.30 -	1.10 -	1.10 -	1.10 -	3.70 J	5.50 UJ	0.49 -
A1P1-ST2-BM-10	1.40 -	1.10 -	1.00 -	1.10 -	4.20 -	5.70 J	0.54 -
A1P1-ST2-BM-11	1.30 -	1.10 -	1.10 -	1.10 -	3.70 J	6.00 J	0.52 -
A1P1-ST2-BM-13	1.40 -	1.10 -	1.10 -	1.10 -	4.30 -	4.00 UJ	0.56 -
A1P1-ST2-BM-14	1.20 -	0.98 -	0.97 -	0.98 -	12.00 -	4.80 UJ	0.80 -
A1P1-ST2-BM-15	1.30 -	1.00 -	1.00 -	1.00 -	6.40 -	3.70 UJ	0.38 -
FRL	1.70	1.80	1.70	1.50	82.00	12.00	1.50
Units	pCi/g	pCi/g	pCi/g	pCi/g	ug/g	mg/kg	mg/kg
Confidence Level	95%	95%	95%	95%	95%	90%	90%
Max Result	1.50 @	1.20 @	1.20 @	1.20 @	12.00 @	6.00 @	0.80 @
Standardized Skewness	--	--	--	--	--	--	--
W-Statistic Probability *	--	--	--	--	--	--	--
Test Procedure	--	--	--	--	--	--	--
Sample Size	12	12	12	12	12	12	12
Estimated Mean**	1.34	1.10	1.10	1.10	4.45	2.20	0.51
UCL of the Mean	--	--	--	--	--	--	--
Non-Parametric Prob.	--	--	--	--	--	--	--
Est. Mean - Pass / Fail	--	--	--	--	--	--	--
2x Rule - Pass / Fail	--	--	--	--	--	--	--
a posteriori Sample Size Calculation	2 Pass	2 Pass	2 Pass	2 Pass	3 Pass	2 Pass	1 Pass

Note: Estimated Mean** = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
Results reported below the MDC were corrected to: "<MDC value> UJ"
The maximum value of the two duplicates was used in all statistical equations.
W-Statistic Probability* = 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.
@ - Maximum result below the FRL, Certification Statistics not calculated - Analyte passes certification.

CU: A1P1-ST2-SB

Station Number	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Arsenic	Beryllium
A1P1-ST2-SB-01	1.25 -	1.05 -	1.03 -	1.05 -	8.37 -	5.60 UJ	0.39 UJ
A1P1-ST2-SB-01D	1.28 -	1.08 -	1.08 -	1.08 -	6.06 -	5.90 UJ	0.46 UJ
A1P1-ST2-SB-02	1.28 -	1.03 -	1.03 -	1.03 -	4.26 -	6.40 U	0.48 UJ
A1P1-ST2-SB-03	1.32 -	1.17 -	1.13 -	1.17 -	2.89 -	10.30 U	0.45 UJ
A1P1-ST2-SB-05	1.35 -	1.15 -	1.13 -	1.15 -	4.62 -	5.00 U	0.50 UJ
A1P1-ST2-SB-06	1.30 -	1.09 -	1.07 -	1.09 -	4.58 J	7.40 U	0.58 J
A1P1-ST2-SB-07	1.36 -	1.22 -	1.21 -	1.22 -	4.73 -	7.00 U	0.48 J
A1P1-ST2-SB-09	1.43 -	1.12 -	1.12 -	1.12 -	5.80 U	7.90 U	0.69 J
A1P1-ST2-SB-10	1.34 -	1.09 -	1.08 -	1.09 -	3.66 J	6.80 U	0.42 UJ
A1P1-ST2-SB-11	1.35 -	1.14 -	1.13 -	1.14 -	5.37 -	7.00 U	0.44 UJ
A1P1-ST2-SB-13	1.36 -	1.14 -	1.15 -	1.14 -	3.07 -	7.60 U	0.57 J
A1P1-ST2-SB-14	1.38 -	1.15 -	1.15 -	1.15 -	5.14 -	6.40 UJ	0.42 UJ
A1P1-ST2-SB-15	1.34 -	1.16 -	1.15 -	1.16 -	5.47 -	8.40 UJ	0.59 J
FRL	1.70	1.80	1.70	1.50	82.00	12.00	1.50
Units	pCi/g	pCi/g	pCi/g	pCi/g	ug/g	mg/kg	mg/kg
Confidence Level	95%	95%	95%	95%	95%	90%	90%
Max Result	1.43 @	1.22 @	1.21 @	1.22 @	8.37 @	10.3 U @	0.69 @
Standardized Skewness	--	--	--	--	--	--	--
W-Statistic Probability *	--	--	--	--	--	--	--
Test Procedure	--	--	--	--	--	--	--
Sample Size	12	12	12	12	12	12	12
Estimated Mean**	1.34	1.13	1.12	1.13	4.60	3.50	0.25
UCL of the Mean	--	--	--	--	--	--	--
Non-Parametric Prob.	--	--	--	--	--	--	--
Est. Mean - Pass / Fail	--	--	--	--	--	--	--
2x Rule - Pass / Fail	--	--	--	--	--	--	--
a posteriori Sample Size Calculation	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass

Note: Estimated Mean** = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
Results reported below the MDC were corrected to: "<MDC value> UJ"
The maximum value of the two duplicates was used in all statistical equations.
W-Statistic Probability* = 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.
@ - Maximum result below the FRL, Certification Statistics not calculated - Analyte passes certification.

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CU: A1P1-ST3-BB

Station Number	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Arsenic	Beryllium
A1P1-ST3-BB-01	1.11 -	1.26 -	1.27 -	1.26 -	9.80 U	9.60 J	0.89 J
A1P1-ST3-BB-02	1.41 -	1.14 -	1.17 -	1.14 -	1.92 U	8.80 J	0.70 J
A1P1-ST3-BB-02D	1.50 -	1.16 -	1.17 -	1.16 -	3.52 U	9.60 J	0.74 J
A1P1-ST3-BB-03	1.40 -	1.31 -	1.29 -	1.31 -	1.92 U	12.80 J	0.75 J
A1P1-ST3-BB-05	1.25 -	1.27 -	1.26 -	1.27 -	6.27 -	6.10 UJ	0.46 UJ
A1P1-ST3-BB-06	1.25 -	1.19 -	1.16 -	1.19 -	2.01 U	6.90 UJ	0.61 J
A1P1-ST3-BB-07	1.02 J	0.94 -	0.93 -	0.94 -	16.28 -	4.50 UJ	0.48 UJ
A1P1-ST3-BB-09	0.93 J	1.16 -	1.14 -	1.16 -	8.80 U	7.20 J	0.48 UJ
A1P1-ST3-BB-10	0.99 J	1.18 -	1.12 -	1.18 -	3.73 J	7.50 J	0.80 J
A1P1-ST3-BB-11	1.10 -	1.15 -	1.06 -	1.15 -	12.71 J	6.30 UJ	0.72 J
A1P1-ST3-BB-13	1.22 -	1.29 -	1.26 -	1.29 -	2.02 U	9.60 J	0.70 J
A1P1-ST3-BB-14	1.26 -	1.36 -	1.32 -	1.36 -	1.94 U	6.20 UJ	0.67 J
A1P1-ST3-BB-15	1.13 J	1.24 -	1.25 -	1.24 -	7.80 U	7.70 J	0.96 J
FRL	1.70	1.80	1.70	1.50	82.00	12.00	1.50
Units	pCi/g	pCi/g	pCi/g	pCi/g	ug/g	mg/kg	mg/kg
Confidence Level	95%	95%	95%	95%	95%	90%	90%
Max Result	1.50 @	1.36 @	1.32 @	1.36 @	16.28 @	12.80	0.96 @
Standardized Skewness	--	--	--	--	--	0.31	--
W-Statistic Probability *	--	--	--	--	--	0.119	--
Test Procedure	--	--	--	--	--	Wilcoxon SR	--
Sample Size	12	12	12	12	12	12	12
Estimated Mean**	1.18	1.21	1.18	1.21	3.82	7.35	0.71
UCL of the Mean	--	--	--	--	--	--	--
Non-Parametric Prob.	--	--	--	--	--	0.003	--
Est. Mean - Pass / Fail	--	--	--	--	--	Pass	--
2x Rule - Pass / Fail	--	--	--	--	--	Pass	--
a posteriori Sample Size Calculation	3 Pass	2 Pass	2 Pass	3 Pass	3 Pass	4 Pass	2 Pass

Note: Estimated Mean** = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
Results reported below the MDC were corrected to: "<MDC value> UJ"
The maximum value of the two duplicates was used in all statistical equations.
W-Statistic Probability* = 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.
@ - Maximum result below the FRL, Certification Statistics not calculated - Analyte passes certification.

CU: A1P1-ST3-BM

Station Number	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Arsenic	Beryllium
A1P1-ST3-BM-01	1.20 -	1.20 -	1.10 -	1.20 -	11.00 -	8.70 J	0.59 -
A1P1-ST3-BM-02	1.50 -	1.20 -	1.20 -	1.20 -	6.80 J	8.80 J	0.69 -
A1P1-ST3-BM-02D	1.50 -	1.10 -	1.10 -	1.10 -	4.70 -	9.00 J	0.71 -
A1P1-ST3-BM-03	1.40 -	1.20 -	1.10 -	1.20 -	3.10 J	10.60 J	0.62 -
A1P1-ST3-BM-05	1.40 -	1.10 -	1.10 -	1.10 -	5.60 -	9.60 J	0.54 -
A1P1-ST3-BM-06	1.30 -	1.00 -	1.00 -	1.00 -	7.90 -	5.10 J	0.67 -
A1P1-ST3-BM-07	1.40 -	1.20 -	1.20 -	1.20 -	3.30 -	10.00 J	0.57 -
A1P1-ST3-BM-09	1.40 -	1.10 -	1.10 -	1.10 -	6.30 -	7.50 J	0.45 -
A1P1-ST3-BM-10	1.50 -	1.20 -	1.10 -	1.20 -	5.00 -	10.30 J	0.64 -
A1P1-ST3-BM-11	1.40 -	1.10 -	1.10 -	1.10 -	5.00 -	10.00 J	0.51 -
A1P1-ST3-BM-13	1.30 -	1.10 -	1.10 -	1.10 -	6.30 -	8.10 J	0.50 -
A1P1-ST3-BM-14	1.30 -	1.10 -	1.10 -	1.10 -	7.00 -	7.60 J	0.40 -
A1P1-ST3-BM-15	1.30 -	1.10 -	1.10 -	1.10 -	5.00 -	8.10 J	0.50 -
FRL	1.70	1.80	1.70	1.50	82.00	12.00	1.50
Units	pCi/g	pCi/g	pCi/g	pCi/g	ug/g	mg/kg	mg/kg
Confidence Level	95%	95%	95%	95%	95%	90%	90%
Max Result	1.50 @	1.20 @	1.20 @	1.20 @	11.00 @	10.60 @	0.71 @
Standardized Skewness	--	--	--	--	--	--	--
W-Statistic Probability *	--	--	--	--	--	--	--
Test Procedure	--	--	--	--	--	--	--
Sample Size	12	12	12	12	12	12	12
Estimated Mean**	1.37	1.10	1.10	1.10	6.06	8.72	0.56
UCL of the Mean	--	--	--	--	--	--	--
Non-Parametric Prob.	--	--	--	--	--	--	--
Est. Mean - Pass / Fail	--	--	--	--	--	--	--
2x Rule - Pass / Fail	--	--	--	--	--	--	--
a posteriori Sample Size Calculation	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	1 Pass

Note: Estimated Mean** = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
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CU: A1P1-ST3-SB

Station Number	Radium-226	Radium-228	Thorium-228	Thorium-232	Uranium, Total	Arsenic	Beryllium
A1P1-ST3-SB-01	1.33 -	1.08 J	1.05 J	1.08 J	5.56 J	6.80 J	0.63 J
A1P1-ST3-SB-01D	1.35 -	1.25 J	1.30 J	1.25 J	7.76 -	5.90 J	0.72 J
A1P1-ST3-SB-02	1.02 -	1.10 -	1.11 -	1.10 -	5.41 J	3.70 UJ	0.46 J
A1P1-ST3-SB-03	1.00 -	1.13 -	1.10 -	1.13 -	4.14 J	3.50 UJ	0.66 J
A1P1-ST3-SB-05	1.13 -	1.02 -	1.01 -	1.02 -	4.41 J	7.10 J	0.75 J
A1P1-ST3-SB-06	1.32 -	1.21 -	1.21 -	1.21 -	6.50 J	4.40 J	0.32 J
A1P1-ST3-SB-07	1.21 -	1.06 -	1.06 -	1.06 -	3.09 J	6.00 J	0.57 J
A1P1-ST3-SB-09	1.08 -	1.19 -	1.16 -	1.19 -	6.19 -	4.00 J	0.36 J
A1P1-ST3-SB-10	1.23 -	1.17 -	1.15 -	1.17 -	8.26 -	5.00 J	0.44 J
A1P1-ST3-SB-11	1.05 -	1.17 -	1.16 -	1.17 -	5.89 J	5.60 J	0.52 J
A1P1-ST3-SB-13	1.06 -	1.15 -	1.12 -	1.15 -	6.62 J	4.90 J	0.49 J
A1P1-ST3-SB-14	1.10 -	1.22 -	1.22 -	1.22 -	5.79 J	5.10 J	0.51 J
A1P1-ST3-SB-15	1.17 -	1.19 -	1.17 -	1.19 -	7.89 -	4.40 J	0.41 J
FRL	1.70	1.80	1.70	1.50	82.00	12.00	1.50
Units	pCi/g	pCi/g	pCi/g	pCi/g	ug/g	mg/kg	mg/kg
Confidence Level	95%	95%	95%	95%	95%	90%	90%
Max Result	1.35 @	1.25 @	1.30 @	1.25 @	8.26 @	7.10 @	0.75 @
Standardized Skewness	--	--	--	--	--	--	--
W-Statistic Probability *	--	--	--	--	--	--	--
Test Procedure	--	--	--	--	--	--	--
Sample Size	12	12	12	12	12	12	12
Estimated Mean**	1.14	1.15	1.15	1.15	5.99	4.74	0.52
UCL of the Mean	--	--	--	--	--	--	--
Non-Parametric Prob.	--	--	--	--	--	--	--
Est. Mean - Pass / Fail	--	--	--	--	--	--	--
2x Rule - Pass / Fail	--	--	--	--	--	--	--
a posteriori Sample Size Calculation	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass	2 Pass

Note: Estimated Mean** = Estimated measure of central tendency(Normal: Mean; LogNormal: Est. Mean; Non-Parametric: Median)
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