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Site Screening Process Report

Site 1 – Thorium Spill

Naval Support Facility
Indian Head
Indian Head, Maryland

Naval Facilities Engineering Command
Washington

Contract Number N62472-03-D-0057

Contract Task Order 5

May 2009

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SITE SCREENING PROCESS REPORT

SITE 1 – THORIUM SPILL

NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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1314 Harwood Street, SE
Washington Navy Yard, D.C. 20374-5018

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ACRONYMS

bgs	below ground surface
CLEAN	Comprehensive Long-Term Environmental Action Navy
cpm	counts per minute
CTO	Contract Task Order
DCGL	Derived Concentration Guideline Level
DoN	Department of the Navy
EPA	United States Environmental Protection Agency
FFA	Federal Facility Agreement
FS	feasibility study
IDW	investigation-derived waste
IHDIV-NSWC	Indian Head Division, Naval Surface Warfare Center
IHIRT	Indian Head Installation Restoration Team
kcpm	kilocounts per minute
mrem/y	milli-rem per year
NAD	North American Datum
NaI	Sodium iodide
NORM	naturally occurring radioactive material
NSA	Naval Support Activity
NSF-IH	Naval Support Facility Indian Head
pCi/g	pico curies per gram
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RASO	Radiological Affairs Support Office
rem	roentgen equivalent in man
RESRAD	Residual Radioactivity
RI	remedial investigation
SI	Site Inspection
SOW	Statement of Work
SSI	Site Screening Investigation
SSP	Site Screening Process
TtNUS	Tetra Tech NUS, Inc.
µR/hr	micro-Roentgen per hour

EXECUTIVE SUMMARY

This Site Screening Process (SSP) Report for Site 1 (Thorium Spill) at the Naval Support Facility Indian Head (NSF-IH) in Indian Head, Maryland was prepared by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order 5 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-D-03-0057. NSF-IH is a Naval Support Activity South Potomac facility within the Naval District Washington Region.

The objective of the Site 1 SSP was to collect and evaluate sufficient data to provide the basis for a determination that either: (1) a Remedial Investigation (RI)/Feasibility Study (FS), an FS, another investigation, and/or removal action, as appropriate, is required by the area addressed by the SSP or (2) the area does not pose a threat or potential threat to public health, welfare, or the environment and therefore the area should be removed from further study under the Federal Facility Agreement (FFA) (EPA Region 3 and DoN, 2000). The field investigations leading to this report were outlined in a site-specific work plan (TtNUS, 2005) that detailed the environmental samples and analytical methods needed to make a decision for this site.

Site 1 is an area of approximately 60 feet by 135 feet located between Strauss Avenue and Building 1662. Thorium was first placed on the ground at Site 1 in 1962 in connection with radiation training exercises conducted by the Naval School, Explosive Ordnance Disposal (NAVSCOLEOD) then at the facility. Thorium ore from approximately five drums of 30- to 50-gallon capacity was spread over the site. Removal actions were undertaken at the site in July 1972, November 1972, and sometime in approximately 1983.

Site 1 was subjected to an initial SSP field investigation in 2005 and a second SSP field investigation in 2007. In 2005, sampling was also performed at a reference area located on the facility and selected on the basis of having no apparent physical or historical reason for being contaminated by radioactive material. Twenty-seven samples were collected from Site 1, and 27 were collected from the reference area during the 2005 field effort. An additional 14 samples were collected from Site 1 in 2007. The samples were collected from 36-inch deep boreholes. Each borehole was divided into three vertical intervals [18 to 24 inches below ground surface (bgs), 24 to 30 inches bgs, and 30 to 36 inches bgs]. One sample from each borehole was selected on the basis of gross gamma radiation for analysis of thorium-232 by a fixed-base laboratory.

A site-specific derived concentration guidance level (DCGL) was developed for a residential gardener exposure scenario (on-site resident tending to a vegetable garden) to relate thorium concentration to the acceptable United States Environmental Protection Agency (EPA) cancer risk level. This scenario is

judged most likely for the site in the event the Navy relinquishes the site for public use. Using the Residual Radioactivity (RESRAD) computer model with inputs appropriate to a resident gardener, a thorium-232 concentration of 3 picocuries per gram (pCi/g) corresponds to a cancer risk of approximately 1E-05. This is within the EPA acceptable risk range of 1E-06 to 1E-04.

Analytical results were evaluated following guidance contained in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (EPA et al., 2000). There were several sampling locations that exhibited elevated activity. Further evaluation of the sampling results identified two areas where thorium-232 concentrations were greater than the site-specific DCGL of 3 picocuries per gram (pCi/g). Based on exceedances of this DCGL, there are nine sampling locations within two areas that are candidates for excavation and removal to depths ranging from 24 to 36 inches bgs.

The first area is defined by two sample locations in the northern portion of the site. The estimated area of contamination is 300 square feet, and the depth of contamination is 30 inches (2.5 feet). The estimated volume of soil in this area is 28 cubic yards. The second area is defined by seven sample locations in the central portion of the site. The estimated area of contamination is 775 square feet, and the average depth of soil contamination is 30 inches (2.5 feet). The estimated volume of soil in this area is 72 cubic yards.

The contaminated soil could be removed for off-site disposal. Based on the site history and surface radiation measurements, the upper 18 inches of soil may not be contaminated. If this soil is removed, screened for radiation, and found to be uncontaminated, it could be stockpiled for use as backfill. This would reduce the volume of soil for off-site disposal by more than 50 percent. Another option would be to implement land use controls to prevent residential use.

1.0 INTRODUCTION

This Site Screening Process (SSP) Report for Naval Support Facility Indian Head (NSF-IH) in Indian Head, Maryland was prepared by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 5 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-03-D-0057. NSF-IH is a Naval Support Activity South Potomac facility within the Naval District Washington Region. Until October 1, 2005, NSF-IH was referred to as Naval District Washington, Indian Head. This report describes the SSP for Site 1 – Thorium Spill.

1.1 PURPOSE AND REPORT ORGANIZATION

The purpose of the SSP was to determine whether operations at Site 1 resulted in the release of thorium at concentrations of potential environmental concern. The SSP was conducted in response to a requirement in the Federal Facility Agreement (FFA) (EPA Region III and DoN, 2000) for a site screening investigation (SSI) at Site 1.

Section 1.0 presents the purpose, objective, and scope of this report and summarizes facility background information. Section 2.0 provides the general investigative procedures. Section 3.0 provides the evaluation methods and the results of the SSP for Site 1.

1.2 OBJECTIVE AND SCOPE

The Site 1 SSP investigation was conducted in two phases. Phase 1 was conducted as described in the SSP Investigation Work Plan (TtNUS, 2005). The results from Phase 1 were presented in a technical memorandum dated March 10, 2006, which is included in Appendix A. That technical memorandum concluded with a description of a potential second round of sampling. Through several meetings and discussions that included the Indian Head Installation Restoration Team (IHIRT) and the Navy Radiological Affairs Support Office (RASO), a scope of work for a second sampling round was developed. That scope was described in a technical memorandum dated June 7, 2007, which is included in Appendix B.

Throughout the two sampling phases, the objective of the SSP investigation was to collect sufficient data to provide the basis for a determination that either: (1) a Remedial Investigation (RI)/Feasibility Study (FS), an FS, another investigation, and/or removal action, as appropriate, is required by the area addressed by the SSP or (2) the area does not pose a threat or potential threat to public health, welfare, or the environment and therefore the area should be removed from further study under the FFA.

The overall investigation process consisted of research, media sampling, and analytical data evaluation. The research consisted of reviewing historical documents related to operations at Site 1. Soil samples were collected. Analytical data were evaluated via a formal data validation process, background comparisons, and a statistical evaluation as described in the Site 1 SSP Investigation Work Plan (TtNUS, 2005).

1.3 FACILITY BACKGROUND

NSF-IH is located in northwestern Charles County, Maryland. As shown on Figure 1-1, NSF-IH is approximately 25 miles southwest of Washington, D.C. NSF-IH is a military facility consisting of the Main Area on the Cornwallis Neck Peninsula and the Annex on Stump Neck. As shown on Figure 1-2, the Main Area is bounded by the Potomac River on the northwest, west, and south, Mattawoman Creek to the south and east, and the Town of Indian Head to the northeast. Stump Neck Annex is located across Mattawoman Creek and is not contiguous with the Main Area. The location of Site 1 is shown on Figure 1-2.

The primary mission of the Indian Head Division, Naval Surface Warfare Center (IHDIV-NSWC), the main tenant of NSF-IH, is as follows:

- To provide services in energetics for all warfare centers through engineering, fleet and operation support, manufacturing technology, limited production, and industrial base support.

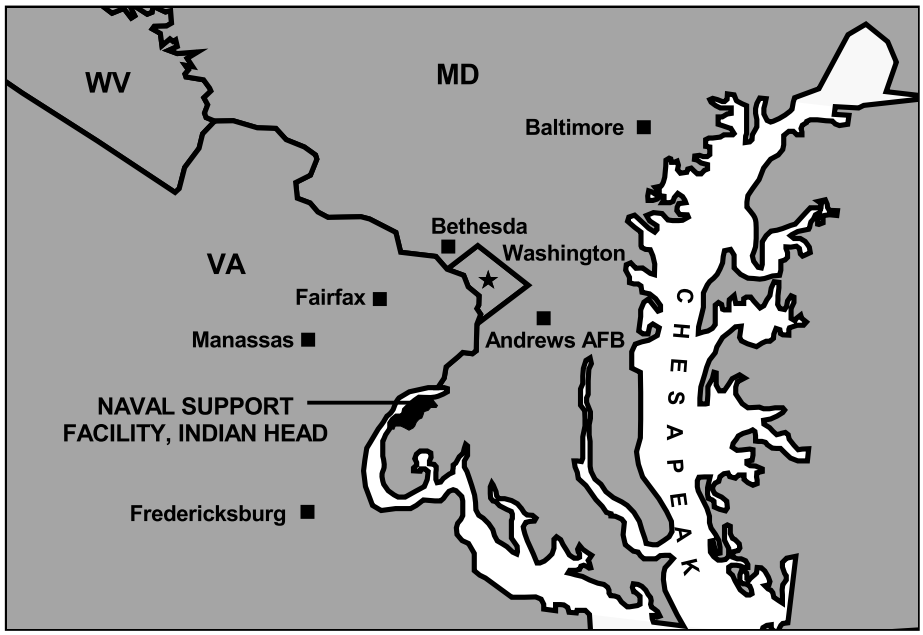
- To provide research, development, testing, and evaluation of energetic materials, ordnance devices and components, and other related ordnance engineering standards including chemicals, propellants and their propulsion systems, explosives, pyrotechnics, warheads, and simulators.

- To provide support to all warfare centers, military departments, and the ordnance industry for special weapons, explosive safety, and ordnance environmental issues.

- To execute other responsibilities as assigned by the Commander of the IHDIV-NSWC.

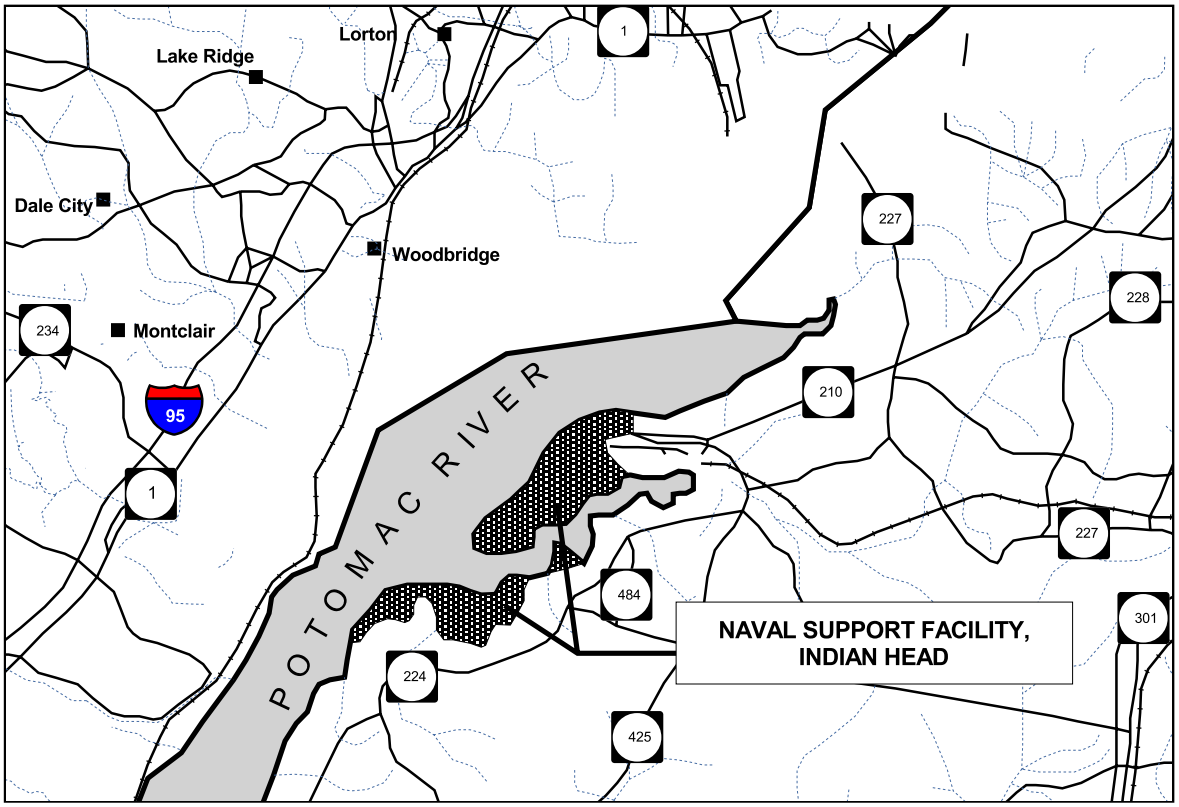
Site 1 is an area of approximately 60 by 135 feet located between Building 1662 and Strauss Avenue. The area is currently covered by a parking lot and maintained lawn. Building 1662 is used for electrical and satellite communications. Future land use is expected to be any military, industrial, or commercial use needed to support the NSF-IH mission. It is unlikely that the site area would be developed for residential use while under government control. However, hypothetical future residential land use was evaluated to determine whether the site could be released for unrestricted use without the need for land

use controls. Future use as farmland is not likely for a site that overlooks the Potomac River in proximity to the Washington, D.C. area.



LEGEND

- City
- Highway
- Railroad
- River



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K. PEILA	3/17/05		2144	005
CHECKED BY	DATE	FACILITY LOCATION MAP	APPROVED BY	DATE
G. LATULIPPE	12/03/07	NAVAL SUPPORT FACILITY, INDIAN HEAD	G LATULIPPE	12/03/07
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CHECKED BY G. LATULIPPE — DATE 12/11/07	SITE LOCATION MAP SITE 1 - THORIUM SPILL NAVAL SUPPORT FACILITY, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE	DATE 11/30/07
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2.0 GENERAL INVESTIGATIVE PROCEDURES

The investigations at Site 1 were discussed in the SSP Work Plan (TtNUS, 2005) and in the June 7, 2007 technical memorandum (Appendix B).

2.1 FIELD SAMPLING

2.1.1 Soil Sampling

The rationale supporting the first sampling phase for Site 1 is described in detail in the Site 1 SSP Work Plan (TtNUS, 2005). Twenty-seven samples (from locations S01SB001 through S01SB027) were collected from the site area, and 27 samples were collected from a reference area. The locations of Site 1 and the reference area within the facility are shown on Figure 1-2. The reference area and the Site 1 area, along with the sampled locations, are shown on Figures 2-1 and 2-2, respectively.

The reference area samples were collected in 2005 prior to collecting the Site 1 samples. At each reference area sample location, a direct-push drill rig was used to create a 3-inch-diameter borehole to approximately 36 inches below ground surface (bgs). A disposable macro-core sampling device was used to extract the soil from the boring at each sampling location. As soil was extracted from the borehole, the soil from the 18- to 24-inches bgs interval, 24- to 30-inches bgs interval, and 30- to 36-inches bgs interval was placed in separate piles on a plastic sheet on a temporary work table placed near the borehole. The soil from the middle interval (24 to 30 inches) in each reference area borehole was packaged for shipment to the fixed-base laboratory for a determination of the thorium-232 concentration. A gamma probe scintillator was lowered into each borehole to measure gross gamma radiation at each of three intervals (18 to 24 inches bgs, 24 to 30 inches bgs, and 30 to 36 inches bgs). It was planned that if a comparison of the gamma radiation level for the middle (24- to 30-inches) interval with the gamma radiation levels for the remaining two intervals indicated a difference greater than 1,000 counts per minute (cpm), the soil from the interval indicating the greatest difference from the 24- to 30-inches interval would also be shipped to the fixed-base laboratory. This situation did not occur at any of the reference area sampling locations; therefore, only a single sample from each of the 27 reference area sample locations was shipped to the laboratory. Additional field readings were taken of the soil extracted from the borehole using a pancake probe prior to packaging the soil for shipment to the laboratory. Field documentation from the 2005 reference area field investigation is included in Appendix C. The field readings are presented in Appendix C.5. The analytical results for the reference area samples are presented in Appendix D, Table D-1.

Site 1 samples collected during the first (2005) sampling phase were collected using techniques similar to those applied to the reference area. A disposable macro-core sampling device was used to extract the soil from the boring at each sampling location. As soil was extracted from the borehole, the soil from the 18- to 24-inches bgs interval, 24- to 30-inches bgs interval, and 30- to 36-inches bgs interval was placed in separate piles on a plastic sheet on a temporary work table placed near to the borehole. A gamma probe scintillator was lowered into each borehole to measure gross gamma radiation at each of three intervals (18 to 24 inches bgs, 24 to 30 inches bgs, and 30 to 36 inches bgs). It was planned that at each Site 1 borehole, only the soil from the boring interval exhibiting the highest gamma radiation level would be shipped to the fixed-base laboratory for analysis. If none of the three sample intervals in a borehole exhibited an apparently high reading, one of the three samples from that borehole was to be selected randomly for shipment to the fixed-base laboratory. A deviation from the work plan (TtNUS, 2005) occurred when a pancake probe was used to measure the radioactivity for the soil pile from each of the sampled intervals and the sample exhibiting the highest gamma reading was sent to the laboratory for analysis. The result was that the sample shipped to the laboratory for analysis did not always correspond to the borehole interval exhibiting the highest down-hole field gamma reading as determined with the scintillator in the borehole. The deviation is discussed further in Section 3.5 as part of the data evaluation. Field documentation from the Site 1 field investigation is included in Appendix C. The field readings for the 2005 field investigation are presented in Appendix C.6. The analytical results for the 2005 Site 1 samples are presented in Appendix D, Table D-1.

The rationale supporting the second (2007) phase of Site 1 sampling is described in the June 7, 2007, technical memorandum (work plan) included in Appendix B. In addition to the data evaluation specified in the SSP Work Plan (TtNUS, 2005), data from the 2005 sampling were compared to data from a RASO investigation conducted in 1972. This comparison indicated that the area sampled in 2005 did not include all of the locations identified in 1972 as potentially containing elevated thorium-232 concentrations and that the site was larger than originally anticipated. The 2007 technical memorandum included sample locations to improve the understanding of the extent of thorium-232 contamination and to verify the presence or absence of thorium-232 contamination at the locations identified during the 1972 investigation. During the 2007 field investigation, samples were collected from locations S01SB020, S01SB021, and S01SB028 through S01SB041. The approach employed for collecting the soil samples during the 2007 field work was the same as that planned for the first phase of the Site 1 investigation, with field measurements of down-hole gamma readings at the same three depth intervals. At each borehole, the soil from the interval exhibiting the highest gamma measurement was shipped to the laboratory for analysis of thorium-232. (Two exceptions to this approach occurred in connection with sample locations S01SB028 and S01SB039. Those samples are addressed in Section 3 as part of the data evaluation in Table 3-3.). Field documentation from the 2007 Site 1 field investigation is included in

Appendix C. The field readings for the 2007 field investigation are presented in Appendix C.7. The analytical results for the 2007 Site 1 samples are presented in Appendix D, Table D-1.

2.1.2 Quality Assurance/Quality Control

Equipment employed in the field for measuring radiological parameters was calibrated by the manufacturer prior to shipping the equipment to the field. Calibration documentation is included in Appendix C.

Field quality control (QC) samples consisted of field duplicates. Each duplicate sample underwent the same preservation, analysis, and reporting procedures as the associated environmental sample. The duplicate samples were collected at a rate of 1 per 10 or fewer environmental samples. The analytical results for the duplicate samples are included in Appendix E.

During the 2005 sampling effort at the Site 1 area, one location (S01SB014) exhibited a significantly higher gamma radiation reading [747 kilo counts per minute (kcpm)] than any of the other Site 1 locations. The next highest reading was 36.8 kcpm at location S01SB011. To provide a more complete basis for evaluating the high reading at S01SB014, a sample of the soil from the boring interval exhibiting the high reading (24 to 30 inches) was shipped to the fixed-base laboratory for analysis by gamma spectroscopy of the following Naturally Occurring Radioactive Material (NORM) isotopes:

- actinium-228
- bismuth-212 and -214
- lead-212 and -214
- potassium-40
- radium 224
- radium-226
- radium 228
- thallium-208
- thorium-234

Samples collected in 2005 from locations S01SB020 and S0SB021 exhibited relatively low concentrations of thorium-232 [0.64 and 0.66 picocuries per gram (pCi/g) respectively] compared to the Site 1 samples with the highest concentrations (see Table D-1 in Appendix D). However, the down-hole gamma readings for both boreholes were relatively high (13.1 and 14.4 kcpm respectively) (see Table C.6-1 in Appendix C.6) compared to the down-hole gamma readings for other sampled borings from which samples exhibited similar thorium-232 concentrations. During planning for the second phase of Site 1

sampling, it was determined, in consultation with RASO, that soil samples should also be collected from locations S01SB020 and S01SB021 for analysis of NORM parameters. The NORM analyses were performed to examine the possibility that a radioactive material other than thorium-232 may have caused the elevated gamma reading in the boreholes. Those samples were analyzed for the following NORM parameters:

- actinium-228
- bismuth-212 and -214
- lead-212 and -214
- potassium-40
- radium-226
- thallium-208
- thorium-234

2.2 LABORATORY ANALYSIS

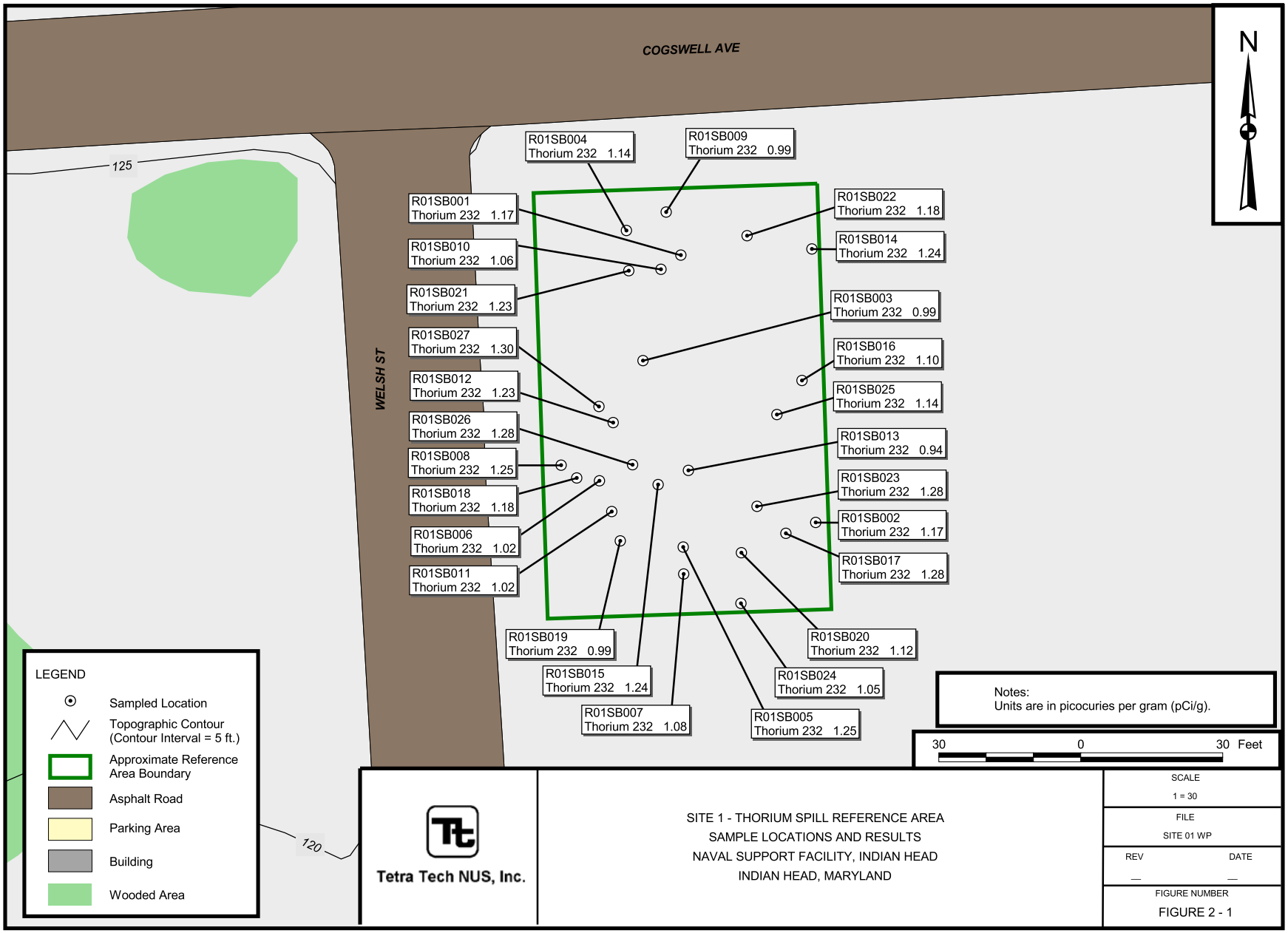
The soil samples were subjected to analysis for thorium-232 by a fixed-base laboratory using alpha spectroscopy. The three samples (S01SB0140201, S01SB0200201, and S01SB0210201) analyzed for the NORM parameters listed in Section 2.1.2 were analyzed in a fixed-base laboratory using gamma spectroscopy. The analytical results are included in Appendix D.

2.3 INVESTIGATION-DERIVED WASTE HANDLING

The investigation-derived waste (IDW) produced during the SSP investigation included borehole cuttings, disposable sampling equipment, personnel protective equipment (PPE), and miscellaneous trash. Soil boring cuttings were used to backfill the open boreholes after soil samples were collected. The remaining materials were screened in the field as described in the Site 1 Work Plan, determined to be non-radioactive, and disposed as trash.

2.4 SURVEYING

The horizontal coordinates of each sampled location were determined by field sampling personnel using a global positioning device. Coordinates were determined based on the Maryland State Plane Coordinate system [North American Datum (NAD) 1983]. No elevations were determined because they were not critical to the objectives of the SSP investigation. The horizontal coordinates of sample locations at Site 1 and the reference area are included in Appendix F.



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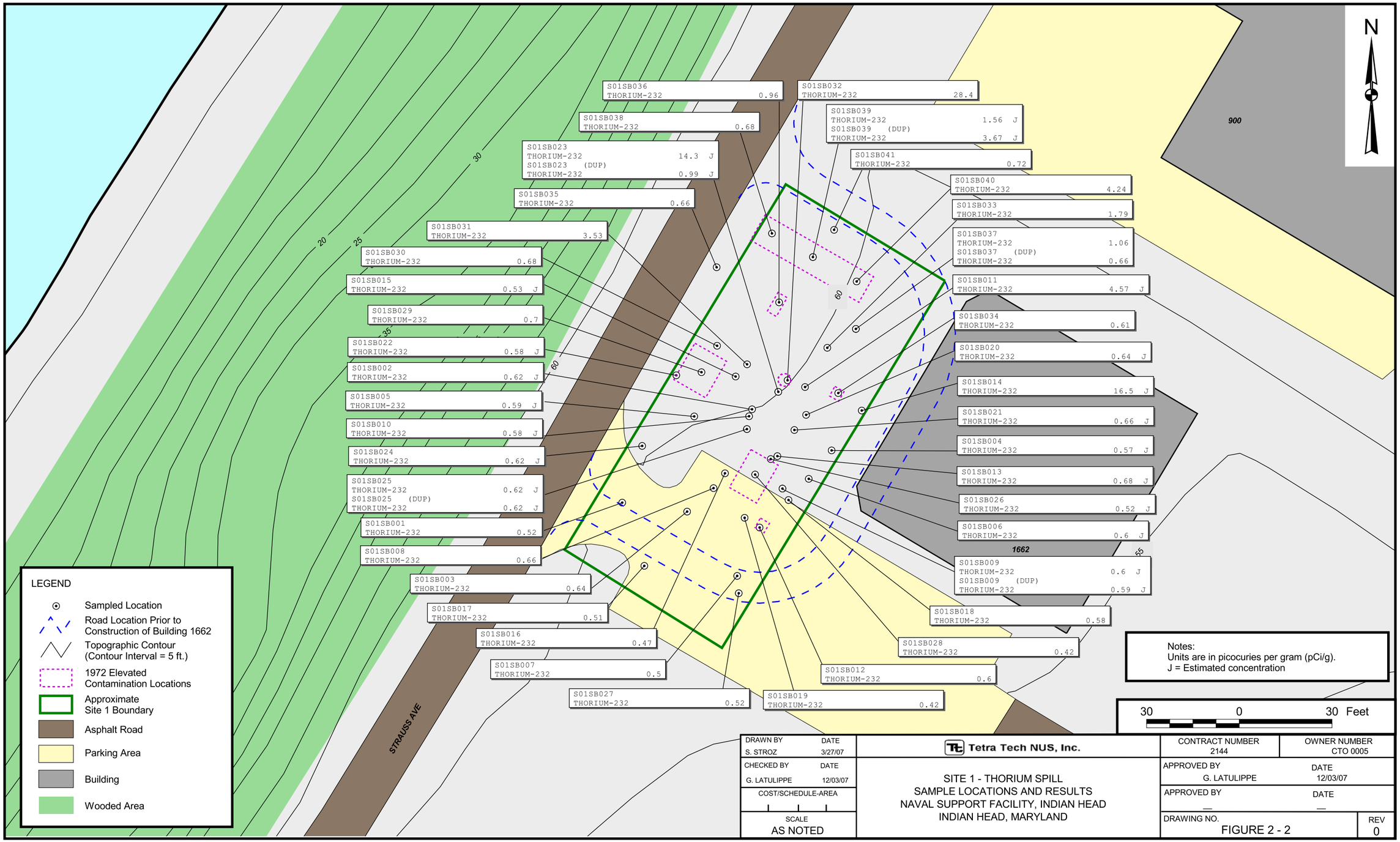

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COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 2 - 2 / REV 0

3.0 DATA EVALUATION

3.1 GENERAL EVALUATION CRITERIA

As required by the Site 1 SSP Investigation Work Plan (TtNUS, 2005), the fixed-base-laboratory analytical results for the Site 1 investigation are evaluated in this SSP Report to determine what action, if any, may be appropriate for Site 1. The presence or absence of residual contamination at Site 1 is to be determined by comparing Site 1 analytical results to reference area analytical results using the Wilcoxon Rank Sum (WRS) test as required by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Section 8.4.1 (EPA et al., 2000). As expressed in the Work Plan, decision rules for the Site 1 Investigation were as follows:

- If the result of the WRS test indicates that the Site 1 thorium-232 concentration does not exceed the sum of the reference area thorium-232 concentration plus 1 pCi/g, Site 1 will be recommended for no action.

- If the result of the WRS test indicates that the Site 1 thorium-232 concentration exceeds the sum of the reference area thorium-232 concentration plus 1 pCi/g, Site 1 will be subjected to further evaluation.

Subsurface soil locations with elevated activity and ground surface radiation measurements were also evaluated.

3.2 DATA VALIDATION

All samples were subjected to data validation. The data validation consisted of a review of the data completeness, holding times, laboratory method/preparation blanks, laboratory duplicate results, field duplicate results, laboratory control sample results, and detection limits. Appendix D contains the analytical data for all samples. The analytical data validation memoranda are provided in Appendix E.

3.3 REFERENCE AREA DATABASE

As described in Section 2.1.1, 27 soil samples were collected from the reference area locations shown on Figure 2-1 along with thorium-232 analytical results. The results are provided in Table 3-1. The reference area was located within NSF-IH in an open field as free as possible from known sources of radioactive contamination and sufficiently unobstructed to allow the sampled area to mimic the size and shape of Site 1 as configured during the 2005 field investigation. Section 2.1.1 describes the sampling

techniques employed. The data are presented in Appendix D. No facility-wide radiological database was available for this investigation.

A review of 2001 sampling results from an area adjacent to Building 900 indicates that a background concentration of approximately 0.57 pCi/g for thorium-232 may be appropriate. In addition, many of the thorium-232 concentrations and associated borehole radiation measurements at Site 1 indicate a background concentration of approximately 0.58 pCi/g. In contrast, an examination of the thorium-232 concentrations and associated borehole radiation measurements in the reference area sampled in 2005 indicates an average concentration of approximately 1 pCi/g. Based on this information, RASO recommended that any future remediation and surveys establish a reference area that is radiologically similar to the Site 1 area (RASO, 2008).

3.4 WILCOXON RANK SUM TEST

In accordance with the MARSSIM, Section 8.4.1, the Site 1 data set and the reference area data set were compared using the WRS test. Application of the WRS test to the Site 1 data required the development of a derived concentration guideline level (DCGL), which is defined in the MARSSIM (EPA, et al., 2000) as "A derived, radionuclide-specific activity concentration within a survey unit corresponding to the release criterion." MARSSIM also describes DCGLs as "…average levels of radiation or radioactivity above appropriate background levels."

Based on computer model runs by the Navy's RASO during planning for this investigation using Residential Radioactivity (RESRAD) computer software (Yu, et al., 2001) and a conservative residential farmer risk scenario [Section 2.3.3 of the Site 1 SSP Work Plan (TtNUS, 2005)], a thorium-232 concentration of 1 pCi/g above background was determined to be a suitable preliminary DCGL. Therefore, 1 pCi/g was added to each of the analytical results in the reference area data set prior to initiating the WRS test. The adjustment of the reference area data and the WRS calculation are presented in Appendix G.

As noted in the MARSSIM, the hypotheses tested by the WRS test is as follows:

<u>Null Hypothesis</u>

H_o: The median concentration in the survey unit exceeds that in the reference area by more that the $DCGL_W$. [Note: "The $DCGL_W$, based on pathway modeling, is the uniform residual radioactivity concentration level within a survey unit that corresponds to the release criterion." (EPA, et al., 2000).]

Versus

Alternative Hypothesis

H_a: The median concentration in the survey unit exceeds that in the reference area by less than the $DCGL_W$.

The null hypothesis is assumed to be true unless the statistical test indicates that it should be rejected in favor of the alternative hypothesis. The result of the hypotheses test determines whether or not the survey unit as a whole is deemed to meet the release criterion (EPA, et al., 2000).

As demonstrated in Appendix G, application of the WRS test to the Site 1 and reference area data resulted in the rejection of the null hypothesis. There is some uncertainty in this statistical analysis because the reference area and site area are not radiologically similar. As discussed in Section 3.3, the background concentration of thorium-232 in the reference area (approximately 1 pCi/g) is greater than that at Site 1 (approximately 0.58 pCi/g). Also, the difference between the average thorium-232 concentrations at Site 1 (2.37 pCi/g) and at the reference area (1.15 pCi/g) is greater than the preliminary DCGL (1 pCi/g) (see Table 3-1). According to MARSSIM guidance, this indicates that the preliminary release criterion (1 pCi/g) is not met. Regardless of this statistical analysis and associated uncertainties, it was necessary to evaluate sample locations with elevated thorium-232 concentrations (hot spots).

3.5 EVALUATION OF AREAS OF ELEVATED ACTIVITY

In addition to the WRS test, MARSSIM guidance states that areas of elevated activity need to be evaluated. For purposes of this SSP, areas of elevated activity are individual sample locations where thorium-232 concentrations are greater than the DCGL, determined as described in Section 3.5.1, or that have elevated borehole gamma field measurements. Thorium-232 concentrations detected in Site 1 samples are provided in Table 3-1.

3.5.1 Derived Concentration Guideline Level Determination

It was necessary to develop a DCGL to evaluate areas of elevated activity. The RESRAD computer software was used in conjunction with a residential gardener exposure scenario that considered residents who did not raise their own meat, milk, or aquatic food on the property but are exposed to radiation via external gamma radiation, inhalation, plant ingestion, drinking water, and soil ingestion. All of these factors were included in the more conservative human health exposure scenario applied for previous RESRAD modeling runs resulting in the 1 pCi/g preliminary DCGL used for the WRS test described in Section 3.4.

Several model runs were made using assumed DCGLs from 1 to 4 pCi/g for thorium-232 in soil to determine the resulting cancer risk levels. The goal was to develop a DCGL that corresponded to a cancer risk within the EPA acceptable risk range of 1E-04 to 1E-06. The maximum DCGL that results in a cancer risk less than 1E-04 is 3 pCi/g. The cancer risk levels and corresponding radiation dose rates resulting from the RESRAD modeling are shown in Table 3-2. RESRAD modeling run outputs are provided in Appendix H.

3.5.2 Evaluation of Data Points

The evaluation of individual data points is presented in Table 3-3. The table is arranged as follows:

- Column 1 lists the identifying sample number for each sample collected from Site 1.

- Columns 2, 5, and 8 indicate the down-hole gamma readings at each of the three vertical intervals in each borehole. During the 2005 field investigation, single readings were taken from the mid-point of each interval. During the 2007 field investigation, the readings were taken at the top and bottom of each interval, thus two readings are shown for each borehole interval in the table for the 2007 field investigation.

- An "S" in columns 3, 6, and 9 indicates that the soil sample from that borehole interval was shipped to the fixed-base laboratory for analysis of thorium-232.

- An "H" in columns 4, 7, and 10 indicates the interval in each borehole that exhibited the highest down-hole gamma reading.

- Column 11 indicates the thorium-232 concentration detected in the sample shipped to the fixed-base laboratory.

- Columns 12, 13, 15, and 16 indicate a yes (Y) or no (N) response to the question in the column heading.

- Column 14 considers the fact that the precision of the readings from the field instrument used for collecting the down-hole gamma readings could vary. To be conservative, a precision of ±10 percent was selected arbitrarily. For cases where the sample shipped to the fixed-base laboratory was not from the borehole interval exhibiting the highest gamma reading, the gamma reading associated with the shipped sample was increased by 10 percent and entered into this column for comparison to the actual highest down-hole gamma reading. If the gamma reading in column 14 is greater than the

reading for the borehole interval with the actual highest reading, the reading associated with the shipped sample was deemed acceptable for the purpose of determining which sample was shipped to the laboratory. In that event, the thorium-232 concentration detected by the laboratory in the shipped sample was deemed acceptable for evaluating the need for removing contaminated soil (e.g., location S01SB007). When the column 14 value is less than the reading for the borehole interval with the actual highest reading, the thorium-232 concentration detected in the shipped sample was not applied in a critical manner to the decision that the location is or is not a candidate for remediation. Three exceptions occurred when the two values were considered so close to each other as to be essentially equal. Those are S01SB006 (0.05 kcpm difference), S01SB016 (0.02 kcpm difference), and S01SB018 (0.02 kcpm difference).

- Column 17 lists the rationale leading to the determination in column 16 that the soil sample analytical data and/or the borehole gamma readings indicate a need to remove contaminated soil.

The rationale in Table 3-3, column 17 repeatedly includes one or more of the following three points of comparison:

- The "+10%" figure refers to the consideration of field instrument precision as described above for Table 3-3, column 14.

- The 3 pCi/g value refers to the DCGL developed using the RESRAD model as described in Section 3.5.1.

- The 3 kcpm value was developed as described below.

Section 2.1.1 identified a deviation from the work plan (TtNUS, 2005) that occurred during the 2005 Site 1 sampling. As a result of the deviation, 15 of the Site 1 soil samples shipped to the fixed-base laboratory were not from the down-hole boring interval exhibiting the highest gamma screening level. For Site 1 data from the 2005 field investigation, Table 3-3 shows (using the "S" and "H" entries in the table) the shipped samples that did or did not correspond to the interval with the highest gamma reading. For one (S01SB0140201) of the 15 affected soil samples, although the soil shipped to the laboratory was taken from the down-hole interval exhibiting the second highest gamma reading, the thorium-232 concentration was high enough at 16.5 pCi/g in the sample from the 18 to 24 inches interval to indicate a need for remediating that location.

For the remaining 14 locations, an attempt was made to determine a correlation that would allow reasonable conclusions to be drawn regarding the need to excavate contaminated soil based on the field

gamma readings. Table 3-4 shows the 2005 Site 1 data sorted in the order of increasing down-hole field gamma readings. A visual check of the arrayed data shows that the thorium-232 concentrations in the soil samples were consistently less than 1 pCi/g (more accurately, 0.68 pCi/g) for field gamma readings less than 3.26 kcpm in the corresponding down-hole boring interval. In the interest of conservativeness, a field gamma reading of 3 kcpm was applied in Table 3-3 as a limit below which thorium-232 concentrations in soil were very likely to be less than the 3 pCi/g DCGL previously determined in Section 3.5.1. Two sampling locations (S01SB020 and S01SB021) were determined to be candidates for excavation and removal solely on the basis of the 3 kcpm criterion.

All the remaining 13 sampling locations (S01SB001, S01SB002, S01SB006, S01SB007, S01SB010, S01SB015, S01SB016, S01SB017, S01SB018, S01SB019, S01SB023, S01SB026, and S01SB027) were determined not to be candidates for remediation. The 3 kcpm criterion was the primary reason for this determination at two of these locations (S01SB0001 and S01SB019). The remaining 11 locations have additional rationale to support the determination that the sampling locations are not candidates for remediation.

The 3 kcpm criterion was not a consideration for the evaluation of 2007 Site 1 data in Table 3-3.

3.6 NORM DATA EVALUATION

The NORM data mentioned in Section 2.1.2 were evaluated to determine if radioactive isotopes other than thorium-232 might be the cause of elevated down-hole gamma readings observed at locations S01SB014, S01SB020, and S01SB021.

Samples from S01SB020 and S01SB021 collected in 2005 exhibited relatively low concentrations (less than 1 pCi/g) of thorium-232 when analyzed using alpha spectroscopy; however, the down-hole gamma measurements were relatively high (greater than 10 kcpm). Additional samples from these locations were collected in 2007 and analyzed for NORM parameters using gamma spectroscopy. The gamma spectroscopy results (Table D-2 in Appendix D) provide evidence of thorium-232 even though the alpha spectroscopy results for thorium-232 (Table D-1 in Appendix D) were less than those from the reference area. The samples collected in 2007 contained significant concentrations of thorium-232 daughter radionuclides. The likely cause is the difference in sample sizes for alpha and gamma spectroscopy and sample heterogeneity. The amount of sample used in alpha spectroscopy is a small portion of the borehole sample received at the laboratory, and the results can be subject to variation if the thorium is not evenly distributed throughout the sample. Much more of the borehole sample received at the laboratory is used for gamma spectroscopy. Therefore, it can be assumed that the elevated down-hole gamma measurements at locations S01SB020 and S01SB020 can be attributed to thorium-232.

Sample S01SB0140101 (collected in 2005) was also analyzed for NORM isotopes in addition to thorium-232. The NORM isotope concentrations were similar to those for the samples collected in 2007. The thorium-232 concentration in the 2005 sample was elevated (16.5 pCi/g), and the sample also contained elevated levels of radium-224 and radium-228, which is characteristic of the thorium decay chain. Therefore, it can be assumed that the elevated down-hole gamma readings at location S01SB014 can be attributed to thorium-232.

3.7 EVALUATION OF SURFACE RADIATION LEVELS

Historical information indicated that, based on previous removal actions, there should be no thorium on the ground surface at Site 1. During borehole sampling, ground surface radiation readings at the reference area and Site 1 were measured using a 2-inch-diameter by 2-inch-long sodium iodide (NaI) detector to verify this information. At the reference area, surface readings ranged from 7,752 to 8,515 cpm with an average of 8,113 cpm. At Site 1, surface readings ranged from 5,418 to 8,096 cpm with an average of 6,222 cpm. The surface radiation levels at the reference area were greater than those from Site 1, indicating that there is not likely any residual thorium above natural background levels on the surface at Site 1. Surface screening results are included in Appendix A (Enclosures 3 and 4), Appendix C.5, and Appendix C.6.

3.8 CONCLUSIONS

Column 16 in Table 3-3 summarized the results of the Site 1 data evaluation by indicating with “Y” and “N” entries if sampled locations were determined to be candidates for excavation and removal (or land use controls). Nine sampling locations shown on Figure 3-1 (S01SB011, S01SB014, S01SB020, S01SB021, S01SB023, S01SB031, S01SB032, S01SB039, and S01SB040) were determined to be candidates for soil excavation and removal. Of these, seven locations (S01SB011, S01SB014, S01SB023, S01SB031, S01SB032, S01SB039, and S01SB040) had soil concentrations of thorium-232 greater than 3 pCi/g. Two locations (S01SB020 and S01SB021) had thorium-232 concentrations less than 3 pCi/g; however, the down-hole gamma readings were greater than 3 kcpm. In addition, the analytical data for the NORM parameters provide evidence of thorium-232.

There are two areas of thorium-232 contamination at Site 1. The first area is defined by sample locations S01SB039 and S01SB40 in the northern portion of the site (see Figure 3-1). The estimated area of contamination is 300 square feet, and the depth of contamination is 30 inches (2.5 feet). The estimated volume of soil in this area is 28 cubic yards. The second area is defined by the remaining sample locations in the central portion of the site (see Figure 3-1). The estimated area of contamination is 775 square feet, and the average depth of contamination is 30 inches (2.5 feet). The estimated volume of soil in this area is 72 cubic yards.

The contaminated soil could be removed for off-site disposal. Based on the site history and surface radiation measurements, the upper 18 inches of soil may not be contaminated. If this soil is removed, screened for radiation, and found to be uncontaminated, it could be stockpiled for use as backfill. This would reduce the volume of soil for off-site disposal by more than 50 percent. Another option would be to implement land use controls to prevent future residential use.

There is some uncertainty with the WRS test results because the reference area and site area seem to have different background concentrations of thorium-232. Based on this information, RASO recommended that any future remediation and surveys establish a reference area that is radiologically similar to the Site 1 area.

TABLE 3-1

SITE 1 AND REFERENCE AREA DATA COMPARISON
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

Reference Area Sample Location	Thorium - 232 Concentration (pCi/g)	Site 1 Sample Location	Thorium - 232 Concentration (pCi/g)
R01SB001	1.17	S01SB001	0.52
R01SB002	1.17	S01SB002	0.62
R01SB003	0.99	S01SB003	0.64
R01SB004	1.14	S01SB004	0.57
R01SB005	1.25	S01SB005	0.59
R01SB006	1.02	S01SB006	0.60
R01SB007	1.08	S01SB007	0.50
R01SB008	1.25	S01SB008	0.66
R01SB009	0.99	S01SB009	0.60
R01SB010	1.06	S01SB010	0.58
R01SB011	1.02	S01SB011	4.57
R01SB012	1.23	S01SB012	0.60
R01SB013	0.94	S01SB013	0.68
R01SB014	1.24	S01SB014	16.50
R01SB015	1.24	S01SB015	0.53
R01SB016	1.10	S01SB016	0.47
R01SB017	1.28	S01SB017	0.51
R01SB018	1.18	S01SB018	0.58
R01SB019	0.99	S01SB019	0.42
R01SB020	1.32	S01SB020	0.64
R01SB021	1.23	S01SB021	0.66
R01SB022	1.18	S01SB022	0.58
R01SB023	1.28	S01SB023	14.30
R01SB024	1.05	S01SB024	0.62
R01SB025	1.14	S01SB025	0.62
R01SB026	1.28	S01SB026	0.52
R01SB027	1.30	S01SB027	0.52
Average	1.15	S01SB028	0.42
		S01SB029	0.70
		S01SB030	0.68
		S01SB031	3.53
		S01SB032	28.40
		S01SB033	1.79
		S01SB034	0.61
		S01SB035	0.66
		S01SB036	0.96
		S01SB037	1.06
		S01SB038	0.68
		S01SB039	3.67
		S01SB040	4.24
		S01SB041	0.72
		Average	2.37

pCi/g - Picocuries per gram.

TABLE 3-2

RESRAD MODELING RESULTS
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

Cancer Risk

Duration (years)	Thorium-232 Concentration in Soil (pCi/g)			
	1	2	3	4
0	2.59E-05	5.18E-05	7.77E-05	1.04E-04
1	2.69E-05	5.39E-05	8.08E-05	1.08E-04
3	2.87E-05	5.74E-05	8.61E-05	1.15E-04
10	3.17E-05	6.33E-05	9.50E-05	1.27E-04
30	2.97E-05	5.93E-05	8.90E-05	1.19E-04
100	1.17E-05	2.34E-05	3.50E-05	4.67E-05

Radiation Dose (mrem/yr)

Duration (years)	Thorium-232 Concentration in Soil (pCi/g)			
	1	2	3	4
0	0.10	0.21	0.31	0.42
1	0.23	0.47	0.70	0.94
3	0.52	1.03	1.55	2.07
10	1.21	2.47	3.64	4.85
23.05	1.49	2.98	4.47	5.96
30	1.46	2.97	4.39	5.85
100	0.73	1.47	2.20	2.94

mrem/yr - Millirems per year
pCi/g - Picocuries per gram.

TABLE 3-3

DATA EVALUATION
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sample Number[1]	**Down-Hole Reading 18 to 24 inches bgs[2] (kcpm)[3]**	**Sample Shipped[4]**	**Highest Screening[5]**	**Down-Hole Reading 24 to 30 inches bgs[2] (kcpm)[3]**	**Sample Shipped**	**Highest Screening**	**Down-Hole Reading 30 to 36 inches bgs[2] (kcpm)[3]**	**Sample Shipped**	**Highest Screening**	**Thorium-232 in Shipped Sample (pCi/G)[6]**	**Was the sample from the boring interval with the highest field gamma reading sent to the laboratory? (Y/N)[7]**	**Does the detected thorium-232 concentration exceed 3 pCi/g? (Y/N)**	**Field Gamma Reading for Shipped Sample +10%[9] (kcpm)**	**Does the field gamma reading from the boring interval with the highest field gamma reading exceed 3 kcpm? (Y/N)**	**Is the sample location a candidate for excavation and removal? (Y/N)**	**CONCLUSION AND RATIONALE**
FIRST ROUND DATA (2005)																
S01SB0010201	2.23		H	1.98	S		1.93			0.52	N	N	2.18	N	N	- Field gamma reading from the interval with the highest-reading was < 3 kcpm - Thorium-232 concentration was < 3 pCi/g
S01SB0020201	4.86		H	4.01			3.63	S		0.62	N	N	3.99	Y	N	- Thorium-232 concentration was < 3 pCi/g - Field gamma readings were only twice many other readings that reflect thorium-232 concentrations of ~0.5 pCi/g
S01SB0030201	2.10	S	H	1.63			1.54			0.64	Y	N		N	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0040201	2.26	S	H	1.69			1.52			0.57	Y	N		N	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0050201	3.23	S	H	2.31			2.13			0.59	Y	N		Y	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0060201	2.26		H	2.01	S		1.82			0.60	N	N	2.21	N	N	- Field gamma reading for the shipped sample was very nearly within +10% of highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - Field gamma reading from the interval with the highest reading was < 3 kcpm
S01SB0070201	1.55	S		1.57	H		1.52			0.50	N	N	1.70	N	N	- Field gamma reading for the shipped sample was within +10% of highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - Field gamma reading from the interval with the highest reading was < 3 kcpm
S01SB0080201	1.84	S	H	1.67			1.79			0.66	Y	N		N	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0090201	2.02		H	1.96	S		1.84			0.60	N	N	2.16	N	N	- Field gamma reading for the shipped sample was within +10% of highest-reading borehole interval - For the sample, the field gamma reading from the interval with the highest reading was < 3 kcpm - For the duplicate, the sample from the interval with the highest field reading was shipped to the laboratory - Field gamma readings for the shipped interval for both the sample and the duplicate were nearly identical - Thorium-232 concentrations in the duplicate and the analyzed sample were < 3 pCi/g.
S01SB0090201DUP	1.95			1.95	S	H	1.79			0.59	Y	N		N		
S01SB0100201	3.42		H	2.69	S		1.98			0.58	N	N	2.96	Y	N	- Thorium-232 concentration was < 3 pCi/g - Field gamma readings were only twice many other readings that reflect thorium-232 concentrations of ~0/5 pCi/g
S01SB0110201	36.80	S	H	25.00			4.50			4.57	Y	Y		Y	Y	- EXCAVATE TO 36 INCHES BGS - Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was > 3 pCi/g - Field gamma readings were > 3 kcpm to 36 inches bgs.
S01SB0120201	2.08	S	H	1.98			1.82			0.60	Y	N		N	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0130201	3.26	S	H	2.32			1.92			0.68	Y	N		Y	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0140201	541.00	S		747.00		H	10.40			16.5	N	Y	595.10	Y	Y	- EXCAVATE TO 36 INCHES BGS - Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was > 3 pCi/g - Lowest field gamma reading was > 3 kcpm

TABLE 3-3

DATA EVALUATION
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sample Number[1]	**Down-Hole Reading 18 to 24 inches bgs[2] (kcpm)[3]**	**Sample Shipped[4]**	**Highest Screening[5]**	**Down-Hole Reading 24 to 30 inches bgs[2] (kcpm)[3]**	**Sample Shipped**	**Highest Screening**	**Down-Hole Reading 30 to 36 inches bgs[2] (kcpm)[3]**	**Sample Shipped**	**Highest Screening**	**Thorium-232 in Shipped Sample (pCi/G)[6]**	**Was the sample from the boring interval with the highest field gamma reading sent to the laboratory? (Y/N)[7]**	**Does the detected thorium-232 concentration exceed 3 pCi/g? (Y/N)**	**Field Gamma Reading for Shipped Sample +10%[9] (kcpm)**	**Does the field gamma reading from the boring interval with the highest field gamma reading exceed 3 kcpm? (Y/N)**	**Is the sample location a candidate for excavation and removal? (Y/N)**	**CONCLUSION AND RATIONALE**
S01SB0150201	2.83	S		2.84		H	2.11			0.53	N	N	3.11	N	N	- Field gamma reading for the shipped sample was within +10% of high-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - Feld gamma reading from the interval with the highest reading was < 3 kcpm
S01SB0160201	1.70	S		1.70			1.89		H	0.47	N	N	1.87	N	N	- Field gamma reading for the shipped sample was very nearly within +10% of the highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - Field gamma reading from the highest-reading interval was < 3 kcpm
S01SB0170201	1.63	S		1.66		H	1.56			0.51	N	N	1.79	N	N	- Field gamma reading for the shipped sample was within +10% of highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - ield gamma reading from the interval with the highest reading was < 3 kcpm
S01SB0180201	2.02		H	1.82	S		1.76			0.58	N	N	2.00	N	N	- Field gamma reading for the shipped sample is very nearly within +10% of highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - Field gamma reading from the interval with the highest reading was < 3 kcpm
S01SB0190201	2.20		H	1.76	S		1.79			0.42	N	N	1.94	N	N	- Field gamma reading from the interval with the highest reading was < 3 kcpm - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample
S01SB0200201	13.10		H	4.06			2.43	S		0.64	N	N	2.67	Y	Y	- EXCAVATE TO 30 INCHES BGS - Field gamma reading for the two intervals with the highest readings were both > 3 kcpm - NORM analytical results (Section 3.6 and Appendix D) provide evidence of thorium-232
S01SB0210201	14.40	S	H	3.42			1.97			0.66	Y	N		Y	Y	- EXCAVATE TO 24 INCHES BGS - Sample from the interal with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g - NORM analytical results (Section 3.6 and Appendix D) provide evidence of thorium-232
S01SB0220201	3.89	S	H	3.56			2.40			0.58	Y	N		Y	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0230201	5.67		H	3.52	S		2.47			14.30	N	Y	3.87	Y	Y	- EXCAVATE TO 30 INCHES BGS - Thorium-232 concentration was > 3 pCi/g in the shipped sample - Field gamma reading for the interval with the highest reading was > 3 kcpm
S01SB0230201DUP	24.40		H	5.62	S		2.32			0.99	N	N	6.18	Y		
S01SB0240201	2.32	S	H	2.25			2.14			0.62	Y	N		N	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0250201	3.85	S	H	2.47			2.30			0.62	Y	N		Y	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0250201DUP	2.67	S	H	2.60			2.32			0.62	Y	N		N	N	
S01SB0260201	2.42		H	2.21	S		2.10			0.52	N	N	2.43	N	N	- Field gamma reading for the shipped sample is within +10% of highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample - Field gamma reading from the interval with the highest reading was < 3 kcpm
S01SB0270201	1.58	S		1.59		H	1.56			0.52	Y	N	1.74	N	N	- Field gamma reading for interval with highest field reading and interval for shipped sample essentially equal - Thorium-232 concentration in the shipped sample was < 3 pCi/g - Field gamma reading for the interval with the highest reading was < 3 kcpm

TABLE 3-3

DATA EVALUATION
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

(1) Sample Number[1]	(2) Down-Hole Reading 18 to 24 inches bgs[2] (kcpm)[3]	(3) Sample Shipped[4]	(4) Highest Screening[5]	(5) Down-Hole Reading 24 to 30 inches bgs[2] (kcpm)[3]	(6) Sample Shipped	(7) Highest Screening	(8) Down-Hole Reading 30 to 36 inches bgs[2] (kcpm)[3]	(9) Sample Shipped	(10) Highest Screening	(11) Thorium-232 in Shipped Sample (pCi/G)[6]	(12) Was the sample from the boring interval with the highest field gamma reading sent to the laboratory? (Y/N)[7]	(13) Does the detected thorium-232 concentration exceed 3 pCi/g? (Y/N)	(14) Field Gamma Reading for Shipped Sample +10%[9] (kcpm)	(15) Does the field gamma reading from the boring interval with the highest field gamma reading exceed 3 kcpm? (Y/N)	(16) Is the sample location a candidate for excavation and removal? (Y/N)	(17) CONCLUSION AND RATIONALE
SECOND ROUND DATA (2007)																
S01SB0280302	9.0 to 8.5		H	8.5 to 8.5			8.5 to 8.5	S		0.42	N	N	9.35	N/A[8]	N	- Field gamma reading for the shipped sample was within +10% of highest-reading borehole interval - Thorium-232 concentration was < 3 pCi/g in the analyzed (shipped) sample
S01SB0290202	12 to 12.5			12.5 to 12.5	S	H	12.5 to 11			0.70	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0300302	12.7 to 12.9			12.9 to 12.9			12.9 to 12.9	S	H	0.68	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0310102	84 to 43	S	H	43 to 19			19 to 14			3.53	Y	N		N/A	Y	- EXCAVATE TO 24 INCHES BGS - Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was > 3 pCi/g
S01SB0320202	36 to 100			100 to 49	S	H	49 to 21			28.40	Y	Y		N/A	Y	- EXCAVATE TO 30 INCHES BGS - Sample from the interval with the highest field reading interval was shipped to the laboratory - Thorium-232 concentration was > 3 pCi/g in the analyzed (shipped) sample
S01SB0330102	33.8 to 24	S	H	24 to 15			15 to 15			1.79	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0340102	20 to 13.5	S	H	13.5 to 8.8			8.8 to 7.6			0.61	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0350102	13.5 to 12	S	H	12 to 11.5			11.5 to 10			0.66	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0360102	16 to 14.4	S	H	14.4 to 12.8			12.8 to 12.2			0.96	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0370102	22.6 to 13	S	H	13 to 9.3			9.3 to 8.7			1.06	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0370102DUP	33.3 to 14.5	S	H	14.5 to 9.7			9.7 to 9.2			0.66	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0380202	12.6 to 13.5			13.5 to 13.3	S	H	13.3 to 12 4			0.68	Y	N		N/A		- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g
S01SB0390102	17.2 to 23	S		23 to 19	H		19 to 12.6			1.56	N	N	22.11	N/A	Y	- EXCAVATE TO 30 INCHES BGS - Average field gamma reading for the interval with the highest field reading was 21 kcpm. - Average field gamma reading for the shipped-sample interval was 20.1 kcpm - Thorium-232 concentration was > 3 pCi/g in the analyzed (shipped) field duplicate sample - Average field gamma reading for shipped sample was within +10% of the highest average field gamma reading
S01SB0390102DUP	19 to 21	S	H	21 to 15.5			15.5 to 13.5			3.67	Y	N		N/A		
S01SB0400202	22.8 to 46			46 to 59	S	H	59 to 23.3			4.24	Y	Y		N/A	Y	- EXCAVATE TO 30 INCHES BGS - Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was > 3 pCi/g
S01SB0410102	14 to 14.4	S	H	14.4 to 12			12 to 11.8			0.72	Y	N		N/A	N	- Sample from the interval with the highest field reading was shipped to the laboratory - Thorium-232 concentration was < 3 pCi/g

(1) Sample number for the sample shipped to the analytical laboratory.
(2) Bgs = Below ground surface.
(3) kcpm = Kilocounts per minute.
(4) "S" indicates that the sample shipped to the laboratory was collected from this borehole interval.
(5) "H" indicates that the highest field gamma reading in kcpm occurred in this borehole interval.
(6) pCi/g = Picocuries per gram.
(7) Y/N = Yes or no.
(8) N/A = Criterion not applicable to second (2007) sampling round.
(9) Values are provided only for the sampled locations where the sample shipped to the laboratory did not correspond to the highest reading (kcpm) detected in the field. 10% corresponds to the ± 10 % precision of the field instrumentation.

TABLE 3-4

GAMMA READINGS AND THORIUM-232 CONCENTRATIONS
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

SAMPLE NUMBER(1)	DOWN-HOLE FIELD GAMMA READING FOR SAMPLED BOREHOLE INTERVAL (kcpm)(2)	THORIUM-232 CONCENTRATION (pCi/G)(6)
FIRST ROUND DATA (2005)		
S01SB0070201	1.55	0.50
S01SB0270201	1.58	0.52
S01SB0170201	1.63	0.51
S01SB0160201	1.70	0.47
S01SB0190201	1.76	0.42
S01SB0180201	1.82	0.58
S01SB0080201	1.84	0.66
S01SB0090201DUP	1.95	0.59
S01SB0090201	1.96	0.60
S01SB0010201	1.98	0.52
S01SB0060201	2.01	0.60
S01SB0120201	2.08	0.60
S01SB0030201	2.10	0.64
S01SB0260201	2.21	0.52
S01SB0040201	2.26	0.57
S01SB0240201	2.32	0.62
S01SB0200201	2.43	0.64
S01SB0250201DUP	2.67	0.62
S01SB0100201	2.69	0.58
S01SB0150201	2.83	0.53
S01SB0050201	3.23	0.59
S01SB0130201	3.26	0.68
S01SB0230201	3.52	14.30
S01SB0020201	3.63	0.62
S01SB0250201	3.85	0.62
S01SB0220201	3.89	0.58
S01SB0230201DUP	5.62	0.99
S01SB0210201	14.40	0.66
S01SB0110201	36.80	4.57
S01SB0140201	541.00	16.5

(1) Sample number for the sample shipped to the analytical laboratory.
(2) kcpm = kilocounts per minute
(3) pCi/g = picocuries per gram

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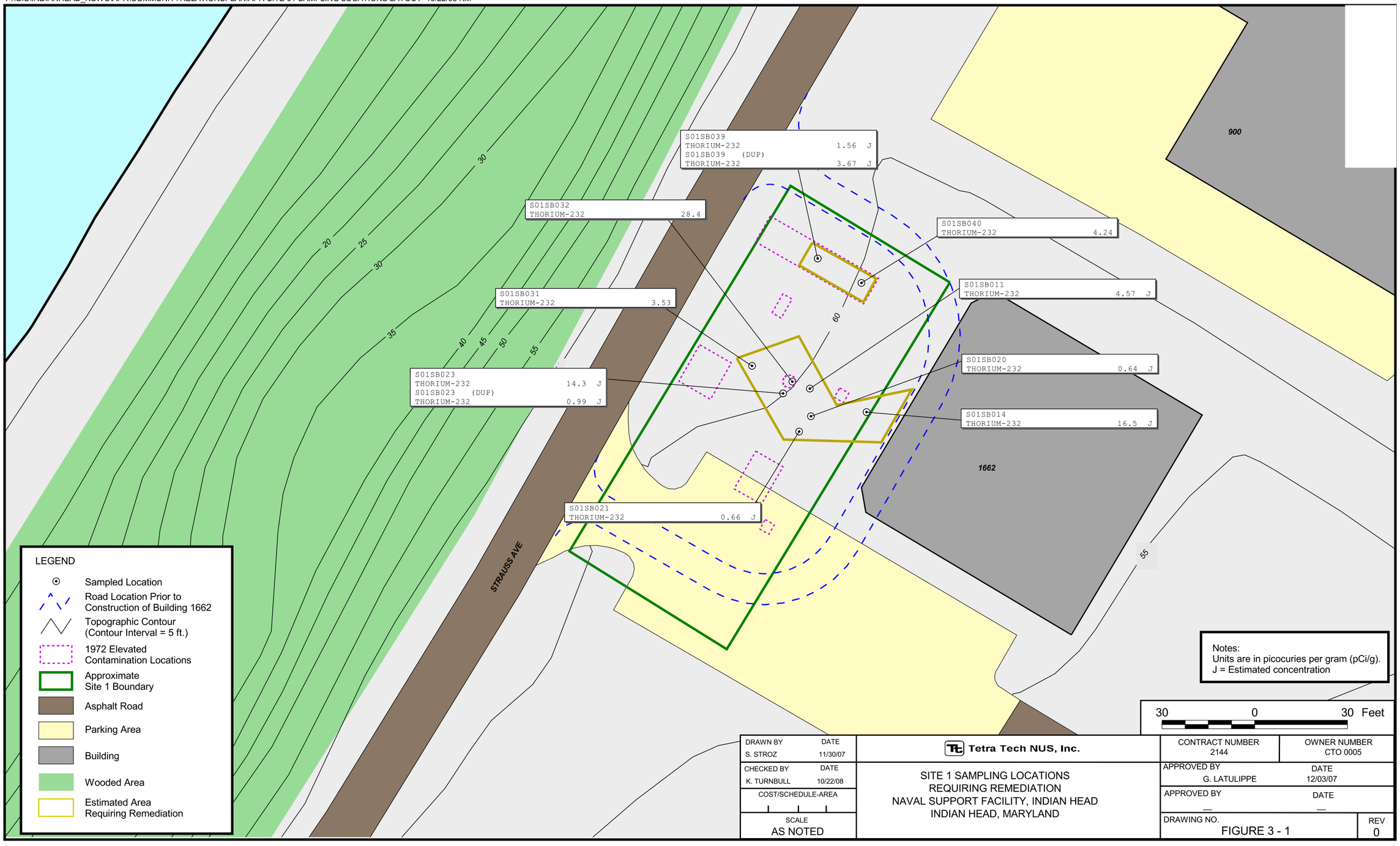

DRAWN BY S. STROZ	DATE 11/30/07	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2144 / OWNER NUMBER CTO 0005
CHECKED BY K. TURNBULL	DATE 10/22/08	SITE 1 SAMPLING LOCATIONS REQUIRING REMEDIATION NAVAL SUPPORT FACILITY, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 12/03/07
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 3 - 1 / REV 0

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APPENDIX A

TECHNICAL MEMORANDUM DATED MARCH 10, 2006:
SITE SCREENING PROCESS (SSP) INVESTIGATION, SITE 1 – THORIUM SPILL

TECHNICAL MEMORANDUM

Date: March 10, 2006

To: Jeff Morris, NAVFAC - Washington
Joseph Rail, P.E., NAVFAC - Washington
Shawn Jorgensen, NDW-IH
Dennis Orenshaw, US EPA Region 3
Curtis DeTore, MDE

From: George J. Latulippe, P.E., Tetra Tech NUS, Inc.

Subject: Site Screening Process (SSP) Investigation
Site 1 – Thorium Spill
Naval Support Facility, Indian Head
Indian Head, Maryland

1.0 INTRODUCTION

This technical memorandum summarizes a Site Screening Process (SSP) investigation conducted during November and December 2005 at Site 1 (Thorium Spill) located on the Naval Support Facility, Indian Head (NSF-IH) in Indian Head, Maryland by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 005 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-03-D-0057.

The purpose of the investigation was to determine whether operations at Site 1 have resulted in the release of thorium at concentrations of potential environmental concern. The SSP was conducted in response to a requirement in the Federal Facility Agreement (FFA) (EPA Region 3 and DoN, 2000a) for a site screening investigation (SSI) at Site 1.

The objective of the investigation was to collect sufficient data to provide the basis for a determination that either: (1) an RI/FS, an FS, another investigation, and/or removal action, as appropriate, is required by the area addressed by the SSP, or (2) the area does not pose a threat or potential threat to public health, welfare, or the environment and therefore the area should be removed from further study under the FFA. The general scope of the SSP investigation at Site 1 was agreed upon by the Indian head Installation Restoration Team (IHIRT) through approval of the SSP Investigation Work Plan (TtNUS, 2005).

2.0 INVESTIGATION RATIONALE

The rationale for the sampling scheme employed for Site 1 is described in detail in the Site 1 SSP Work Plan (TtNUS, 2005). The Work Plan described an investigation that conformed to the Multi-Agency Radiation Survey and Site Investigation Manual

(MARSSIM) (EPA, et al., 2000b) and was coordinated closely with the Navy's Radiological Affairs Support Office (RASO). The Work Plan defined an evaluation process whereby the presence or absence of residual contamination at Site 1 is to be determined by comparing the Site 1 analytical results to the reference area analytical results by first adding 1 picoCurie per gram (pCi/g) to each result in the reference area data set, then comparing the two data sets using the Wilcoxon Rank Sum (WRS) test. The 1 pCi/g was determined by RASO to be appropriate incremental concentration by which the site could not exceed the reference area.

The decision rules developed in the Work Plan for the Site 1 investigation are as follows:

- If the result of the WRS test indicates that the Site 1 thorium-232 concentration does not exceed the sum of the reference area thorium-232 concentration plus 1 pCi/g, Site 1 will be recommended for no action.

- If the result of the WRS test indicates that the Site 1 thorium-232 concentration exceeds the sum of the reference area thorium-232 concentration plus 1 pCi/g, Site 1 will be subjected to further evaluation.

In the event the investigation determines that further evaluation is appropriate for the site, the form and extent of the evaluation is to be discussed within the Indian Head Installation Restoration Team (IHIRT).

Based on statistical parameters defined in the Work Plan for a random sampling scheme, it was determined that 27 samples needed to be collected from Site 1 in addition to an equal quantity from the reference area, for a total of 54 samples.

3.0 FIELD INVESTIGATION

Field Activities were conducted between November 28, 2005, and December 2, 2005. Twenty-seven samples were collected from the site area and 27 samples were collected from a reference area. The Site 1 area and the reference area, along with the sampled locations and the thorium-232 analytical results, are shown on Enclosure 1 (Figure 1) and Enclosure 2 (Figure 2) respectively.

3.1 Sample Collection

The reference area samples were collected prior to collecting the Site 1 samples. At each reference area sample location, a direct push drill rig was used to create a 3-inch-diameter borehole down to approximately 36 inches below ground surface (bgs). A macro-core sampling device lined with a disposable plastic sleeve was used to extract the soil from the borehole at each sampling location. The disposable sleeve full of soil was removed from the macro-core sampler and placed on a field work bench to be cut open. The soil from the middle interval (24- to 30-inches bgs) in each reference area borehole was removed from the disposable sleeve and packaged for shipment to the

fixed-base laboratory for a determination of the thorium-232 concentration. A gamma probe scintillator was lowered into each borehole to measure gross gamma radiation at each of three intervals (18- to 24-inchs bgs, 24- to 30-inchs bgs, and 30- to 36-inchs bgs). It was planned that if a comparison of the radiation level for the middle (24- to 30-inchs bgs) interval with the radiation levels for the remaining two intervals indicated a difference greater than 1,000 counts per minute (cpm), then the soil from the interval indicating the greatest difference from the 24- to 30-inchs bgs interval would also be shipped to the fixed-base laboratory. This situation did not occur at any of the reference area sampling locations. Therefore only a single sample from each of the 27 reference area sample location was shipped to the laboratory. Field readings from the reference area sampling locations are included in Enclosure 3. The analytical results for the reference area samples are shown on Enclosure 2.

Site 1 samples were collected using the same technique with the exception of the following. At each Site 1 borehole, only the soil from the boring interval exhibiting the highest radiation level was shipped to the fixed-base laboratory for analysis. If none of the three sample intervals in a borehole exhibited an apparently high reading, one of the three samples from that borehole was selected randomly for shipment to the fixed-base laboratory. Field readings from the Site 1 sampling locations are included in Enclosure 4. The analytical results for the Site 1 samples are shown on Enclosure 1.

3.2 Quality Assurance/Quality Control

Radiological field detection instruments were calibrated by the equipment supplier prior to shipping the items to the field. Each item was additionally calibrated daily by TtNUS personnel during the field investigation.

The field QC samples consisted of field duplicates. Each duplicate sample underwent the same preservation, analysis, and reporting procedures as the respective environmental sample. The duplicate samples were collected at a rate of one per ten or fewer environmental samples.

During the sampling effort at the Site 1 area, one location in particular (S01SB014) exhibited a significantly higher radiation reading [747 kilo counts per minute (kcpm)] than any of the other Site 1 locations. The next highest reading was 36.8 kcpm at location S01SB011. To provide a more complete basis for evaluating the high reading at S01SB014, a sample of the soil from the boring interval exhibiting the elevated reading (24 to 30 inches bgs) was shipped to the fixed-base laboratory for analysis of naturally occurring radioactive material (NORM) by gamma spectroscopy. The following NORM isotopes were selected for analysis.

- actinium-228
- bismuth-212 and -214
- lead-212 and -214
- potassium-40

- radium-226
- thallium-208
- thorium-234

These isotopes were selected because potassium-40 is a non-series radionuclide that may be naturally present in soil, and the other radionuclides in the list are part of naturally occurring decay series that may be naturally present in soil. The analysis is an effort to determine if a NORM isotope may be the cause of the elevated field reading.

3.3 Laboratory Analysis

The subsurface soil samples were subjected to analysis for thorium-232 by a fixed-base laboratory using alpha spectroscopy. Alpha spectroscopy was employed because it provides a more targeted analysis of the analyte of interest (in this case thorium-232) in addition to providing lower detection limits. It also yields some insight into whether the observed thorium concentrations are naturally occurring by providing thorium isotope-specific data that would not be possible with gamma spectroscopy. Gamma spectroscopy is more suitable for determining the concentration of a broader array of analytes with a single analysis when higher detection limits are satisfactory. In fact, one soil sample (the sample from location S01SB014 described in Section 2.1.2) was analyzed by the fixed-base laboratory using gamma spectroscopy to analyze for actinium-228, bismuth-212 and -214, lead-212 and -214, potassium-40, radium-226, thallium-208, and thorium-234. The analytical results are shown below. All analytical results were subjected to an analytical data validation process.

Analytical Results for Sample S01SB0140101

Parameter	Result
Actinium-228	11.5
Bismuth-212	8.1
Bismuth-214	0.51
Lead-212	12.3
Lead-214	0.46
Potassium-40	6.9
Radium-224	13.6
Radium-226	0.51
Radium-228	11.5
Thallium-208	3.91
Thorium-234	2.2U

U = Not detected

3.4 Investigation-Derived Waste

The investigation-derived waste (IDW) produced during the SSP investigation included borehole cuttings, disposable sampling equipment, personnel protective equipment (PPE), and miscellaneous trash. Soil boring cuttings were used to backfill the open boreholes after soil samples were collected. The remaining materials were screened in the field as described in the Site 1 Work Plan, determined to be non-radioactive, and disposed as trash.

3.5 Surveying

The horizontal position of each sampled location was determined by field sampling personnel using a global positioning device. Coordinates were determined based on the Maryland State Plane Coordinate system [North American Datum (NAD) 1983]. No vertical elevations were determined because they were not critical to the objectives of the SSP investigation.

4.0 INVESTIGATION RESULTS

Enclosures 1 and 2 are figures showing sampled areas, sample locations, and thorium-232 concentrations for Site 1 and the reference area respectively. The field readings made during the field activities are provided on Enclosures 3 and 4 for the reference area and Site 1 respectively.

4.1 Wilcoxon Rank Sum Test

The Wilcoxon Rank Sum (WRS) test was performed on the data set composed of the thorium-232 analytical results shown on in Enclosures 1 and 2 for Site 1 and the reference area. The results of the WRS test appear on Enclosure 5.

The null hypothesis for this study was:

> The median concentration in the survey unit (Site 1) exceeds that in the reference area by more than 1 pCi/g.

In summary, the results of the WRS test indicated that the reference area rank sum of 1026 exceeded the critical value of 837.53. That is, the WRS rejects the null hypothesis. Based solely on the WRS, the site is therefore viewed as being appropriate for a "no action" determination.

4.2 Other Observations Regarding Site 1 Analytical Data

As indicated by the analytical data on Enclosure 1, three of the samples exhibited elevated (relative to the other Site 1 samples) thorium-232 concentrations. They appear in the table below.

SAMPLED LOCATION	THORIUM-232 CONCENTRATION (pCi/g)
S01SB011	4.57
S01SB014	16.5
S01SB023	14.3

To gain some perspective regarding the three elevated thorium-232 concentrations, they were compared to the published EPA preliminary remediation goals (PRGs) (EPA. 2006) shown below.

Thorium-232 Preliminary Remediation Goals (PRG)				Thorium-232 Soil to Groundwater	
Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	DAF=20 (pCi/g)	DAF=1 (pCi/g)
3.1	0.00942	19	34.8	6.06	0.303

All three of the elevated concentrations are less than the PRGs for the Outdoor Worker and the Indoor Worker. All three of the elevated concentrations exceed the PRGs for Agricultural Soil and the soil concentration necessary to protect groundwater at a dilution factor of one (3.03E-01 pCi/g) (as do all the detected concentrations in the data set). Two of the elevated concentrations exceed the soil concentration necessary to protect groundwater at a dilution factor of 20 (6.06E+00). All three of the elevated concentrations exceed the Residential soil concentration corresponding to a 10E-6 excess cancer risk, but they are less than the concentration corresponding to an excess cancer risk of 10E-5 (i.e., 31E+00 pCi/g).

As an additional consideration, the possibility that the high concentrations may indicate the presence of a localized area of highly concentrated thorium-232 was examined by revisiting the historical information describing the location of Site 1. That effort led to the identification of certain information not previously factored into the position of the site on the facility relative to Building 1662. The information led to the more clear definition of the site's position as shown on Enclosure 6 (Latulippe, 2006).

The new Site 1 definition is approximately 2.4 times larger than previously thought, and it covers nearly all of the area occupied by the area formerly defined as Site 1.

With respect to the new definition of the Site 1 boundary, it can be observed that:

- The elevated thorium-232 concentrations detected at Site 1 may represent an outer boundary of a localized area of higher concentrations,
- The elevated thorium-232 concentrations are generally located near the center of the area newly defined as Site 1,
- The updated understanding of the Site 1 boundary nearly surrounds the former Site 1 boundary and is larger.

Based on the above observations it is judged prudent to conduct additional sampling at Site 1 to verify that the larger area is not in need of further remediation.

5.0 POTENTIAL SECOND ROUND OF SITE 1 SAMPLING

A second round of sampling conducted within the new Site 1 boundary could be conducted to conform to the previously developed Site 1 work plan, null hypothesis, and statistical assumptions, all of which conform to MARSSIM requirements. The previously sampled reference area could be used in applying the WRS test to the new data, thus mitigating the cost associated with reference area samples and analyses. Given the application of the same assumptions to the sampling planning process, 27 samples would need to be collected with the newly defined Site 1 area. The new 27-sample data set could be evaluated against the original reference area data set using the WRS test to determine if the null hypothesis should be accepted or not.

Applying the same technique as for the original work plan to determine the quantity and location of sampling locations [i.e., the Visual Sampling Plan software (PNNL, 2002)], yields the sampling locations listed in Enclosure 7 and shown on Enclosure 8. As with the previous sampling event, the coordinates assume the southern corner of the site as the origin. Coordinates for X values are measured along the southeastern side of the site, and coordinates for the Y values are measured along the southwestern side of the site.

ENCLOSURES

Enclosure 1: Figure 1 - Site 1 SSP Investigation Results
Enclosure 2: Figure 2 - Reference SSP Investigation Results
Enclosure 3: Referenced Area Gamma Screening
Enclosure 4: Site 1 Gamma Screening
Enclosure 5: Wilcoxon Rank Sum Test
Enclosure 6: Modified Site 1 Area
Enclosure 7: Sample Locations for Second Round Samples
Enclosure 8: Modified Site 1 Area and Sample Locations

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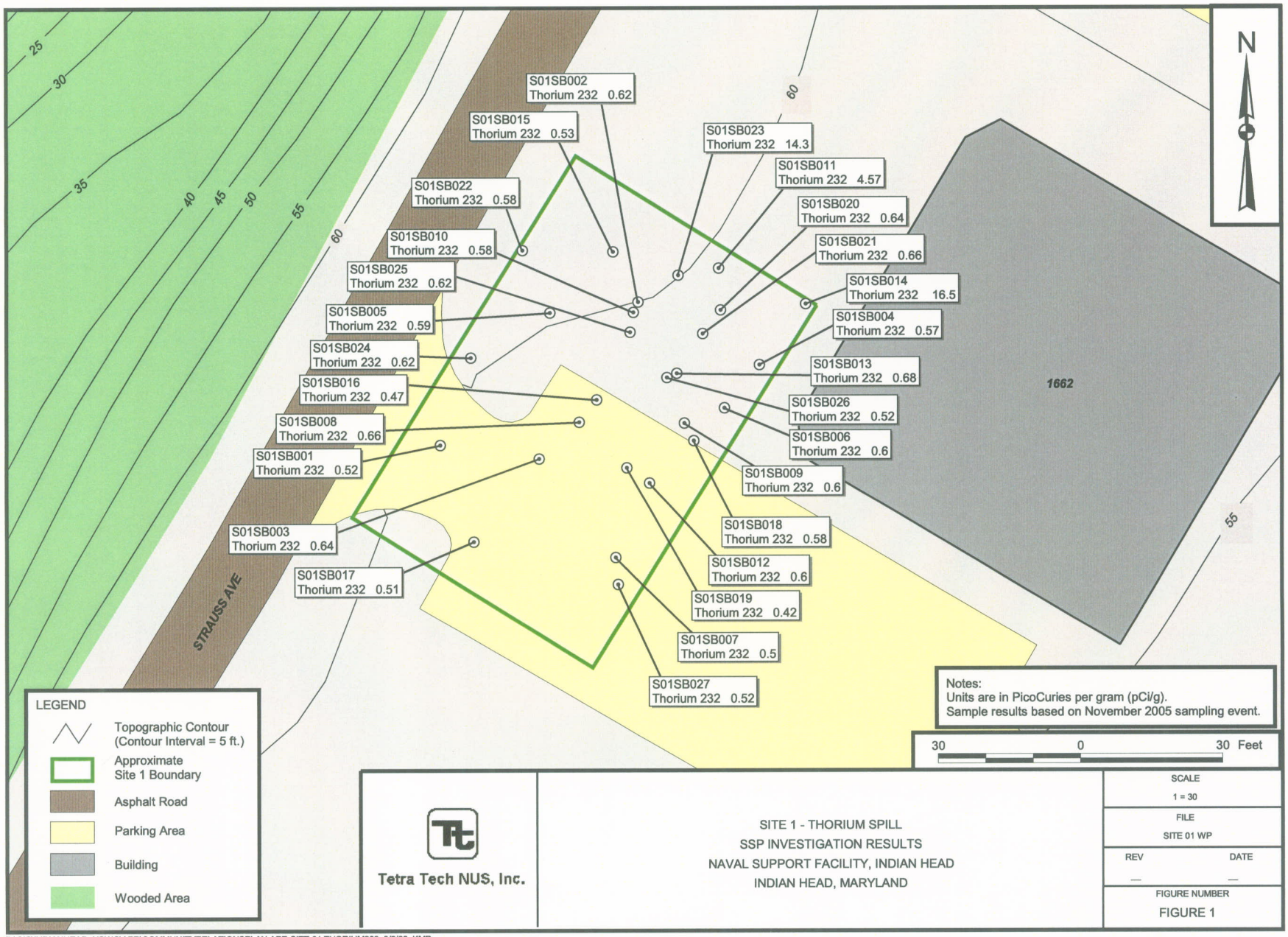

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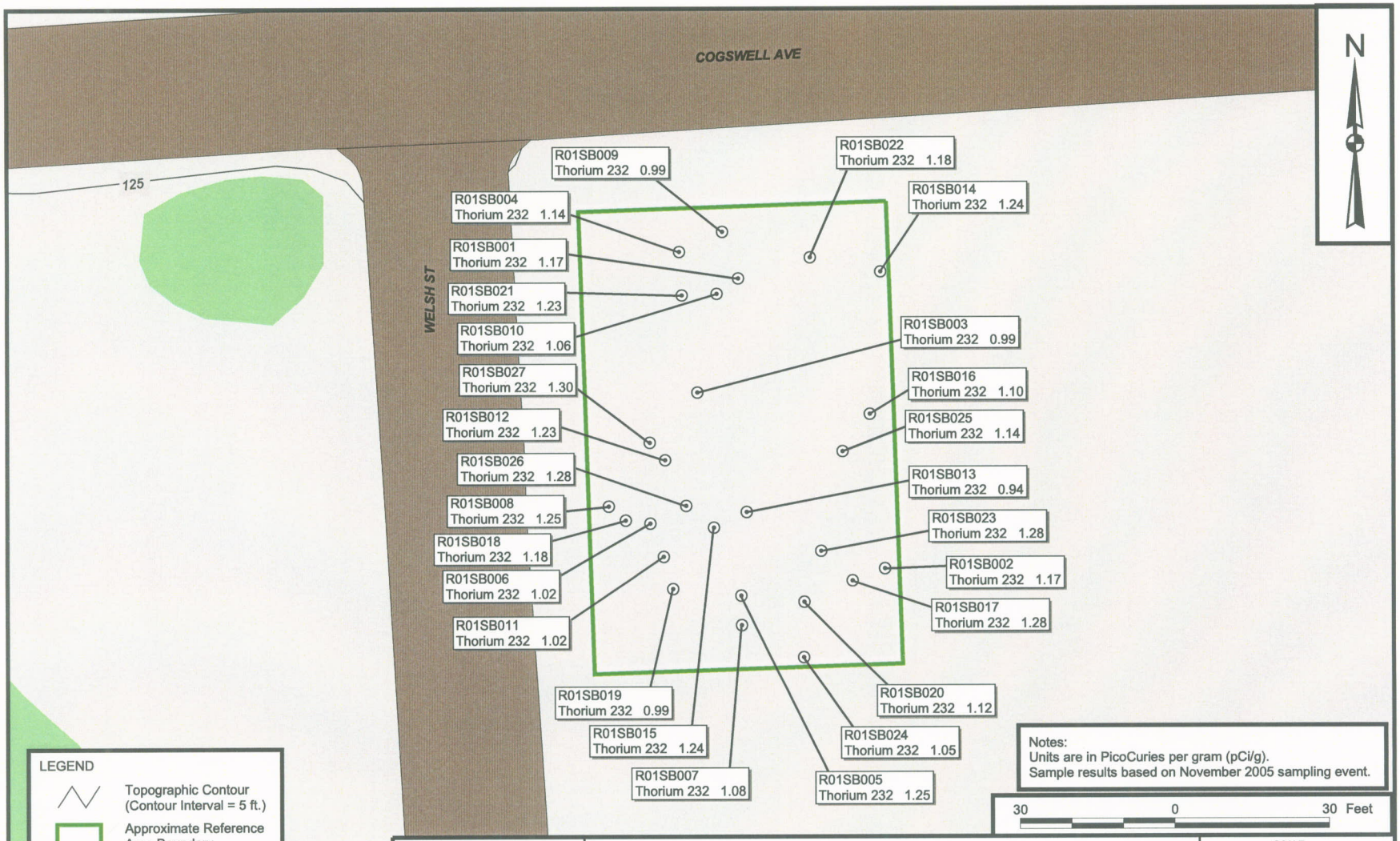
ENCLOSURE 1



P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE 01 THORIUM232REFERENCE 3/2/06 KMP

ENCLOSURE 2

ENCLOSURE 3

REFERENCE AREA GAMMA SCREENING[1]
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

SAMPLE NUMBER	SOIL SAMPLE FROM 24-INCH TO 30-INCH BGS[2] BORING INTERVAL (kcpm)[3]	GROUND SURFACE AT BORING LOCATION (cpm)[4]	DOWN-HOLE READING FROM 18-INCH TO 24-INCH BGS BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 24-INCH TO 30-INCH BGS BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 30-INCH TO 36-INCH BGS BORING INTERVAL (kcpm)
R01SB0010201	6.4	8414	17.8	18.1	18.2
R01SB0020201	6.8	8412	17.8	18.4	18.2
R01SB0030201	6.7	8004	17.5	17.8	17.6
R01SB0040201	6.7	8302	17.8	17.9	18.1
R01SB0040201DUP	6.7	8515	17.6	18.3	18.1
R01SB0050201	5.9	8167	16.4	16.9	16.8
R01SB0060201	6.2	7945	16.9	17.5	17.6
R01SB0070201	6.2	8100	17.1	17.5	17.6
R01SB0080201	5.8	7752	17.4	18.1	17.9
R01SB0090201	6.4	8439	17.9	18.1	18.1
R01SB00100201	6.6	8100	17.3	17.7	17.6
R01SB00110201	6.5	8103	17.5	18.2	17.8
R01SB00120201	6.8	7969	18.4	18.6	17.6
R01SB00130201	6.9	8213	17.4	17.6	18.0
R01SB00140201	6.8	8121	17.6	18.1	17.9
R01SB00150201	6.6	7897	17.4	18.0	17.9
R01SB00160201	6.8	7944	17.2	17.4	17.4
R01SB00160201DUP	6.8	7954	17.3	17.6	17.6
R01SB00170201	6.5	8446	17.2	17.6	17.9
R01SB00180201	5.75	8235	17.1	17.8	18.1
R01SB00190201	6.5	7866	17.2	17.6	17.8
R01SB00200201	6.5	7780	17.2	17.4	17.3
R01SB00200201DUP	6.9	8113	17.5	18.0	17.2
R01SB00210201	6.8	8014	17.8	18.5	18.2
R01SB00220201	6.8	7833	17.5	17.9	17.8
R01SB00230201	6.8	8405	17.4	17.6	17.5
R01SB00240201	6.9	8144	17.5	17.7	18.1
R01SB00250201	6.8	8002	17.3	17.5	17.6
R01SB00260201	6.9	7989	17.9	18.1	18.0
R01SB00270201	6.7	8200	18.3	18.6	18.6

(1) Borehole logging and sample survey performed using a 2-inch diameter X 2-inch long NaI detector
(2) BGS = below ground surface
(3) kcpm = kilo counts per minute
(4) cpm = counts per minute

ENCLOSURE 4

SITE 1 AREA GAMMA SCREENING
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

SAMPLE NUMBER	SOIL SAMPLE FROM BORING INTERVAL WITH HIGHEST READING (kcpm)(1)	GROUND SURFACE AT BORING USING 1x1 DETECTOR(2) (cpm)(3)	GROUND SURFACE AT BORING USING 2X2 DETECTOR(4) (cpm)	DOWN-HOLE READING FROM 18-INCH TO 24-INCH BGS(5) BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 24-INCH TO 30-INCH BGS BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 30-INCH TO 36-INCH BGS BORING INTERVAL (kcpm)
S01SB0010201	1.32	1493	6493	2.23	1.98	1.93
S01SB0020201	1.20	1368	6194	4.86	4.01	3.63
S01SB0030201	1.31	1483	6271	2.10	1.63	1.54
S01SB0040201	1.18	1650	7133	2.26	1.69	1.52
S01SB0050201	1.21	1242	5500	3.23	2.31	2.13
S01SB0060201	1.38	1395	6144	2.26	2.01	1.82
S01SB0070201	1.32	1369	6141	1.55	1.57	1.52
S01SB0080201	1.32	1444	6288	1.84	1.67	1.79
S01SB0090201	1.31	1344	6028	2.02	1.96	1.84
S01SB0090201DUP	1.34	1386	6315	1.95	1.95	1.79
S01SB00100201	1.24	1383	6064	3.42	2.69	1.98
S01SB00110201	1.38	1534	6568	36.80	25.00	4.50
S01SB00120201	1.37	1421	6164	2.08	1.98	1.82
S01SB00130201	1.28	1425	6451	3.26	2.32	1.92
S01SB00140201	7.08	1796	8096	541.00	747.00	10.40
S01SB00150201	1.30	1405	6052	2.83	2.84	2.11
S01SB00160201	1.30	1338	5934	1.70	1.70	1.89
S01SB00170201	1.27	1295	5538	1.63	1.66	1.56
S01SB00180201	1.29	1385	5984	2.02	1.82	1.76
S01SB00190201	1.35	1506	6578	2.20	1.76	1.79
S01SB00200201	1.38	1533	6633	13.10	4.06	2.43
S01SB00210201	1.36	1442	6171	14.40	3.42	1.97
S01SB00220201	1.32	1350	5856	3.89	3.56	2.40
S01SB00230201	1.34	1461	6451	5.67	3.52	2.47
S01SB00230201DUP	1.30	1398	6414	24.40	5.62	2.32
S01SB00240201	1.22	1255	5418	2.32	2.25	2.14
S01SB00250201	1.31	1366	6011	3.85	2.47	2.30
S01SB00250201DUP	1.24	1398	6112	2.67	2.60	2.32
S01SB00260201	1.27	1325	5533	2.42	2.21	2.10
S01SB00270201	1.38	1387	6131	1.58	1.59	1.56
@ sidewalk		1331	5848			
@ outer wall of Building 1662		2086	9142			

(1) cpm = counts per minute
(2) Borehole logging and sample survey performed using the 1-inch diameter by 1-inch long NaI detector
(3) kcpm = kilo counts per minute
(4) Surface readings also performed using the 2-inch diameter by 2-inch long NaI detector for comparison
(5) BGS = below ground surface

ENCLOSURE 5
WILCOXON RANK SUM ANALYSIS

SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

Sample Source	Thorium-232 Concentration pCi/g	Adjusted Concentration[1] pCi/g	Rank	Adj. Rank
SITE	0.42	0.42	1	1
SITE	0.47	0.47	2	2
SITE	0.5	0.5	3	3
SITE	0.51	0.51	4	4
SITE	0.52	0.52	5	6
SITE	0.52	0.52	6	6
SITE	0.52	0.52	7	6
SITE	0.53	0.53	8	8
SITE	0.57	0.57	9	9
SITE	0.58	0.58	10	11
SITE	0.58	0.58	11	11
SITE	0.58	0.58	12	11
SITE	0.59	0.59	13	13
SITE	0.6	0.6	14	15
SITE	0.6	0.6	15	15
SITE	0.6	0.6	16	15
SITE	0.62	0.62	17	18
SITE	0.62	0.62	18	18
SITE	0.62	0.62	19	18
SITE	0.64	0.64	20	20.5
SITE	0.64	0.64	21	20.5
SITE	0.66	0.66	22	22.5
SITE	0.66	0.66	23	22.5
SITE	0.68	0.68	24	24
REF[2]	1.94	2.94	25	25
REF	1.99	2.99	26	27
REF	1.99	2.99	27	27

Sample Source	Thorium-232 Concentration pCi/g	Adjusted Concentration[1] pCi/g	Rank	Adj. Rank
REF	1.99	2.99	28	27
REF	2.02	3.02	29	29.5
REF	2.02	3.02	30	29.5
REF	2.05	3.05	31	31
REF	2.06	3.06	32	32
REF	2.08	3.08	33	33
REF	2.1	3.1	34	34
REF	2.12	3.12	35	35
REF	2.14	3.14	36	36.5
REF	2.14	3.14	37	36.5
REF	2.17	3.17	38	38.5
REF	2.17	3.17	39	38.5
REF	2.18	3.18	40	40.5
REF	2.18	3.18	41	40.5
REF	2.23	3.23	42	42.5
REF	2.23	3.23	43	42.5
REF	2.24	3.24	44	44.5
REF	2.24	3.24	45	44.5
REF	2.25	3.25	46	46.5
REF	2.25	3.25	47	46.5
REF	2.28	3.28	48	49
REF	2.28	3.28	49	49
REF	2.28	3.28	50	49
REF	2.3	3.3	51	51
SITE	4.57	4.57	52	52
SITE	14.3	14.3	53	53
SITE	16.5	16.5	54	54

(1) The thorium-232 concentration plus 1 pCi/g equals the adjusted concentration.
(2) REF = Reference Area

Site Rank Sum = 459
Reference Area Rank Sum = 1026

CRITICAL VALUE = $$m(n+m+1)\frac{1}{2}+z\sqrt{\frac{nm}{12}[(n+m+1)-\sum_{j=1}^{g}\frac{t_j(t_j^2-1)}{(n+m)(n+m-1}]}$$

Where: g = the number of data groups of tied measurements.
t_j = the number of tied measurements in the jth group.
z = the (1-α) percentile of a standard norman distribution = 1.645 for α = 0.05

$$m(n+m+1)\frac{1}{2} = 742.50$$

$$z = 1.645$$

$$\frac{nm}{12} = 60.75$$

$$n+m+1 = 55.00$$

$$\sum_{j=1}^{g}\frac{t_j(t_j^2-1)}{(n+m)(n+m-1}] = 0.0692$$

$$742.5+1.645\sqrt{60.75[(55)-0.0692]} = 837.53$$

CRITICAL VALUE = 837.53

t	$\frac{t_j(t_j^2-1)}{(n+m)(n+m-1}$
3	0.00839
3	0.00839
3	0.00839
3	0.00839
2	0.00210
2	0.00210
3	0.00839
2	0.00210
2	0.00210
2	0.00210
2	0.00210
2	0.00210
2	0.00210
2	0.00210
3	0.00839
∑=	0.06918
n	= 27
m	= 27

REFERENCE AREA RANK SUM = 1026 > CRITICAL VALUE = 837.53

THE NULL HYPOTHESIS IS REJECTED.

Tetra Tech NUS, Inc.

MODIFIED SITE 1 AREA
SSP INVESTIGATION
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

SCALE	
1 = 50	
FILE	
SITE 01 WP	
REV	DATE
0	6/23/04
FIGURE NUMBER	
FIGURE 3	

P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE01 MODIFIEDAREA 3/2/06 KMP

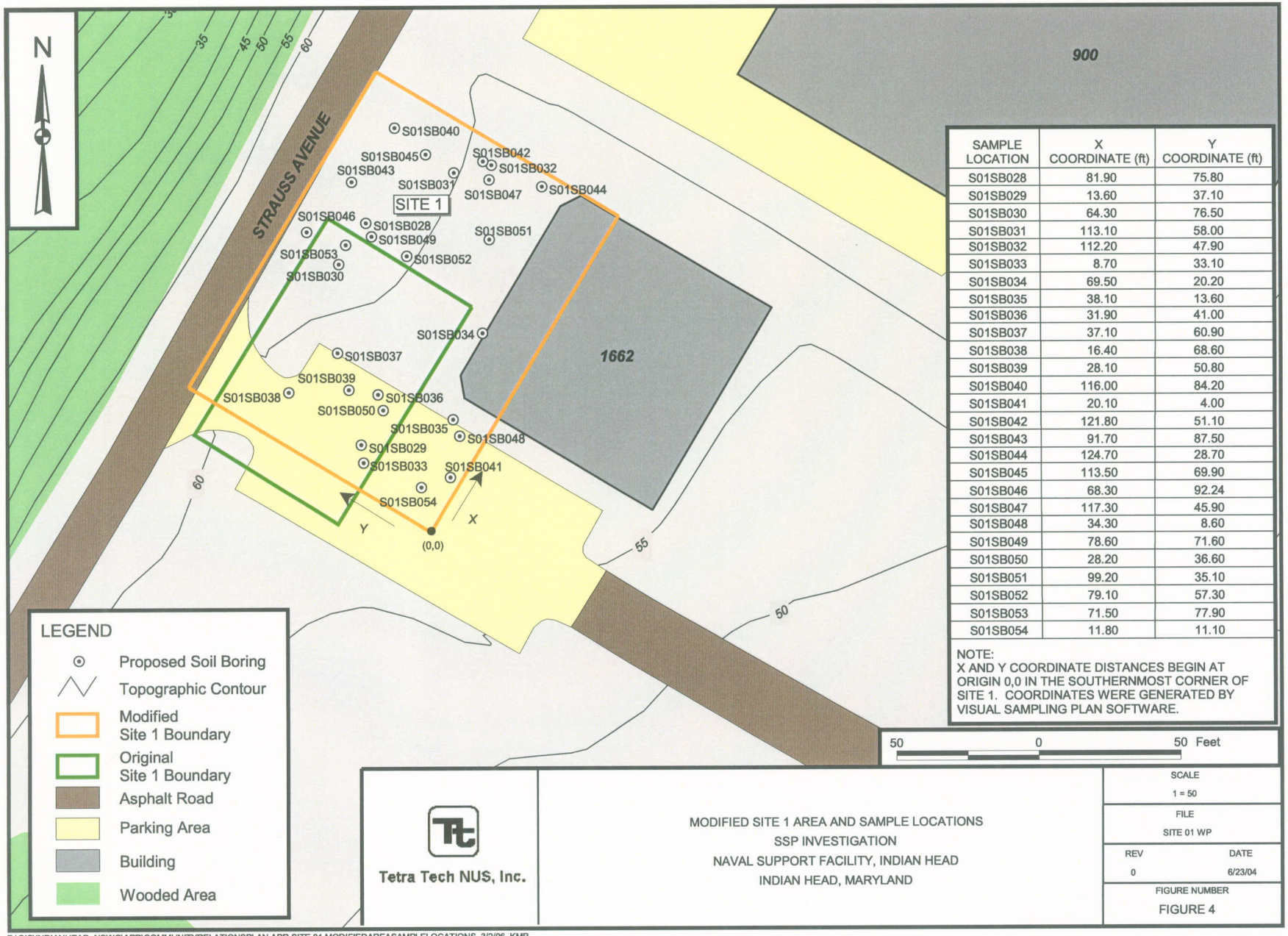
ENCLOSURE 6

ENCLOSURE 7

SAMPLE LOCATIONS FOR SECOND ROUND SAMPLES
SITE 1 - THORIUM SPILL
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

SAMPLE LOCATION	SAMPLE NUMBER	X Coordinate(1) (feet)	Y Coordinate(1) (feet)
S01SB028	S01SB0280102	81.9	75.8
S01SB029	S01SB0290102	13.6	37.1
S01SB030	S01SB0300102	64.3	76.5
S01SB031	S01SB0310102	113.1	58.0
S01SB032	S01SB0320102	122.2	47.9
S01SB033	S01SB0330102	8.7	33.1
S01SB034	S01SB0340102	69.5	20.2
S01SB035	S01SB0350102	38.1	13.6
S01SB036	S01SB0360102	31.9	41.0
S01SB037	S01SB0370102	37.1	60.9
S01SB038	S01SB0380102	16.4	68.6
S01SB039	S01SB0390102	28.1	50.8
S01SB040	S01SB0400102	116.0	84.2
S01SB041	S01SB0410102	20.1	4.0
S01SB042	S01SB0420102	121.8	51.1
S01SB043	S01SB0430102	91.7	87.5
S01SB044	S01SB0440102	124.7	28.7
S01SB045	S01SB0450102	113.5	69.9
S01SB046	S01SB0460102	68.3	92.2
S01SB047	S01SB0470102	117.3	45.9
S01SB048	S01SB0480102	34.3	8.6
S01SB049	S01SB0490102	78.6	71.6
S01SB050	S01SB0500102	28.2	36.6
S01SB051	S01SB0510102	99.2	35.1
S01SB052	S01SB0520102	79.1	57.3
S01SB053	S01SB0530102	71.5	77.9
S01SB054	S01SB0540102	11.8	11.1

(1) Coordinates are measured form the southernmost corner of the rectangular site area with X and Y coordinates being measured at 90 degrees from each other.



SAMPLE LOCATION	X COORDINATE (ft)	Y COORDINATE (ft)
S01SB028	81.90	75.80
S01SB029	13.60	37.10
S01SB030	64.30	76.50
S01SB031	113.10	58.00
S01SB032	112.20	47.90
S01SB033	8.70	33.10
S01SB034	69.50	20.20
S01SB035	38.10	13.60
S01SB036	31.90	41.00
S01SB037	37.10	60.90
S01SB038	16.40	68.60
S01SB039	28.10	50.80
S01SB040	116.00	84.20
S01SB041	20.10	4.00
S01SB042	121.80	51.10
S01SB043	91.70	87.50
S01SB044	124.70	28.70
S01SB045	113.50	69.90
S01SB046	68.30	92.24
S01SB047	117.30	45.90
S01SB048	34.30	8.60
S01SB049	78.60	71.60
S01SB050	28.20	36.60
S01SB051	99.20	35.10
S01SB052	79.10	57.30
S01SB053	71.50	77.90
S01SB054	11.80	11.10

NOTE:
X AND Y COORDINATE DISTANCES BEGIN AT ORIGIN 0,0 IN THE SOUTHERNMOST CORNER OF SITE 1. COORDINATES WERE GENERATED BY VISUAL SAMPLING PLAN SOFTWARE.

Tetra Tech NUS, Inc.

MODIFIED SITE 1 AREA AND SAMPLE LOCATIONS
SSP INVESTIGATION
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

SCALE	
1 = 50	
FILE	
SITE 01 WP	
REV	DATE
0	6/23/04
FIGURE NUMBER	
FIGURE 4	

P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE 01 MODIFIEDAREASAMPLELOCATIONS 3/2/06 KMP

ENCLOSURE 8

APPENDIX B

TECHNICAL MEMORANDUM DATED JUNE 7, 2007: WORK PLAN FOR EXPANDED SITE SCREENING PROCESS (SSP) INVESTIGATION, SITE 1 – THORIUM SPILL

TECHNICAL MEMORANDUM

Date: June 7, 2006

To: Jeff Morris, NAVFAC - Washington
Joseph Rail, P.E., NAVFAC - Washington
Shawn Jorgensen, NSF-IH
Dennis Orenshaw, US EPA Region 3
Curtis DeTore, MDE

From: George J. Latulippe, P.E., Tetra Tech NUS, Inc.

Subject: Work Plan for Expanded Site Screening Process (SSP) Investigation
Site 1 – Thorium Spill
Naval Support Facility, Indian Head
Indian Head, Maryland

1.0 INTRODUCTION

A previous technical memorandum (TtNUS, 2006) summarized the Site Screening Process (SSP) investigation conducted during November and December 2005 at Site 1 (Thorium Spill) located on the Naval Support Facility, Indian Head (NSF-IH) in Indian Head, Maryland by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 005 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-03-D-0057.

The purpose of the investigation was to determine whether operations at Site 1 have resulted in the release of thorium at concentrations of potential environmental concern. The SSP was conducted in response to a requirement in the Federal Facility Agreement (FFA) (EPA Region 3 and DoN, 2000) for a site screening investigation (SSI) at Site 1.

The objective of the investigation was to collect sufficient data to provide the basis for a determination that either: (1) an RI/FS, an FS, another investigation, and/or removal action, as appropriate, is required by the area addressed by the SSP, or (2) the area does not pose a threat or potential threat to public health, welfare, or the environment and therefore the area should be removed from further study under the FFA. The general scope of the SSP investigation at Site 1 was developed in conjunction with the Navy's Radiological Affairs Support Office (RASO) and was agreed upon by the Indian Head Installation Restoration Team (IHIRT) through approval of the SSP Investigation Work Plan (TtNUS, 2005).

The investigation was conducted in November 2005. Subsurface soil samples exhibited elevated concentrations of thorium-232 (refer to Exhibit 1: S01SB011 at 4.57 pCi/g, S01SB014 at 16.5 pCi/g, and S01SB023 at 14.3 pCi/g), and led to a determination by the IHIRT and RASO that additional sampling at the site is advisable for the purpose of

improving the understanding of the extent of thorium-232 contamination in the subsurface soil.

2.0 INVESTIGATION RATIONALE

In addition to the data evaluation called for by the Site 1 SSP work plan (TtNUS, 2005) the analytical data was also examined from a historical perspective by comparing sample locations and thorium-232 concentrations to the data from a RASO investigation conducted in 1972. Exhibit 2 is a sketch from the historical RASO file documenting the 1972 investigation. The sketch shows six rectangular areas and a circular area identified as potentially containing elevated thorium-232 concentrations in subsurface soil. Exhibit 3 is a drawing of the site area with features from the 1972 sketch superimposed and shown with dashed lines. The result is a composite drawing showing existing topography, the sampled locations from the 2005 investigation, and the locations of potentially elevated contamination as identified in 1972. Exhibit 3 quickly leads to the realization that the area sampled in 2005 did not account for all of the locations identified in 1972 as potentially containing elevated thorium-232 concentrations. This technical memorandum proposes sample collection locations (identified in Exhibit 3) that are intended to:

- Improve the understanding of the extent of thorium-232 contamination around sample locations S01SB011, S01SB014, and S01SB023, and

- Verify the presence or absence of thorium-232 contamination at the locations identified during the 1972 investigation.

The rationale for the proposed soil sample locations shown on Exhibit 3 is as follows:

1. As indicated on Exhibit 3, previously sampled (November 2005) location S01SB012 was located within one of the areas identified by RASO in 1972 as exhibiting elevated contamination levels. No additional samples are proposed for that area.
2. Proposed sample locations S01SB028, S01SB029, S01SB032, S01SB034, S01SB036, S01SB038, S01SB039 and S01SB040 are intended to capture soil samples from within unsampled areas potentially containing elevated soil contamination as identified in 1972 (Exhibit 2).
3. Previously sampled (November 2005) locations S01SB011, S01SB014, and S01SB023 are located near the northeast boundary of the original Site 1 area. They are the only three locations that exhibited noticeably elevated thorium-232 concentrations (4.57, 16.5, and 14.3 pCi/g respectively compared to <0.69 pCi/g for the remaining 23 Site 1 locations from November 2005). Proposed sample locations S01SB032 and S01SB034 together with proposed sample locations

S01SB031 and S01SB033 will help to bound the extent of the elevated contamination identified during the November 2005 investigation.

4. As suggested by RASO, sample locations S01SB030 and S01SB041 have been positioned 10 feet northeast of locations S01SB029 and S01SB039 to address the potential that contaminated material may have been spilled during the past remedial effort at the site and to address the possibility that the position of the respective areas of elevated contamination may actually extend somewhat toward the northeast.
5. As also suggested by RASO, sample locations S01SB020 and S01SB021 will be resampled during the expanded investigation and analyzed by gamma spectroscopy to address uncertainties arising from the fact that field screening during the November 2005 field investigation yielded relatively high screening counts at these locations while the laboratory analyses indicated relatively low thorium-232 concentrations.

3.0 FIELD INVESTIGATION

It is intended that the field sampling procedure will follow that described in the October 2005 Work Plan for Site Screening Process Investigation at Site 1 - Thorium Spill (TtNUS, 2005).

3.1 Sample Collection

Subsurface soil samples will be collected from Site 1 as described in Section 4.1.1 of the Site 1 work plan (TtNUS, 2005). Table 1 lists the locations to be sampled. Note that, although three samples are indicated for each location, only one of the samples from each location will be submitted to the fixed-base laboratory. Sample selection will follow the procedure described in Section 4.1.1 of the Site 1 work plan. The proposed sample locations are shown on Exhibit 3.

TABLE 1 - SITE 1 SAMPLES FOR EXTENDED SSP INVESTIGATION[1]

Location	Sample Number	Sample Depth (inches)	LABORATORY ANALYSIS	
			Gamma Spectroscopy	Thorium-232
S01SB020	S01SB0200102	18 to 24	X	
	S01SB0200202	24 to 30	X	
	S01SB0200302	30 to 36	X	
S01SB021	S01SB0210102	18 to 24	X	
	S01SB0210202	24 to 30	X	
	S01SB0210302	30 to 36	X	
S01SB028	S01SB0280102	18 to 24		X
	S01SB0280202	24 to 30		X
	S01SB0280302	30 to 36		X
S01SB029	S01SB0290102	18 to 24		X
	S01SB0290202	24 to 30		X
	S01SB0290302	30 to 36		X
S01SB030	S01SB0300102	18 to 24		X
	S01SB0300202	24 to 30		X
	S01SB0300302	30 to 36		X
S01SB031	S01SB0310102	18 to 24		X
	S01SB0310202	24 to 30		X
	S01SB0310302	30 to 36		X
S01SB032	S01SB0320102	18 to 24		X
	S01SB0320202	24 to 30		X
	S01SB0320302	30 to 36		X
S01SB033	S01SB0330102	18 to 24		X
	S01SB0330202	24 to 30		X
	S01SB0330302	30 to 36		X
S01SB034	S01SB0340102	18 to 24		X
	S01SB0340202	24 to 30		X
	S01SB0340302	30 to 36		X
S01SB035	S01SB0350102	18 to 24		X
	S01SB0350202	24 to 30		X
	S01SB0350302	30 to 36		X
S01SB036	S01SB0360102	18 to 24		X
	S01SB0360202	24 to 30		X
	S01SB0360302	30 to 36		X
S01SB037	S01SB0370102	18 to 24		X
	S01SB0370202	24 to 30		X
	S01SB0370302	30 to 36		X

TABLE 1 - SITE 1 SAMPLES FOR EXTENDED SSP INVESTIGATION[1]

Location	Sample Number	Sample Depth (inches)	LABORATORY ANALYSIS	
			Gamma Spectroscopy	Thorium-232
S01SB038	S01SB0380102	18 to 24		X
	S01SB0380202	24 to 30		X
	S01SB0380302	30 to 36		X
S01SB039	S01SB0390102	18 to 24		X
	S01SB0390202	24 to 30		X
	S01SB0390302	30 to 36		X
S01SB040	S01SB0400102	18 to 24		X
	S01SB0400202	24 to 30		X
	S01SB0400302	30 to 36		X
S01SB041	S01SB0410102	18 to 24		X
	S01SB0420202	24 to 30		X
	S01SB0430302	30 to 36		X

[1] Three sample depths are shown for each sample location. Only one of the samples listed for each location will be submitted to the fixed-base laboratory for analysis as described in Section 4.1.1 of the Site 1 work plan (TtNUS, 2005)

3.2 Quality Assurance/Quality Control

Radiological field detection instruments will be calibrated by the equipment supplier prior to shipping the items to the field. Each item will be calibrated daily by TtNUS personnel during the field investigation.

The field QC samples consist of field duplicates. Each duplicate sample will undergo the same preservation, analysis, and reporting procedures as the respective environmental sample. The duplicate samples will be collected at a rate of one per ten or fewer environmental samples.

3.3 Laboratory Analysis

The subsurface soil samples will be subjected to analysis by a fixed-base laboratory. Alpha spectroscopy is planned for thorium-232 analyses because it provides a more targeted analysis of the analyte of interest in addition to providing lower detection limits. It also yields some insight into whether the observed thorium concentrations are naturally occurring by providing thorium isotope-specific data that would not be possible with gamma spectroscopy. Gamma spectroscopy is more suitable for determining the concentration of a broader array of analytes with a single analysis when higher detection

limits are satisfactory. For this investigation, gamma spectroscopy will be used to analyze soil samples for naturally occurring radioactive material (NORM). The following NORM isotopes were selected for analysis.

- actinium-228
- bismuth-212 and -214
- lead-212 and -214
- potassium-40
- radium-226
- thallium-208
- thorium-234

These isotopes were selected because potassium-40 is a non-series radionuclide that may be naturally present in soil, and the other radionuclides in the list are part of naturally occurring decay series that may be naturally present in soil. The analysis is an effort to determine if a NORM isotope may be the cause of the elevated field reading observed in soil samples from locations S01SB020 and S01SB021 during the 2005 investigation.

All analytical results will be subjected to an analytical data validation process.

3.4 Investigation-Derived Waste

Investigation derived waste will be handled as described in Section 3.5 of the Site 1 work plan.

3.5 Surveying

The horizontal position of each sampled location will be determined by field sampling personnel using a global positioning device. Coordinates will be determined based on the Maryland State Plane Coordinate system [North American Datum (NAD) 1983]. No vertical elevations will be determined because they were not critical to the objectives of the SSP investigation.

4.0 POTENTIAL PRELIMINARY REMEDIATION GOALS

The determination of a suitable remediation goal for thorium-232 at Site 1 remains a subject of discussion with RASO. However, to gain some perspective regarding the elevated thorium-232 concentrations, published EPA preliminary remediation goals (PRGs) (EPA, 2006) are shown in Table 2.

TABLE 2 – THORIUM-232 PRELIMINARY REMEDIATION GOALS

Thorium-232 Preliminary Remediation Goals (PRG)				Thorium-232 Soil to Groundwater	
Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	DAF=20 (pCi/g)	DAF=1 (pCi/g)
3.1	0.00942	19	34.8	6.06	0.303

ENCLOSURES

Exhibit 1: Site 1 – Thorium Spill SSP Investigation Results
Exhibit 2: Historical Sketch of Results from 1972 RASO Investigation
Exhibit 3: Site 1 – Thorium Spill Expanded SSP Investigation

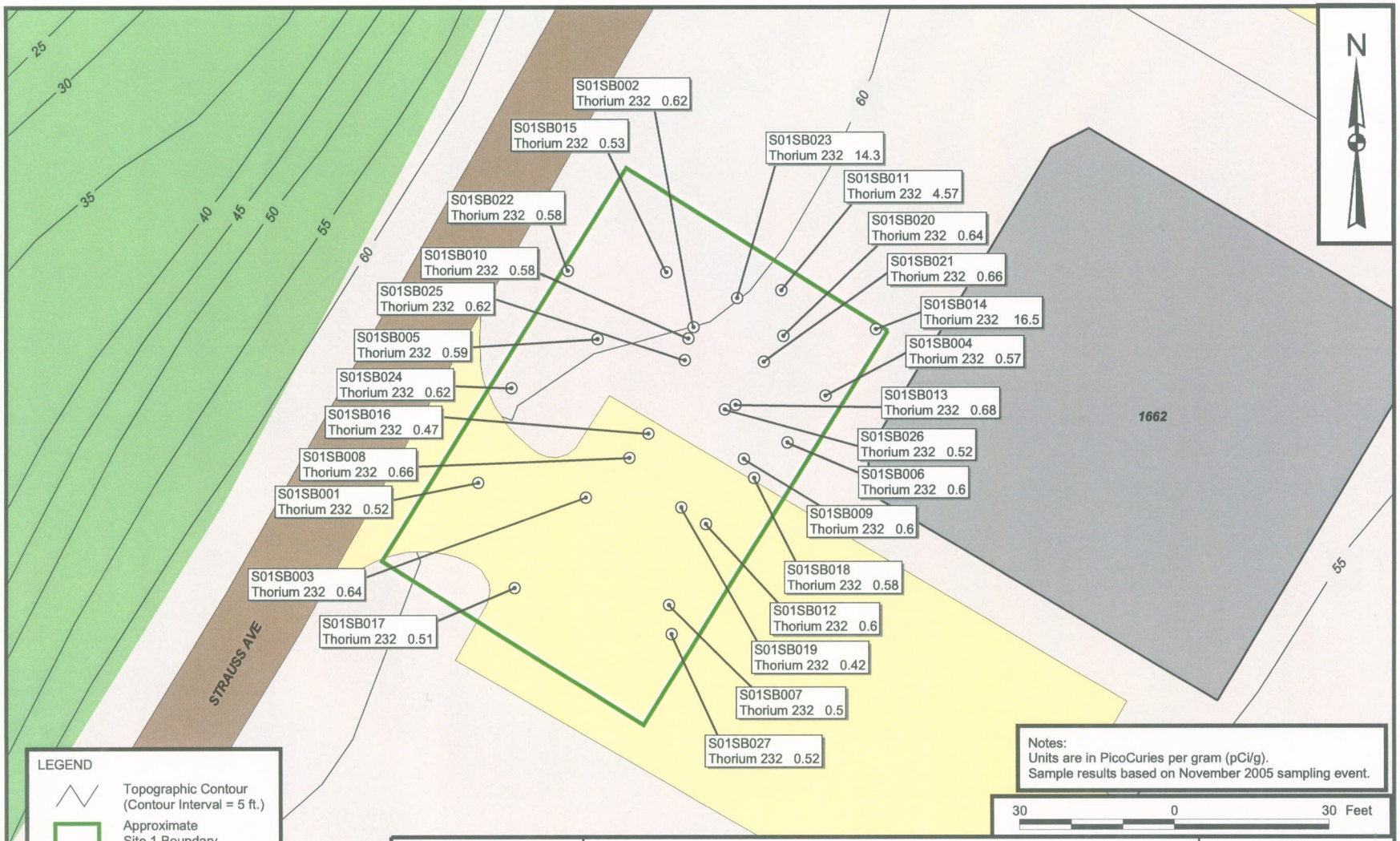
REFERENCES

EPA Region 3 and DoN (US Environmental Protection Agency and the Department of the Navy), 2000. Federal Facility Agreement. U.S. Department of the Navy, Naval Surface Warfare Center, Indian Head Division, Indian Head, Maryland. Docket Number: III-FCA-CERC-018.

EPA, 2006. Preliminary Remediation Goals for Radionuclides, Superfund, US EPA. http://epa-prgs.ornl.gov/radionuclides/prg_search.shtml. February 26.

TtNUS (Tetra Tech NUS, Inc.), 2005. Work Plan for Site Screening Process Investigation at Site 1 – Thorium Spill, Naval Support Facility, Indian Head, Maryland. Prepared for Naval Facilities Engineering Command Washington, Washington Navy Yard, D.C. October.

TtNUS, 2006. Technical Memorandum: Site Screening Process (SSP) Investigation, Site 1 – Thorium Spill, Naval Support Facility, Indian Head, Indian Head, Maryland. March 10.



Tetra Tech NUS, Inc.

SITE 1 - THORIUM SPILL
SSP INVESTIGATION RESULTS
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

SCALE	1 = 30
FILE	SITE 01 WP
REV	DATE
—	—
FIGURE NUMBER	EXHIBIT 1

P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE 01 THORIUM232 1/6/06 KMP

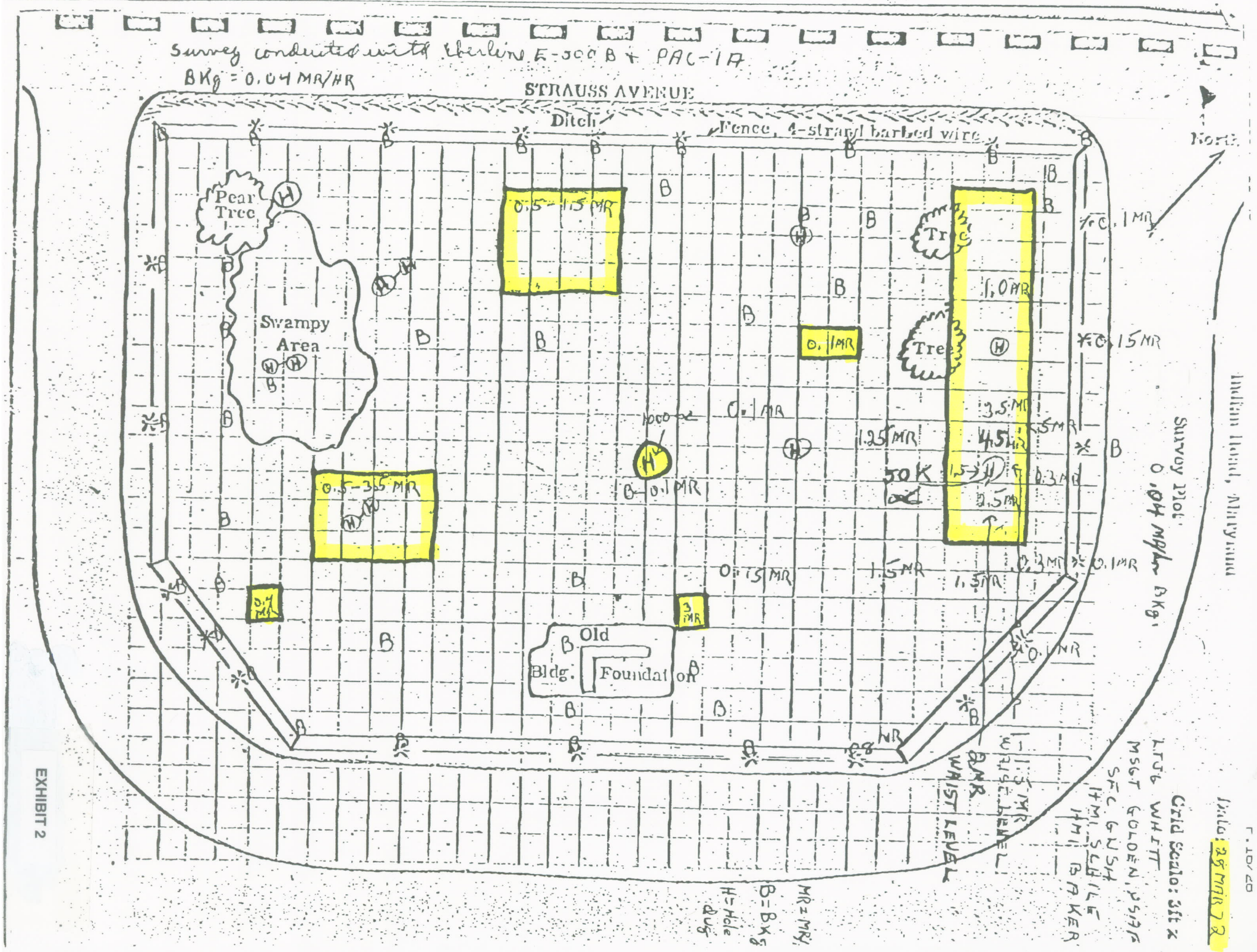
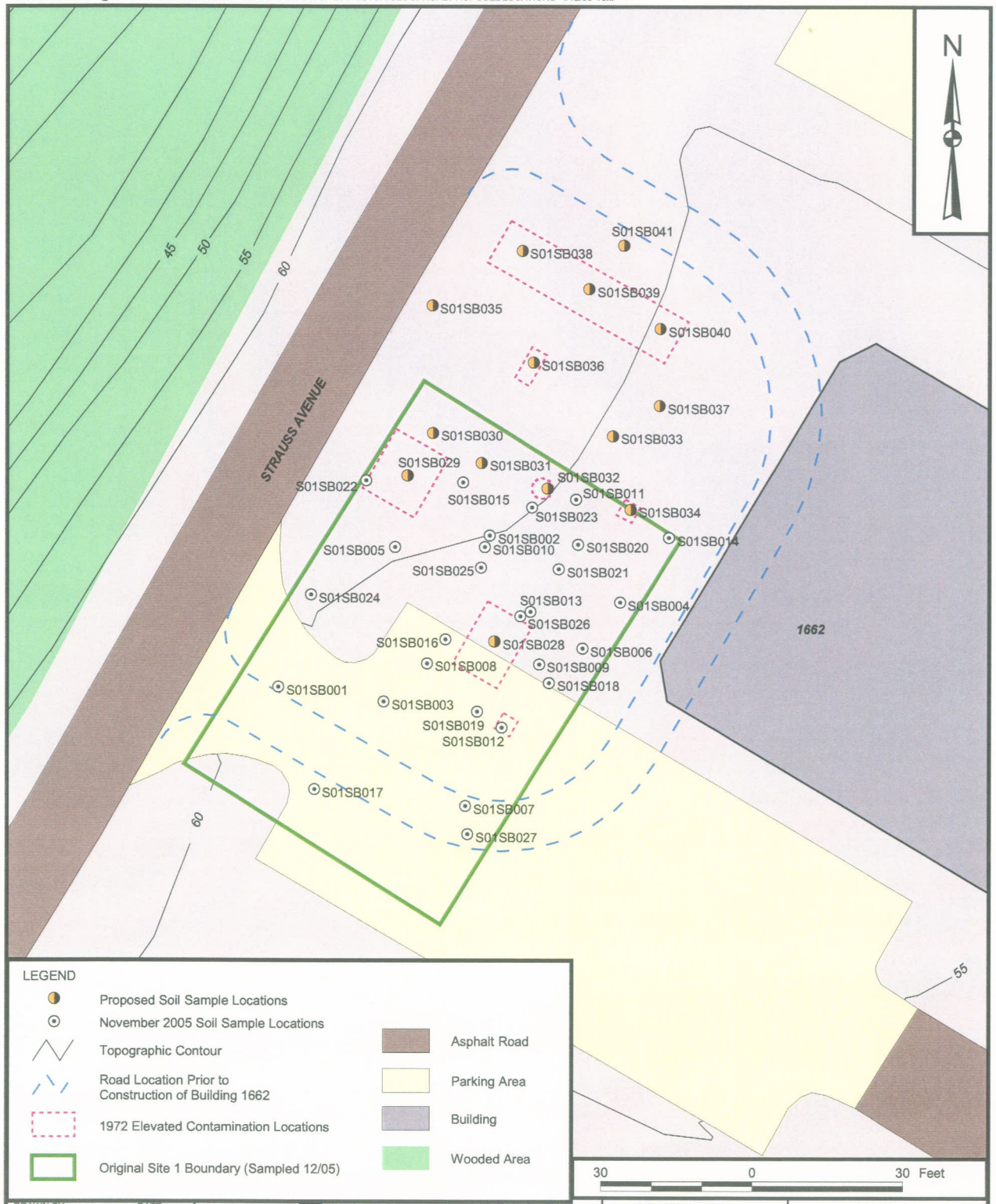

Survey conducted with Eberline E-500 B + PAC-1A
BKg = 0.04 MR/HR
STRAUSS AVENUE
Ditch
Fence, 4-strand barbed wire
North
Pear Tree
Swampy Area
0.5-1.5 MR
0.5-3.5 MR
0.1 MR
1000
Tree
1.0 MR
3.5 MR
4.5 MR
1.25 MR
50K
1.5
2.5 MR
0.3 MR
0.15 MR
1.5 MR
0.3 MR
0.1 MR
3 MR
Old Bldg. Foundation
Survey Plot
0.04 MR/hr BKg.
Grid Scale: 3ft x
LTJG WHITT
MSGT GOLDEN, USAF
SFC GUSH
1TM1 SCHILLE
1TM1 BAKER
BNR WAIST LEVEL
MR = MR/hr
B = BKg
H = Hole dug
Indian Head, Maryland
Date: 28 MAR 78

EXHIBIT 2

P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE01 HISTORICLOOPROADPROPOSEDLOCATIONS 4/12/06 KMP



DRAWN BY K. PEILA — DATE 4/3/06	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2144	OWNER NO. 0310
CHECKED BY G. LATULIPPE — DATE 4/3/06	SITE 1 AREA SSP INVESTIGATION NAVAL SUPPORT FACILITY, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL — DATE 4/3/06	
COST/SCHEDULE-AREA		APPROVED BY — — DATE — —	
SCALE AS NOTED		DRAWING NO.	REV 0

EXHIBIT 3

APPENDIX C

FIELD DOCUMENTATION

APPENDIX C.1 - 2005 CHAIN OF CUSTODY FORMS

APPENDIX C.2 - 2007 CHAIN OF CUSTODY FORMS

APPENDIX C.3 - 2005 FIELD SAMPLING LOG FORMS AND BORING LOGS

APPENDIX C.4 - 2007 FIELD SAMPLING LOG FORMS AND BORING LOGS

APPENDIX C.5 - 2005 REFERENCE AREA GAMMA SCREENING DATA

APPENDIX C.6 - 2005 SITE 1 GAMMA SCREENING DATA

APPENDIX C.7 - 2007 SITE 1 GAMMA SCREENING DATA

APPENDIX C.8 - 2005 FIELD EQUIPMENT CALIBRATION

APPENDIX C.9 - 2007 FIELD EQUIPMENT CALIBRATION

APPENDIX C.1

2005 CHAIN OF CUSTODY FORMS

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 3777 | PAGE 3 OF ____

PROJECT NO: N2144	FACILITY: INDIAN HEAD	PROJECT MANAGER GEORGE L	PHONE NUMBER 412-921-8684
LABORATORY NAME AND CONTACT: STL ST. LOUIS 314-928-8766			
SAMPLERS (SIGNATURE)	FIELD OPERATIONS LEADER FI RAMSF	PHONE NUMBER X8838	ADDRESS 13715 RIDGETRAIL NORTH
	CARRIER/WAYBILL NUMBER FEDEX 8494 1921 4287		CITY, STATE EARTH CITY MO 63045

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): P
PRESERVATIVE USED: 4°C

DATE YEAR 2005	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: GROSS GAMMA SPEC.								COMMENTS
11/30	0820	R01SB023020 1	—	24"	30"	SO	G	1	✓								
	0830	R01SB013020 1	—	24"	30"	SO	G	1	✓								
	0900	R01SB025020 1		24"	30"	SO	G	1	✓								
	0915	R01SB016020 1		24"	30"	SO	G	1	✓								
	0000	R01SBDUP020 1		24"	30"	SO	G	1	✓								COLLECTED @ SB016
	0935	R01SB014020 1		24"	30"	SO	G	1	✓								
	0940	R01SB022020 1		24"	30"	SO	G	1	✓								
	0950	R01SB001020 1		24"	30"	SO	G	1	✓								
	1000	R01SB010020 1		24"	30"	SO	G	1	✓								
	1010	R01SB009020 1		24"	30"	SO	G	1	✓								
	1017	R01SB004020 1		24"	30"	SO	G	1	✓								
	0000	R01SBDUP030 1		24"	30"	SO	G	1	✓								COLLECTED @ SB004
11/30	1038	R01SB021020 1		24"	30"	SO	G	1	✓								

1. RELINQUISHED BY	DATE 11-31-05	TIME 1200	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER 3778 | PAGE 2 OF ____

PROJECT NO: N2144	FACILITY: INDIAN HEAD	PROJECT MANAGER: GEORGE LATULIPPE	PHONE NUMBER: 412-921-8684	LABORATORY NAME AND CONTACT: STL ST. LOUIS 314-248-8566
SAMPLERS (SIGNATURE): [signature]		FIELD OPERATIONS LEADER: FREDW RAMSEYER	PHONE NUMBER: 412-921-8838	ADDRESS: 13715 RIDER TRAIL NORTH
		CARRIER/WAYBILL NUMBER: FED EX 8494 1921 4287		CITY, STATE: EARTH CITY MO 63045

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): P

PRESERVATIVE USED: —

	DATE YEAR 2005	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: GROSS GAMMA SPEC.								COMMENTS
	11/30	1049	R01SB0030201	—	24"	30"	SO	G	1	✓								
		1106	R01SB0120201	—	24"	30"	SO	G	1	✓								
		1120	R01SB0270201	—	24"	30"	SO	G	1	✓								
		1130	R01SB0260201	—	24"	30"	SO	G	1	✓								
		1325	S01SB0270101	—	18"	24"	SO	G	1	✓								
		1430	S01SB0070101		18"	24"	SO	G	1	✓								
		1508	S01SB0030101		18"	24"	SO	G	1	✓								
		1522	S01SB0080101		18"	24"	SO	G	1	✓								
		1539	S01SB0160101		18"	24"	SO	G	1	✓								
		1557	S01SB0190101		24"	30"	SO	G	1	✓								
		1616	S01SB0120101		18"	24"	SO	G	1	✓								
		1630	S01SB0170101		18"	24"	SO	G	1	✓								
	11/30	1656	S01SB0010101		24	30	SO	G	1	✓								

1. RELINQUISHED BY: [signature]	DATE: 11-31-05	TIME: 1200	1. RECEIVED BY	DATE / TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE / TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE / TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 3789 | PAGE 1 OF ____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
N2144	INDIAN HEAD	GEORGE LAT	412-921-8684	STL ST. LOUIS 314-298-8566
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
Fred Ramser		FREDW RAMSER	412-921-8838	13715 RIDGE TRAIL NORTH
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FED EX 8494 1921 4287		EARTH CITY MO 63045

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED
TYPE OF ANALYSIS

DATE YEAR 2005	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	GROSS GAMMA SPEC.								COMMENTS
11/29	1300	R01SB0080201	—	24"	30"	SO	G	1	✓								
	1550	R01SB0180201	—	"	"	"	"	1	✓								
	1600	R01SB0060201	—	24"	30"	SO	G	1	✓								
	1610	R01SB0110201	—	24"	30"	SO	G	1	✓								
	1615	R01SB0190201	—	24"	30"	SO	G	1	✓								
	1625	R01SB0070201	—	24"	30"	SO	G	1	✓								
	1630	R01SB0050201	—	24"	30"	SO	G	1	✓								
11/29	1645	R01SB0150201	—	24"	30"	SO	G	1	✓								
11/30	0725	R01SB0240201	—	24"	30"	SO	G	1	✓								
	0735	R01SB0200201	—	24"	30"	SO	G	1	✓								
	0000	R01SBDUP0101		24"	30"	SO	G	1	✓								COLLECTED @ SB020
	0800	R01SB0170201		24"	30"	SO	G	1	✓								
	0810	R01SB0020201		24"	30'	SO	G	1	✓								

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY Fred Ramser	11-31-05	1200	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2160 | PAGE 4 OF ____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
N2144	INDIAN HEAD	GEORGE L.	412-921-8684	STL ST. LOUIS 314-298-8566
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		F. RAMSEUR	X8838	13715 RIDGETRAIL NORTH
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FED EX 8494 1921 4287		EARTH CITY MO 63045

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): P
PRESERVATIVE USED: 40

DATE YEAR 2005	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: GROSS GAMMA							COMMENTS
12/01	0730	S01SB0180101	–	24"	30"	SO	G	1	✓							
12/01	0740	S01SB0090101	–	24"	30"	SO	G	1	✓							
	0000	S01SBDUP0101	–	24"	30"	SO	G	1	✓							COLLECTED @ SB009
	0751	S01SB0130101	–	18	24	SO	G	1	✓							
	0812	S01SB0260101	–	24"	30"	SO	G	1	✓							
	0822	S01SB0060101	–	24"	30"	SO	G	1	✓							
	0826	S01SB0040101	–	18"	24	SO	G	1	✓							
	0834	S01SB0210101	–	18"	24	SO	G	1	✓							
	0840	S01SB0250101	–	18	24	SO	G	1	✓							
	0000	S01SBDUP0201	–	18	24	SO	G	1	✓							COLLECTED @ SB025
	0856	S01SB0100101	–	24"	30"	SO	G	1	✓							
	0903	S01SB0020101	–	30"	36"	SO	G	1	✓							
12/01	0913	S01SB0050101	–	18"	24"	SO	G	1	✓							

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY	11-31-05	1200	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2159 | PAGE 5 OF ____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
N2144	INDIANHEAD	GEORGE L.	412-921-8684	STL ST LOUIS 314-298-8566

SAMPLERS (SIGNATURE)	FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
Fred M Ramser	F. RAMSER	X8839	13715 RIDGE TRAIL NORTH

CARRIER/WAYBILL NUMBER	CITY, STATE
FED EX 8494 1921 4287	FORTH CITY MO 63045

STANDARD TAT ☐ X
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): P
PRESERVATIVE USED: 4°

DATE YEAR 2005	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: GROSS GAMMA SPEC							COMMENTS
11-4-01	0920	S01SB0240101	—	18"	24"	SO	G	1	✓							
	0940	S01SB0220101	—	18"	24"	SO	G	1	✓							
	0946	S01SB0150101	—	18"	24"	SO	G	1	✓							
	0953	S01SB0230101	—	24"	30"	SO	G	1	✓							
	0000	S01SBDUP0301	—	24	30	SO	G	1	✓							
	05	S01SB0110101	—	18"	24"	SO	G	1	✓							
	12	S[illegible]B0200101	—	30"	36"	SO	G	1	✓							
	1023	S0[illegible]0140101		18"	24"	SO	G	1	✓							
12/01																

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
Fred M Ramser	11-31-05	1200			
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

APPENDIX C.2

2007 CHAIN OF CUSTODY FORMS

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 3751 | PAGE 1 OF 2

PROJECT NO: 2144	FACILITY: INDIAN HEAD	PROJECT MANAGER: GEORGE LATUL	PHONE NUMBER: 412 921 7090	LABORATORY NAME AND CONTACT: STL St LOUIS T. ROMANKO
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER: FRED W RAMSER	PHONE NUMBER: 412 921 8872	ADDRESS: 3715 RIVER TRAIL NORTH
		CARRIER/WAYBILL NUMBER: FEDEX 8545 6732 4814		CITY, STATE: EARTH CITY, MO 63045

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2007	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	THORIUM-232	GAMMA SPECTROSCOPY							COMMENTS
								CONTAINER TYPE PLASTIC (P) or GLASS (G)		P	P						
								PRESERVATIVE USED		/	/						
1/17	1410	S01SB020010 2	—	18"	24"	SO	G	1		✓							
	1400	S01SB021010 2	—	18"	24"	SO	G	1		✓							
	0925	S01SB028030 2	—	30"	36	SO	G	1	✓								
	0935	S01SB029020 2	—	24	30	SO	G	1	✓								
	0950	S01SB030030 2	—	30"	36"	SO	G	1	✓								
	1125 1130	S01SB031010 2	—	18"	24"	SO	G	1	✓								
	1135	S01SB032020 2	—	24	30	SO	G	1	✓								
	1300	S01SB033010 2	—	18	24	SO	G	1	✓								
	1310	S01SB034010 2	—	18	24	SO	G	1	✓								
	1005	S01SB035010 2	—	18	24	SO	G	1	✓								
	1110	S01SB036010 2	—	18	24	SO	G	1	✓								
↓	1330	S01SB037010 2	—	18	24	SO	G	1	✓								
1/17	0000	S01SBDUP020 2	—	18	24	SO	G	1	✓								COLLECTED @ S01SB037010 2

1. RELINQUISHED BY: Fred W Ramser	DATE: 7/22/07	TIME: 1800	1. RECEIVED BY: FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 3752 | PAGE 2 OF 2

PROJECT NO: 2144	FACILITY: INDIANHEAD	PROJECT MANAGER GEORGE LATULIPPE	PHONE NUMBER 412-921-7090	LABORATORY NAME AND CONTACT: STL ST LOUIS T. ROMANKO
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER 412-921-8838	ADDRESS 13715 RIDGETRAIL NORTH
		CARRIER/WAYBILL NUMBER FED EX 8545 6732 4814		CITY, STATE FARTH CITY MO 63045

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2007	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	THORIUM-232	GAMMA SPECTROSCOPY							COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)									P	P							
PRESERVATIVE USED									/	/							
1/17	1010	S01SB0380202	–	24"	30"	SO	G	1	✓	✓							
	1055	S01SB0390102		18"	24"	SO	G	1	✓	✓							
	1345	S01SB0400202		24"	30"	SO	G	1	✓								
	0000	S01SBDUP0102		18"	24"	SO	G	1	✓								COLLECTED @ S01SB[redacted]0390102
1/17	1030	S01SB0410102		18"	24	SO	G	1	✓								

1. RELINQUISHED BY	DATE 7/22/07	TIME 1800	1. RECEIVED BY FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

APPENDIX C.3

2005 FIELD SAMPLING LOG FORMS AND BORING LOGS

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0010101
Sample Location: S01SB001
Sampled By: FRED W. RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1656 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0020101
Sample Location: S01SB002
Sampled By: FRED W. RAMSEY
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0903 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	30'-36"	BRN	SAND TR GRAVEL TR SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s):

Fred W. Ramsey

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0030101
Sample Location: S01SB003
Sampled By: FRED W. RAMSER
C.O.C. No.: 3728

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1508 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND, GRAVEL + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0040101
Sample Location: S01SB004
Sampled By: FRED W. RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0826 Method: DPT, MACROCORE Monitor Reading (ppm): —	18"-24"	BRN	SAND + SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0050101
Sample Location: S01SB005
Sampled By: FRED W RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0913. Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC BAG

MAP:

Circle if Applicable:

MS/MSD ✓

Duplicate ID No.: —

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0060101
Sample Location: S01SB006
Sampled By: FRED W RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0822 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	SAND + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0070101
Sample Location: S01SB007
Sampled By: FRED W. RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1430 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18-24"	BRN	SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0080101
Sample Location: S01SB008
Sampled By: FRED W. RAMSER
C.O.C. No.: 3728

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1522 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	TR GRAVEL SAND + SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0090101
Sample Location: S01SB009
Sampled By: FRED W. RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0740 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	TR GRAVEL SAND + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S01SBDUP0101

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0100101
Sample Location: S01SB010
Sampled By: FRED W. RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0856 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	SAND TR SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

*PLASTIC ZIPLOCK BAG

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0110101
Sample Location: S01SB011
Sampled By: FRED W RAMSER
C.O.C. No.: 2159

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 1005 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND TR SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0120101
Sample Location: S01SB012
Sampled By: FRED W. RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1616 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD: —

Duplicate ID No.: —

Signature(s):

Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0130101
Sample Location: S01SB013
Sampled By: FRED W RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0751 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	TR GRAVEL SAND + SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0140101
Sample Location: S01SB014
Sampled By: FRED W. RAMSER
C.O.C. No.: 2159

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-01-05 Time: 1023 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND TR GRAVEL TR SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0150101
Sample Location: S01SB015
Sampled By: FRED W RAMSER
C.O.C. No.: 2159

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-01-05 Time: 0946 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND TR SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0160101
Sample Location: S01SB016
Sampled By: FRED W. RAMSEY
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1539 Method: DPT/MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0170101
Sample Location: S01SB017
Sampled By: FRED W RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05			
Time: 1630			
Method: DPT, MACRO-CORE	18"-24"	BRN	TR SILT GRAVEL + SAND
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0180101
Sample Location: S01SB018
Sampled By: FRED W. RAMSER
C.O.C. No.: 2160

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0730 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0190101
Sample Location: S01SB019
Sampled By: FRED W. RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1557 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC BAGS.

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0200101
Sample Location: S01SB020
Sampled By: FRED W. RAMSER
C.O.C. No.: 2159

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 1012 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	30"-36"	BRN	SAND TR SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0210101
Sample Location: S01SB021
Sampled By: FRED W RAMSPER
C.O.C. No.: 2160

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 12-1-05	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0834			TR GRAVEL
Method: DPT, MACRO-CORE	18"-24"	BRN	SAND + TR SILT
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsper

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0220101
Sample Location: S01SB022
Sampled By: FRED W. RAMSER
C.O.C. No.: 2159

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0940 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0230101
Sample Location: S01SB023
Sampled By: FRED W. RAMSER
C.O.C. No.: 2159

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0953 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	BRN	SAND TR SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S01DUPSB0301

Signature(s): Fred W. Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0240101
Sample Location: S01SB024
Sampled By: FRED W. RAMSER
C.O.C. No.: 2159

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0920 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0250101
Sample Location: S01SB025
Sampled By: FRED W. RAMSER
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0840 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	18"-24"	BRN	SAND TR SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S01SBDUP0201

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0260101
Sample Location: S01SB026
Sampled By: FRED WRAMSK
C.O.C. No.: 2160

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-1-05 Time: 0812 Method: DPT, MACRO-CORE Monitor Reading (ppm):	24"-30"	BRN	SAND + SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.: —

Signature(s):

Fred Wramsk

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0270101
Sample Location: S01SB027
Sampled By: FRED W. RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05			
Time: 1325			
Method: DPT, MACRO-CORE	18" - 24"	BRN	SAND, GRAVEL TR SILT
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS
- COLLECTED UNDER ASPHALT

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.: —

Signature(s):

Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0010201
Sample Location: R01SB001
Sampled By: FRED W. RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0950 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*PLASTIC BAGS (ZIPLOCK) USED FOR CONTAINERS.

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0020201
Sample Location: R01SB002
Sampled By: FRED W. RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0810 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0030201
Sample Location: R01SB003
Sampled By: FRED W RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1049 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG*		

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0040201
Sample Location: R01SB004
Sampled By: FRED W RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1017 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	R01SBDUP0301

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0050201
Sample Location: R01SB005
Sampled By: FRED W. RAMSEY
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1630 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0060201
Sample Location: R01SB006
Sampled By: FREDW. RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1600 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24" - 30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0070201
Sample Location: R01SB007
Sampled By: FRED W RAMSEY
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1625 Method: DPT/MACRO CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0080201
Sample Location: R01SB008
Sampled By: F.W RAUSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1300 Method: DPT / DIRECT FILL Monitor Reading (ppm): —	24"-30"	YEL BRN	SILT, SAND + CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG		

OBSERVATIONS / NOTES:

- USED Ziplock BAG FOR CONTAINER
- MACRO CORE SAMPLER

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Rauser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0090201
Sample Location: R01SB009
Sampled By: FRED W. RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1010 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0100201
Sample Location: R01SB010
Sampled By: FRED W. RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1000 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0110201
Sample Location: R01SB011
Sampled By: FRED W RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1610 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0120201
Sample Location: R01SB012
Sampled By: FRED W. RAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1106 Method: DPT, MACROCORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: ___

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0130201
Sample Location: R01SB013
Sampled By: FRED W RAMSEER
C.O.C. No.: 3777

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0830 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0140201
Sample Location: R01SB014
Sampled By: FRED W. RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0935 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0150201
Sample Location: R01SB015
Sampled By: FRED W. RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1645 Method: DPT, MACRO-CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.: —

Signature(s): Fred W. Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0160201
Sample Location: R01SB016
Sampled By: FRED W. RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0915 Method: DPT, MACRO CORE Monitor Reading (ppm): –	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *		

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
–	R01SBDUP0201

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0170201
Sample Location: R01SB017
Sampled By: FREDW.RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0800 Method: DPT, MACRO CORE Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0180201
Sample Location: R01SB018
Sampled By: FVR
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11/29/05 Time: 1550 Method: DPT/DIRECT PUSH Monitor Reading (ppm): —	24" - 30"	YEL BRN	SILT + CLAY + f g SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED ZIPLOCK BAG FOR CONTAINER (DOUBLED BAGGED)

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0190201
Sample Location: R01SB019
Sampled By: FRED W. RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-29-05 Time: 1615 Method: DPT, DIRECT FILL Monitor Reading (ppm):	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS.

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0200201
Sample Location: R01SB020
Sampled By: FRED W RAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0735 Method: DPT, DIRECT FILL Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED PLASTIC ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	R01SBDUP0101

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0210201
Sample Location: R01SB021
Sampled By: FWR
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1038 Method: DPT, Direct Fill Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED PLASTIC BAGS (ZIPLOCK)

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0220201
Sample Location: R01SB022
Sampled By: FWR
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0940 Method: DPT/DIRECT FILL Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0230201
Sample Location: R01SB023
Sampled By: FRED W RAMSEY
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 11-30-05	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0820	24"-30"	YEL BRN	SAND, SILT + CLAY
Method: DPT, DIRECT FILL			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

* USED ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0240201
Sample Location: R01SB024
Sampled By: FREDWRAMSER
C.O.C. No.: 3789

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 0725 Method: DPT/DIRECT FILL Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED ZIPLOCK BAGS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0250201
Sample Location: R01SB025
Sampled By: FRED W RAMSER
C.O.C. No.: 3777

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11/30/05 Time: 0900 Method: DPT/DIRECT FILL Monitor Reading (ppm): —	24"-30"	YEL BRN	SAND, SILT + CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED ZIPLOCK BAGS (DOUBLE + PLASTIC)

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0260201
Sample Location: R01SB026
Sampled By: FWRAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1130 Method: DPT/DIRECT FILL Monitor Reading (ppm):	24"-30"	YEL BRN	SAND + SILT MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG *	✓	

OBSERVATIONS / NOTES:

*USED ZIPLOCK BAGS (DOUBLE)

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.: ___

Signature(s):

Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Site 1, SSP Investigation, NSF Indian Head
Project No.: N2144

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: R01SB0270201
Sample Location: R01SB027
Sampled By: FURAMSER
C.O.C. No.: 3778

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 11-30-05 Time: 1120 Method: MACRO CORE/DIRECT Monitor Reading (ppm):	24" - 30"	YEL BRN	SAND, SILT + CLAY MOIST.

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gross Gamma Spectormetry	8oz WMG	✓	

OBSERVATIONS / NOTES:

-USED ZIPLOCK BAGS FOR CONTAINERS.

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred M Ramser

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE PICK UP TRUCK

BORING No.: S01SB001
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1640 S2									ASPHALT				
						BRN	GRAVEL + SAND	GP	SURFACE ~5" THICK				
	12"					BRN	SAND	SP					
	24"												
							SAND + GRAVEL	GP					
	36"		2.5/3										
							TD = 3'						
							COLLECTED						
							24'-30" INTERVAL						
							FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROB

BORING No.: S01SB002
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0900							LOAM	SM					
							YEL BRN						
							SILT + SAND						
	12"												
	24"												
	30"												
						BRN	SAND TR GRA.	SP					
							TR SILT						
	36"		3/3										
				TD = 3'			COLLECTED SPL						
							S01SB0020101						
							@ 30"-36"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO-CORE W/ ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROB

BORING No.: S01SB003
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1450							ASPHALT SURFACE						
							GRAVEL + SAND	GW					
	12"						SAND + SILT	SP					
							SAND, GRAVEL	GM					
							+ SILT						
	24"												
							LESS SILT						
	36		3/3										
							COLLECTED SPL						
				TD= 3'			S01SB0030101						
							@18'-24"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: ——

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEO PROB

BORING No.: S01SB004
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0826							LOAM						
							YEL BRN SAND	SM					
							+ SILT						
	12"												
							TR GRAVEL						
	24"												
	36"		27/3										
				TD @ 3'									
							COLLECT SOIL						
							@ 18"-24'						
							FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEO PROB.

BORING No.: S01SB005
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0905							LOAM SILT	SM					
						BRW	f-g SAND TR	SP					
	12"						SILT						
							SAND TR GRAVEL						
	24"												
	36"		3/3				GRAVEL + SAND	GW					
				TD @ 3'									
							COLLECT SOIL						
							@ 18-24" FOR						
							ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ACETATE LINER

Drilling Area Background (ppm): 0.0

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB006
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-08ID							LOAM (SAND+SILT)						
							SAND + GRAVEL	GW					
	12"												
							LESS GRAVEL MORE SILT	SP					
	24"												
						BRN	SAND + SILT	SM					
	36"		3/3										
				TD @ 3'									
							COLLECT SOIL @ 24"-30" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE w/ ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB007
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEW S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1430							ASPHALT SURFACE						
							SAND + GRAVEL	GW					
						BRN	f-g SAND	SP					
	12												
	24												
	36		2.5/3										
				TD @ 31'									
							COLLECTED SOIL @ 18-24" for ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO-CORE W/ACETATE LINER

Drilling Area Background (ppm): ____

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROB

BORING No.: S01SB008
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1515							ASPHALT SURFACE						
						BRN	GRAVEL + SAND	GW					
	12"					BRN	SILT + GRAVEL	GM					
							TR f. SAND						
						BRN	SAND + SILT	SM					
	24"						TR GRAVEL						
	36"		3/3										
				TD @ 3'									
							COLLECTED						
							SOIL @ 18"-24"						
							FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACROCORE w/ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB009
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0735							LOAM						
							SAND + GRAVEL	SW					
	12"												
							SAND, SILT + GRAVEL	GM					
	24"												
							SAND + SILT TR GRAVEL						
	36"		3/3										
				TP@ 3'									
							COLLECTED SOIL @ 24"-30" FOR CHEM ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEO PROBE

BORING No.: S01SB010
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0855							LOAM						
								SM					
							YEL BRN						
							SILT + SAND						
	12"												
	24"												
						BRN	SAND	SP					
	36"		3/3										
				TD @ 36" 3'									
							COLLECTED						
							SOIL @ 24"-30"						
							FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEO PROBE

BORING No.: S01SB011
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1000							SILTY SANDY						
							LOAM	SM					
								↓					
							BRN SAND TR	SP					
	12"						SILT						
							↓	↓					
	24"												
	36"		3/3				↓	↓					
				TD @ 3'									
							COLLECT SOIL						
							@ 18"-24"						
							FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 2" x 4' MACRO-CORE w/ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEO PROBE

BORING No.: S01SB012
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1605							ASPHALT SURFACE						
							GRAVEL + SAND	GW					
							TR SILT						
	12"												
	24"												
	36"		3/3										
							COLLECTED SOIL @ 18"-24" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 2" x 4' MACRO-CORE W/ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEO PROBE

BORING No.: S01SB013
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0750							LOAM						
							YEL BRN SILT	SM					
							+ SAND						
	12"												
							TR GRAVEL						
	24"												
							SAND	SP					
	36"		3/3										
				TD @ 3'									
							COLLECTED SOIL						
							@ 18"-24" FOR						
							ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB014
DATE: 12-01-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						BRN	SILT+SAND LOAM						
1015													
							YEL BRN SILTY						
							f-g SAND	SM					
	12"						JR GRAVEL						
	24"												
	36"		3/3										
				TD @ 3'									
							COLLECTED SOIL @ 18"-24" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO-CORE w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB015
DATE: 12-01-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM SILT +						
0942							SAND						
							YEL BRN	SP/SM					
							SILT + SAND						
	12"						TR GRA						
							TR SILT						
	24"												
	36"		3/3										
				TD @ 3'									
							COLLECTED SOIL						
							@ 18" - 24" FOR						
							ANALYSIS.						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB016
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1535							ASPHALT SURFACE						
							GRAVEL + SAND	GW					
	12"					BRN	SILT + GRAVEL TR f-g SAND	GM					
						BRN	SAND + GRAVEL	GW					
	24"												
	36"		3/3										
				TD @ 3'			COLLECTED SOIL @ 18"-24" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): —

Remarks: 2" x 4' MACRO CORE w/ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB017
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							ASPHALT SURFACE						
1625						BRN	GRAVEL, SAND +	GW/					
							SILT	GM					
	12"												
							TR SILT		GW				
	24"												
	36"		3/3										
				TD @ 3'			COLLECT SOIL @ 18"-24" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB018
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM						
0725						BRN	SAND + GRAVEL	GW					
	12"						TR SILT	GM					
	24"												
						BRN	SAND	SP					
	36"		3/3										
				TD @ 3'									
							COLLECT SOIL @ 24"-30" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACROCORE W/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB019
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							ASPHALT SURFACE						
1550							GRAVEL + SAND	GW					
							TR SILT						
	12"												
	24"												
	36"		2.5/3										
				TD @ 3'			COLLECTED SOIL @ 24"-30" FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO-CORE w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE

BORING No.: S01SB020
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN S.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM SILTY	SM					
1010							f-g SAND						
							YEL BRN						
	12"						SAND + SILT						
	24"												
							GRAVEL	GW					
	36"		27/3										
				TP @ 3'			COLLECTED SOIL @ 30-36' FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 2" x 4' MACRO CORE w/ ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB021
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM	SM					
0830							YEL BRN						
							SILT + SAND						
	12"												
							TR SILT						
							TR GRAVEL						
	24"												
							SAND	SP					
									MOIST TO				
	36"		3/3.0						WET				
				TD									
				@			COLLECTED						
				3'			SPL @ 18"-24"						
							S01SB021010 1						
							FOR ANALYSIS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB022
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							SILTY LOAM	SM					
0930													
	12"					BRN	f-g SAND	SP					
							TR SILT						
	24"												
	36"		3/3.0				GRAVEL + SAND	GW					
				TD @ 3'									
							COLLECTED SPL @ 18"-24" FOR LAB. ANALYSIS S01SB022 0101						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB023
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0950						DKBRN	SILTY + SANDY LOAM	SM					
							BRN SAND TR SILT	SP					
	12"												
	24"												
							TR GRAVEL						
	36"		3 / 3.0										
				TD @ 3'									
							COLLECTED SPL @ 24"-30" FOR LAB. ANALYSIS S01SB023 0101						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB024
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						DK	BRN SILTY +	SM					
0915							SAND LOAM						
							SAND + GRAVEL	GW					
	12"												
	24"												
	36"		3/3.0										
				TD @ 3'									
							COLLECTED SPL @ 18"-24" FOR LAB ANALYSIS S01SB0240101						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB025
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM	SM					
0840													
							YEL BRN						
							SILT + SAND						
	12"						TR GRAVEL						
							TR SILT						
	24"												
							SAND	SP					
	36"		3/3.0										
				TD @ 3'									
							COLLECTED SPL @ 18"-24" FOR LAB ANALYSIS S01SB025010L						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB026
DATE: 12-1-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM						
0810													
							YEL BRN SILT						
							+ SAND						
	12"												
							TR GRAVEL						
	24"												
							SAND	SP					
	36"		3/3.0										
				TD @ 3'									
							COLLECTED SPL @24"-30" FOR LAB ANALYSIS S01SB026010 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: S01SB027
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							ASPHALT SURFACE						
1320						BRN	SAND + GRAVEL	GW					
							f-g SAND	SP					
	12"												
						BRN	SAND + GRAVEL	GW					
	24"						TR SILT						
	36"		3/3.0										
				TD @ 3'									
							COLLECTED SPL @ ~~24~~ 18-24" FOR LAB ANALYSIS S01SB027010 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 2" x 4' MACRO CORE SAMPLER w/ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB001
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						BRN	LOAM	SM	TOP SOIL				
0945													
						YEL	SAND, SILT +	SM/SC					
						BRN	CLAY						
	12"												
	24"												
	36"												
				TD @ 3'									
							COLLECTED						
							SPL @ 24"-30"						
							FOR ANALYSIS						
							R01SB0010201						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB002
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0805				SSS		BRN	LOAM						
						YEL	SAND, SILT +	SM/SC					
						BRN	CLAY		DRY				
	12"												
	24"								MOIST				
	36"		3/3										
				TD @ 3'			COLLECT SPL @ 24"-30" FOR LAB ANALYSIS R01SB002020 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB003
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1045							LOAM	SM	TOP SOIL				
							SAND, SILT + CLAY	SM/SC	DRY				
	12"												
	24"								MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL @ 24" TO 30" FOR LAB ANALYSIS R01SB0030201						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB004
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1015							LOAM	SM	TOP SOIL				
							SAND, SILT + CLAY	SC/SM	DRY				
	12'												
	24'												
									MOIST				
	36'		3										
				TD @ 3'									
							COLLECTED SPL @ 24"-30" FOR LAB. ANALYSIS R01SB004D201						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB005
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1													
1625							LOAM		TOP SOIL				
							SAND, SILT +	SM/SP					
	12"						CLAY						
	24"												
	36"		3/3										
				TD @ 3'									
							COLLECT SPL						
							@ 24"-30" FOR						
							LAB. ANALYSIS						
							R01SB005020						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB006
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1555							LOAM		TOP SOIL				
							SAND, SILT + CLAY	SM/SC	DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'									
							COLLECT SPL @ 24" TO 30" LAB ANALYSIS R01SB006020 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB007
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1													
1620							LOAM	SM	TOP SOIL				
							SAND, SILT + CLAY	SC/SM	DRY				
	12"												
	24"												
									MOIST				
	36"		3 / 3										
				TD @ 3'									
							COLLECTED SPL @ 24"-30" R01SB0070201						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB008
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1300							LOAM	SM	TOPSOIL				
						YEL BRN	SILT, SAND + CLAY	SM/SC					
	12"												
	24"												
	36		2/3										
				TD @ 3'									
							COLLECT SPL R01SB0080201 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB009
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 ~~1005~~							LOAM		TOP SOIL				
						YBR BRN	SAND, SILT + CLAY	SM/SC					
	12"												
	24"												
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB009020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" & 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB010
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1000				SSSC			LOAM	SM	TOP SOIL				
							SAND, SILT + CLAY	SC/SM					
	12"								DRY				
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'									
							COLLECTED SPL R01SB0100201 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB011
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1605							LOAM TOPSOIL						
							SAND, SILT & CLAY	SM/SC	DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB011020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB012
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1105							LOAM, TOPSOIL	SM					
						YEL	SAND, SILT +	SM/SC					
	12"					BRN	CLAY		DRY				
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'									
							COLLECTED SPL R01SB012020201 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB013
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0825				SSIIII			LOAM, TOPSOIL						
							SAND, SILT + CLAY	SW/SC	DRY				
	12												
	24												
									MOIST				
	36		3/3										
				TD @ 3'			COLLECT SPL R01SB013020I @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB014
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0930							LOAM, TOP SOIL						
						YEL BRN	SAND, SILT + CLAY	SM/SC					
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB014020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB015
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1645							LOAM (TOPSOIL)						
							YELBRN SAND, SILT + CLAY	SC/SM	DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'									
							COLLECTED SPL R01SB015020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB016
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0945							LOAM (TOP SOIL)						
						YEL BRN	SAND, SILT + CLAY	SM/SC	DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECT SPL R01SB016020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB017
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM (TOPSOIL)						
0800													
							SAND, SILT +		DRY				
							CLAY	SM/SC					
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'									
							COLLECTED SPL R01SB017020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB018
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1550							LOAM (TOP SOIL)						
							SILT, CLAY + SAND	SM/SC	DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB018020 1 @ 24" - 30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB019
DATE: 11-29-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							LOAM (TOP SOIL)						
1615													
							SAND, SILT + CLAY	SM/SC	DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB019020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB020
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0735				SS/SS11			LOAM (TOP SOIL)						
							YEL BRN SAND	SM/SC					
							SILT + CLAY		DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB020 0201 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB021
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1035				SSSSS			LOAM (TOPSOIL)						
						YEL	SAND, SILT + CLAY	SM/SC					
						BRN			DRY				
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB021020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB022
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0940							LOAM (TOP SOIL)						
						YEL BRN	SAND, SILT + CLAY	SC/SM	DRY				
	12"												
	24"												
									MOIST				
	36"		7/3										
				TD @ 3'									
							COLLECTED SPL R01SB022020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes _____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

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PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB023
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0820							LOAM (TOP SOIL)						
						MFL BRN	SAND, SILT & CLAY	SC/SM					
	12"												
	24"												
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB0230201 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4' x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB024
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0725							LOAM (TOPSOIL)						
							SAND, SILT + CLAY	SM/SC					
	12"								DRY				
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'									
							COLLECTED SPL R01SB024020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB025
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKE

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0900				SSSSS			LOAM (TOP SOIL)						
						YEL BRN	SAND, SILT + CLAY	SC/SM	DRY				
	12"												
	24"												
	36"		3/3						MOIST				
				TD @ 3'			COLLECT SPL R01SB025020 1 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB026
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARKOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1130							LOAM (TOP SOIL)						
						YEL	SAND + SILT	SM	DRY				
						BRN							
	12"												
	24"												
									MOIST				
	36"		3/3										
				TD @ 3'			COLLECTED SPL R01SB026D201 @ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4" x 2" dia MACROCORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: Site 1 SSP Investigation
PROJECT NUMBER: 112GN2144
DRILLING COMPANY: MIG Environmental
DRILLING RIG: GEOPROBE DPT

BORING No.: R01SB027
DATE: 11-30-05
GEOLOGIST: Fred W. Ramser
DRILLER: LEN SZARICOWSKI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1				SSS			LOAM	SM	TOP SOIL				
1120													
						YEL BRN	SAND, SILT +	SM/SC					
							CLAY		DRY				
	12"												
	24"												
									MOIST				
	36"												
				TD			COLLECTED SPL						
				@			R01SB027020 1						
				3'			@ 24"-30"						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: USED 4' x 2" DIA. MACRO CORE SAMPLER w/ PLASTIC LINER

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: —

APPENDIX C.4

2007 FIELD SAMPLING LOG FORMS AND BORING LOGS

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0200102
Sample Location: S01SB020
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1410	18"-24"	YEL BRN	SAND + SILT MOIST
Method: Macro core DPT			
Monitor Reading (ppm NA			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag	✓	
Thorium-232	Ziplock bag		

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	50 → 103	✓
24 - 30	103 → 33.8	
30 - 36	33.8 → 16	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB021010 2
Sample Location: S01SB021
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 1400 Method: Macro core DPT Monitor Reading (ppm NA	18"-24"	YEL BRN	SILT + SAND MOIST

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag	✓	
Thorium-232	Ziplock bag		

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	83→65	✓
24 - 30	65→19	
30 - 36	19→10.3	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0280302
Sample Location: S01SB028
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 0925
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
30"-36"	BRN	SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:
Method:
Monitor Readings (Range in ppm):

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	8.5	
24 - 30	8.5	
30 - 36	8.5	✓

* Thousand counts per min in borehole

MAP:

Circle If Applicable:

MS/MSD —
Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0290202
Sample Location: S01SB029
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 0935 Method: Macro core DPT Monitor Reading (ppm NA	24"-30"	BRN	f.g SAND MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	12 → 12.5	
24 - 30	12.5 → 12.5	✓
30 - 36	12.5 → 11	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0300302
Sample Location: S01SB030
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 0950
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
30"-36"	BRN	SILTY SAND

COMPOSITE SAMPLE DATA:

Date:
Method:
Monitor Readings (Range in ppm):

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	12.9	
24 - 30	12.9	
30 - 36	12.8	✓

* Thousand counts per min in bore hole

MAP:

Circle if Applicable:

MS/MSD —
Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0 310102
Sample Location: S01SB031
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 1125 Method: Macro core DPT Monitor Reading (ppm NA	"18-24"	YEL BRN	SILT + SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	84-43	✓
24 - 30	43→19	
30 - 36	19→14	

*Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0 320202
Sample Location: S01SB0 32
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07	24" - 30"	BRN	SAND MOIST
Time: 1135			
Method: Macro core DPT			
Monitor Reading (ppm NA			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	36 - 100	
24 - 30	100 → 49	✓
30 - 36	49 → 21	

*Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0330102
Sample Location: S01SB033
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 1300
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
18"-24"	BRN	SILTY f-g SAND MOIST

COMPOSITE SAMPLE DATA:

Date:
Method:
Monitor Readings (Range in ppm):

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	33.8 → 24	✓
24 - 30	24 → 15	
30 - 36	15 → 15	

* Thousand counts per min in bore hole

MAP:

Circle if Applicable:

MS/MSD —
Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB034 0102
Sample Location: S01SB034
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 1310
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
18"-24"	YEL BRN	SILTY F-g SAND TR GRA. MOIST

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	20 → 13.5	✓
24 - 30	13.5 → 8.8	
30 - 36	8.8 → 7.6	

*Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0350102
Sample Location: S01SB035
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 1005
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
18"-24"	YEL BRN	f.g SAND+SILT

COMPOSITE SAMPLE DATA:

Date:
Method:
Monitor Readings (Range in ppm):

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	13.5 → 12	✓
24 - 30	12 → 11.5	
30 - 36	11.5 → 10	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —
Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0360102
Sample Location: S01SB036
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 1110 Method: Macro core DPT Monitor Reading (ppm NA	18"-24"	BRN	f-g SAND, TR SILT + GRA.

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	16 → 14.4	✓
24 - 30	14.4 → 12.8	
30 - 36	12.8 → 12.2	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0 370102
Sample Location: S01SB037
Sampled By: Fred Ramser
C.O.C. No.: 3751

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 1330 Method: Macro core DPT Monitor Reading (ppm NA	18"-24"	YEL BRN	SAND + SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	33.3 → 14.5	✓
24 - 30	14.5 → 9.9	
30 - 36	9.7 → 9.2	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD: —

Duplicate ID No.: S01SBDUP0202

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0380202
Sample Location: S01SB038
Sampled By: Fred Ramser
C.O.C. No.: 3752

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 1010 Method: Macro core DPT Monitor Reading (ppm NA	24"-30"	BRN	SILTY SAND TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	12.6 → 13.5	
24 - 30	13.5 → 13.3	✓
30 - 36	13.3 → 12.4	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB039 0102
Sample Location: S01SB039
Sampled By: Fred Ramser
C.O.C. No.: 3752

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1-17-07 Time: 1055 Method: Macro core DPT Monitor Reading (ppm NA	18"-24"	BRN	f.g SAND + SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	19 → 23	✓
24 - 30	23 → 19	
30 - 36	19 → 13.5	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S01SBDUP0102

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB0400202
Sample Location: S01SB040
Sampled By: Fred Ramser
C.O.C. No.: 3752

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 1345
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
24"-30"	BRN	f.g SAND + SILT

COMPOSITE SAMPLE DATA:

Date:
Method:
Monitor Readings (Range in ppm):

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	22.8 → 46	
24 - 30	46 → 59	✓
30 - 36	59 → 23.3	

* Thousand counts per min in hole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Site 1 Indian Head
Project No.: 112GN2144

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S01SB041 0102
Sample Location: S01SB041
Sampled By: Fred Ramser
C.O.C. No.: 3752

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1-17-07
Time: 1030
Method: Macro core DPT
Monitor Reading (ppm NA

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
18"-24"	YEL BRN	SAND + SILT TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:
Method:
Monitor Readings (Range in ppm):

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Gamma Spectroscopy	Ziplock bag		
Thorium-232	Ziplock bag	✓	

OBSERVATIONS / NOTES:

Depth (inches)	Rad. meter reading (kC/min)*	sample collected
18 - 24	14 → 14.4	✓
24 - 30	14.4 → 12	
30 - 36	12 → 11.8	

* Thousand counts per min in borehole

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Page: _____ of _____

BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEO PROBRUBE

BORING NUMBER: S01SB020
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPHERD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD kC/min)	Sample	Sampler BZ	Borehole**	Driller BZ**
							LOAM SILTY	SM					
							f.g SAND						
							YEL BRN						
	12"						SAND + SILT						
	18"									5.8		50	
	24"									6.0		103	
	30"									8.5		33.8	
							GRAVEL	GW					
	36"									6.5		16	
							COLLECTE SPL						
							@ 18"-24"						
							S01SB020010 2						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Drilling Area Background (ppm): —

Remarks: USE MACRO CORE 4' x 2" W/ ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: NA

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 SSP IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE 66DT

BORING NUMBER: S01SB021
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPHERD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD KC/min →)	Reading Sample	Reading Sampler BZ	Reading Borehole**	Reading Driller BZ**
							LOAMY	SM					
							YEL BRN						
							SILT+SAND						
	12"									5.8			
	18"									8.8		83.1	
	24"									8.0		65	
	30"						SAND	SP		6.5		19	
	36"								MOIST TO WET	6.0		10.3	
							COLLECTED SPL @ 18"-24" S01SB021010Z 1400 HRS						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Drilling Area Background (ppm): —

Remarks: USE MACRO CORE 4'x2" w/ ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 SSP IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE 6600T

BORING NUMBER: S01SB028
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	kC/min → RAD → Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
							LOAM SAND + SILT	SM					
							SAND + GRAVEL	GW	COLLECT SPL FOR THORIUM -232				
	1												
							BRN SILT + GRAVEL DRY TR F.g SAND	GW				9.5	
	18"								5.8 kC/min			9.0	
	24"											8.5	
				?					5.8				
	30"											8.5	
									5.8				
	36"		1				19"/36" RECOVER			5.8		8.5	
							COLLECTED FROM 30"-36" (THE LOWER END OF THE CORE)						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USE MACROCORE 4" x 2" w/ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE D-GOOT

BORING NUMBER: S01SB029
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	kC/min → Reading (ppm) RAD: Sample	Sampler BZ	Borehole**	Driller BZ**
							LOAM SILT	SM					
										5.8			
	12"					BRN	f.g SAND TR SILT	SP					
	18"									5.8		12	
	24"									5.8		12.5	
	30"									5.8		12.5	
	36"		31/31				GRAVEL + SAND	GC		6.1		11	
							COLLECTED SPL						
							24" - 30" FOR						
							LAB ANAL.						
							S01SB029020 2						

1
2
3

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Drilling Area Background (ppm): —

Remarks: USED MACRO CORE W/ACETATE LINER

Converted to Well: Yes _____ No ✓ Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROB GDT

BORING NUMBER: S01SB030
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE ~~SPARK~~ SEIFERMANN

ACAD: FORM_BORLOG.dwg 07/27/99 INL

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
									KC/MIN →	~~Reading (ppm)~~ RAD			
							SAND & SILT LOAM	SM					
							BRN SILTY SAND	SM					
	12									5.7	7		
	18"									6.0	12.7		
01	24"									6.0	12.9		
02	30"									6.0	12.9		
03	36"		3/3							6.0	12.9		
							COLLECTED 30" → 36" S01SB030302						

*When rock coring, enter rock brokeness.
**Include monitor reading in 5 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED ACETATE LINE w/ MACRO CORE 4' x 2"

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE
BORING NUMBER: S01SB031
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD kC/min)	Reading Sample	Reading Sampler BZ	Reading Borehole**	Reading Driller BZ**
							LOAM SILT + SAND	SM					
							YEL BRN SILT + SAND TR GRA	SM					
	12"									5.8			
01	18"									6.2		84.0	
	24"									6.2		43	
02													
	30"									6.0		19	
03	36"									6.0		14.0	
							COLLECTED S01SB031010Z @ 18-24" 1125 HRS						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED MACRO CORE 4' x 2" W/ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: SO1SB032
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

ACAD: FORM_BORLOG.dwg 07/27/99 INL

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD KC/min →)	Reading Sample	Sampler BZ	Borehole**	Driller BZ**
							SILTY SANDY LOAM	SM					
							BRN SAND + TR SILT	SP					
	12"									5.8			
	18"									5.8		36	
01													
	24"									6.4		100	
02													
	30"									10		49	
03													
	36"									7		21	
							COLLECT SPL from 24" - 30" SO1SB032020202						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4" x 2" MACRO CORE SPL W/ACETATE LINERS

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

Page: _____ of _____

BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 2 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB033
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

ACAD:FORM_BORLOG.dwg 07/27/99 INL

	Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
										RAD kC/min →	[redacted] Reading [redacted]			
								YEL BRN LOAM						
							BRN	SILTY F-g SAND	SM					
		12"									5.8			
		18"									5.8		33.8	
01														
		24"									5.8		24	
02								RED GRAVEL	GM					
								?						
		30"									5.8		15	
03														
		36"									5.8		15	
								COLLECTED						
								S01SB033 0102						
								@ 18"-24"						
								1300 HRS						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4' x 2" MACRO-CORE SAMPLERS w/ ACETATE LINERS

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

Page: _____ of _____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB0 34
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks (RAD. kC/min→)	Reading Sample	Reading Sampler BZ	Reading Borehole**	Reading Driller BZ**
						BRN	SILT + SAND LOAM						
							YEL BRN						
							SILTY F.g SAND						
	12"						TR GRAVEL			6.0			
	18"									6.0		20.0	
01													
	24"									6.0		13.5	
02													
	30"									6.0		88	
03													
	36									6.0		76	
							COLLECT SPL						
							@ 18"-24" FOR ANALYSIS.						
							S01SB034 0102						

*When rock coring, enter rock brokeness.
**Include monitor reading in 5 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4" x 2" MACRO-CORE SAMPLER W/ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

Page: _____ of _____

BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB035
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD KC/MIN)	Sample Reading**	Sampler BZ	Borehole**	Driller BZ**
							BRN LOAM SILT+SAND	SM					
							YEL BRN f-g SAND +SILT TR GRAVEL						
	12"									5.5			
	18"									6.0		13.5	
	24"									6.0		12	
	30"									6.0		11.5	
	36"		3'/3'							6.0		10	
							COLLECTED SPL @ 18"-24" S01SB035D02						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4'×2" MACRO-CORE SAMPLER w/ ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROB

BORING NUMBER: S01SB036
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DECSRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD kC/min →)	Reading: Sample	Sampler BZ	Borehole**	Driller BZ**
							SILT LOAM	SM					
							BRN						
							F-g SAND						
							TR SILT +						
	12"						GRAVEL			6.0			
01	18									6.0		16.	
01	24"									6.0		14.4	
02													
02													
03	30									6.0		12.8	
03	36"									6.0		12.2	
							COLLECTED						
							SPL 18"-24"						
							FOR LAB ANALYSIS						
							S01SB036 0102						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4' + 2" MACRO CORE SAMPLER w/ ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB037
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD. kC/MIN ⇒ ↓DUP SPL)	Sample	Sampler BZ	Borehole**	DUP BH
						BRN	LOAM SILT+SAND	SM					
							YEL BRN SAND+SILT TR GRAVEL						
	12"								6.0	6.0			
	18"								6.0	6.0		22.6	33.3
	24"								6.0	6.0		13.0	14.5
	30"								6.0	6.0		9.3	9.7
	36"								6.0	6.0		8.7	9.2
							COLLECTED SPL @ 18"-24" AND COLLECTED DUPLICATE @ 18"-24"		S01SB0370102 S01SBDUP0202				

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4' x 2" MACRO CORE SAMPLERS w/ ACETATE LINER, REQUIRED TWO HOLE TO COLLECT DUPLICATE.

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: SITE 1 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB038
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD KC/min →)	Reading** Sample	Sampler BZ	Borehole**	Driller BZ**
							SILT + SAND LOAM	SM					
	12"					BRN	SILT & SAND			5.6			
							TR GRAVEL						
	18"									6.0		12.6	
	24"									6.0		13.5	
	30"									6.0		13.3	
	36"									6.0		12.4	
							S01SB038020Z						
							24-30"						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Drilling Area Background (ppm): —

Remarks: USED 4' x 2" MACRO-CORE SAMPLER w/ ACETATE LINER

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

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BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 1 FH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB039
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

ACAD:FORM_BORLOG.dwg 07/27/99 INL

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks (RAD KC/MIN → DUP)	Reading** Sample	Sampler BZ	Borehole	PID [redacted]
							SILT LOAM BRN f.g SAND + SILT TR GRA	SM					
	12"									6.0	6.0		
01	18"									6.0	6.0	17.2	19
	24"									6.0	6.0	23	21
02													
	30"									6.0	6.0	19	15.5
03	36"									6.0	6.0	12	13.5
							COLLECTED SPL @ 18"-24" AND COLLECTED A DUPLICATE @ 18"-24" S01SBDUP0102						

*When rock coring, enter rock brokeness.
**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED MACRO-CORE SAMPLER W/ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

Page: _____ of _____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: SITE I IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: SO1SB040
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
							BRN SILTY SANDY LOAM	SM	RAD KC/min →				
						BRN	f-g SAND + SILT TRGRA.						
	12"									6.0			
	18"									6.0		22.8	
01	24"									6.0		46	
02													
	30"									7.0		59	
03	36"									7.0		23.3	
							COLLECT SPL @ 24"-30" SO1SB0400202						

*When rock coring, enter rock brokeness.

**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED 4'x2" MACRO CORE SAMPLER W/ ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

BORING LOG

Tetra Tech NUS, Inc.

PROJECT NAME: SITE 2 IH
PROJECT NUMBER: 2144
DRILLING COMPANY: UN-I-TEC
DRILLING RIG: GEOPROBE

BORING NUMBER: S01SB041
DATE: 1-17-07
GEOLOGIST: FRED W. RAMSER
DRILLER: MIKE SHEPARD

Sample No. and Type or RQD	Depth (FT.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	RAD kC/min → Reading (Sample)	Sampler BZ	Borehole**	Driller BZ**
							BRN LOAM SILT +	SM					
							SAND						
							YEL BRN						
	12"						SAND + SILT			58			
							TR GRAVEL						
	18"									58		14.0	
01	24"									58		14.4	
02	30"									60		12.0	
03	36"		3'/3'							60		11.8	
							COLLECT SPL						
							FR 18"-24"						
							S01SB041010L						

*When rock coring, enter rock brokeness.
**Include monitor reading in 5 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: USED MACRO-CORE SAMPLER w/ ACETATE LINER

Drilling Area Background (ppm): —

Converted to Well: Yes _____ No X Well I.D. #: —

ACAD:FORM_BORLOG.dwg 07/27/99 INL

APPENDIX C.5

2005 REFERENCE AREA GAMMA SCREENING DATA

TABLE C.5-1

REFERENCE AREA GAMMA SCREENING[1]
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

SAMPLE NUMBER	SOIL SAMPLE FROM 24-INCH TO 30-INCH BGS[2] BORING INTERVAL (kcpm)[3]	GROUND SURFACE AT BORING LOCATION (cpm)[4]	DOWN-HOLE READING FROM 18-INCH TO 24-INCH BGS BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 24-INCH TO 30-INCH BGS BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 30-INCH TO 36-INCH BGS BORING INTERVAL (kcpm)
R01SB0010201	6.4	8414	17.8	18.1	18.2
R01SB0020201	6.8	8412	17.8	18.4	18.2
R01SB0030201	6.7	8004	17.5	17.8	17.6
R01SB0040201	6.7	8302	17.8	17.9	18.1
R01SB0040201DUP	6.7	8515	17.6	18.3	18.1
R01SB0050201	5.9	8167	16.4	16.9	16.8
R01SB0060201	6.2	7945	16.9	17.5	17.6
R01SB0070201	6.2	8100	17.1	17.5	17.6
R01SB0080201	5.8	7752	17.4	18.1	17.9
R01SB0090201	6.4	8439	17.9	18.1	18.1
R01SB0100201	6.6	8100	17.3	17.7	17.6
R01SB0110201	6.5	8103	17.5	18.2	17.8
R01SB0120201	6.8	7969	18.4	18.6	17.6
R01SB0130201	6.9	8213	17.4	17.6	18.0
R01SB0140201	6.8	8121	17.6	18.1	17.9
R01SB0150201	6.6	7897	17.4	18.0	17.9
R01SB0160201	6.8	7944	17.2	17.4	17.4
R01SB0160201DUP	6.8	7954	17.3	17.6	17.6
R01SB0170201	6.5	8446	17.2	17.6	17.9
R01SB0180201	5.75	8235	17.1	17.8	18.1
R01SB0190201	6.5	7866	17.2	17.6	17.8
R01SB0200201	6.5	7780	17.2	17.4	17.3
R01SB0200201DUP	6.9	8113	17.5	18.0	17.2
R01SB0210201	6.8	8014	17.8	18.5	18.2
R01SB0220201	6.8	7833	17.5	17.9	17.8
R01SB0230201	6.8	8405	17.4	17.6	17.5
R01SB0240201	6.9	8144	17.5	17.7	18.1
R01SB0250201	6.8	8002	17.3	17.5	17.6
R01SB0260201	6.9	7989	17.9	18.1	18.0
R01SB0270201	6.7	8200	18.3	18.6	18.6

(1) Borehole logging and sample survey performed using a 2-inch diameter X 2-inch long NaI detector
(2) BGS = below ground surface
(3) kcpm = kilo counts per minute
(4) cpm = counts per minute

APPENDIX C.6

2005 SITE 1 GAMMA SCREENING DATA

TABLE C.6-1

SITE 1 GAMMA SCREENING DATA - 2005 SAMPLING ROUND
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

SAMPLE NUMBER	SOIL SAMPLE FROM BORING INTERVAL WITH HIGHEST READING (kcpm)(1)	GROUND SURFACE AT BORING USING 1x1 DETECTOR(2) (cpm)(3)	GROUND SURFACE AT BORING USING 2X2 DETECTOR(4) (cpm)	DOWN-HOLE READING FROM 18-INCH TO 24-INCH BGS(5) BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 24-INCH TO 30-INCH BGS BORING INTERVAL (kcpm)	DOWN-HOLE READING FROM 30-INCH TO 36-INCH BGS BORING INTERVAL (kcpm)
S01SB0010201	1.32	1493	6493	2.23	1.98	1.93
S01SB0020201	1.20	1368	6194	4.86	4.01	3.63
S01SB0030201	1.31	1483	6271	2.10	1.63	1.54
S01SB0040201	1.18	1650	7133	2.26	1.69	1.52
S01SB0050201	1.21	1242	5500	3.23	2.31	2.13
S01SB0060201	1.38	1395	6144	2.26	2.01	1.82
S01SB0070201	1.32	1369	6141	1.55	1.57	1.52
S01SB0080201	1.32	1444	6288	1.84	1.67	1.79
S01SB0090201	1.31	1344	6028	2.02	1.96	1.84
S01SB0090201DUP	1.34	1386	6315	1.95	1.95	1.79
S01SB0100201	1.24	1383	6064	3.42	2.69	1.98
S01SB0110201	1.38	1534	6568	36.80	25.00	4.50
S01SB0120201	1.37	1421	6164	2.08	1.98	1.82
S01SB0130201	1.28	1425	6451	3.26	2.32	1.92
S01SB0140201	7.08	1796	8096	541.00	747.00	10.40
S01SB0150201	1.30	1405	6052	2.83	2.84	2.11
S01SB0160201	1.30	1338	5934	1.70	1.70	1.89
S01SB0170201	1.27	1295	5538	1.63	1.66	1.56
S01SB0180201	1.29	1385	5984	2.02	1.82	1.76
S01SB0190201	1.35	1506	6578	2.20	1.76	1.79
S01SB0200201	1.38	1533	6633	13.10	4.06	2.43
S01SB0210201	1.36	1442	6171	14.40	3.42	1.97
S01SB0220201	1.32	1350	5856	3.89	3.56	2.40
S01SB0230201	1.34	1461	6451	5.67	3.52	2.47
S01SB0230201DUP	1.30	1398	6414	24.40	5.62	2.32
S01SB0240201	1.22	1255	5418	2.32	2.25	2.14
S01SB0250201	1.31	1366	6011	3.85	2.47	2.30
S01SB0250201DUP	1.24	1398	6112	2.67	2.60	2.32
S01SB0260201	1.27	1325	5533	2.42	2.21	2.10
S01SB0270201	1.38	1387	6131	1.58	1.59	1.56
@ sidewalk		1331	5848			
@ outer wall of Building 1662		2086	9142			

(1) kcpm = kilo counts per minute
(2) Borehole logging and sample survey performed using the 1-inch diameter by 1-inch long NaI detector
(3) cpm = counts per minute
(4) Surface readings also performed using the 2-inch diameter by 2-inch long NaI detector for comparison
(5) BGS = below ground surface

APPENDIX C.7

2007 SITE 1 GAMMA SCREENING DATA

TABLE C.7-1

SITE 1 GAMMA SCREENING DATA - 2007 SAMPLING ROUND
SITE 1 - THORIUM SPILL SITE
NSF-IH, INDIAN HEAD, MARYLAND

Sample Location	DOWN-HOLE READING FROM 18-Inches (bgs)[1]	DOWN-HOLE READING FROM 24-Inches (bgs)	DOWN-HOLE READING FROM 30-Inches (bgs)	DOWN-HOLE READING FROM 36-Inches (bgs)
S01SB020	50.0	103.0	33.8	16.0
S01SB021	83.1	24.0	30.0	36.0
S01SB028	9.0	8.5	8.5	8.5
S01SB029	12.0	12.5	12.5	11.0
S01SB030	12.7	12.9	12.9	12.8
S01SB031	84.0	43.0	19.0	14.0
S01SB032	36.0	100.0	49.0	21.0
S01SB033	33.8	24.0	15.0	15.0
S01SB034	20.0	13.5	8.8	7.6
S01SB035	13.5	12.0	11.5	10.0
S01SB036	16.0	14.4	12.8	12.2
S01SB037	22.6	13.0	9.3	8.7
S01SBDUP	33.3	14.5	9.7	9.2
S01SB038	12.6	13.5	13.3	12.4
S01SB039	17.2	23.0	19.0	12.6
S01SBDUP	19.0	21.0	15.5	13.5
S01SB040	22.8	46.0	59.0	23.3
S01SB041	14.0	14.4	12.0	11.8

[1] bgs = below ground surface

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

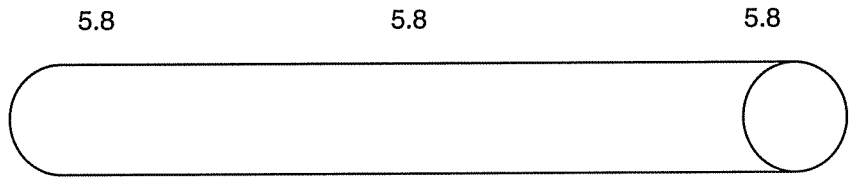
Instrument and Probe Type	Instrument Serial #		Air Sampler Serial #	Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / LBailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α Tranferable Contamination (dpm/100cm²)	β-γ Tranferable Contamination (dpm/100cm²)
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

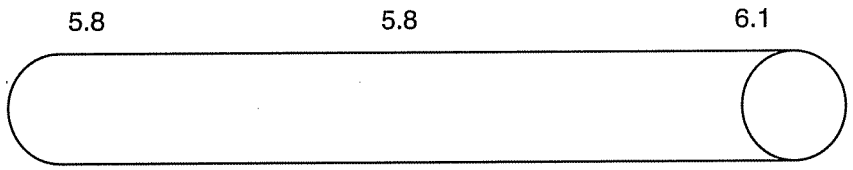
ABC	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB028



Borehole Depth	KCPM
18"	9.0
24"	8.5
30"	8.5
36"	8.5

Core ID # S01SB029



Borehole Depth	KCPM
18"	12.0
24"	12.5
30"	12.5
36"	11.0

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background

(#) = 100cm² wipe | SOP = Step Off Pad | Dose Rates in mrem/hr@30cm (unless otherwise noted)
(#) = LAW | AS-# = Air Sample | GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr
ABC = Static Count | ⬠ = Soil Sample (Results Attached) | CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: Amy Sa[illegible] Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

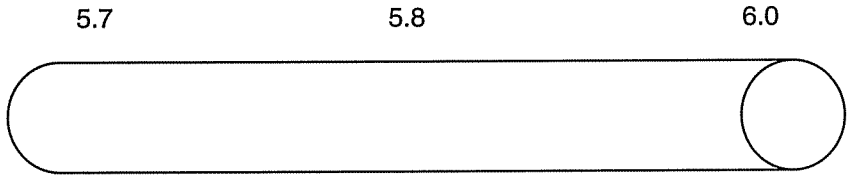
Instrument and Probe Type	Instrument Serial #	Air Sampler Serial #		Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / LBailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α	β-γ
	Tranferable Contamination (dpm/100cm²)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#		
	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

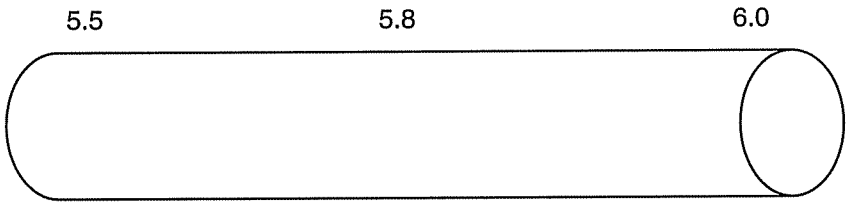
ABC		
	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB030



Borehole Depth	KCPM
18"	12.7
24"	12.9
30"	12.9
36"	12.8

Core ID # S01SB035



Borehole Depth	KCPM
18"	13.5
24"	12.0
30"	11.5
36"	10.0

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background

(#) = 100cm² wipe | SOP = Step Off Pad | Dose Rates in mrem/hr@30cm (unless otherwise noted)

△# = LAW | AS-# = Air Sample | GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr

ABC = Static Count | ⬠ = Soil Sample (Results Attached) | CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: [signature] Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

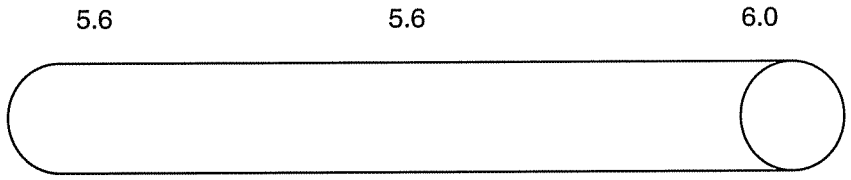
Instrument and Probe Type	Instrument Serial #	Air Sampler Serial #		Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / L Bailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α	βγ
	Tranferable Contamination (dpm/100cm²)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#		
	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

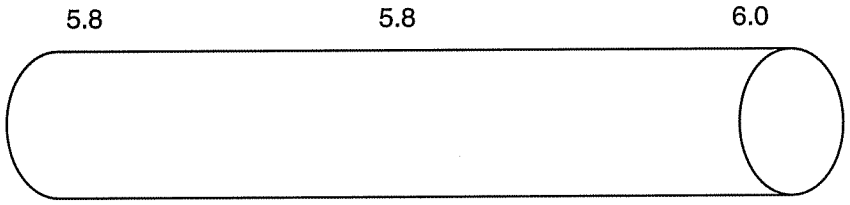
ABC		
	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB038



Borehole Depth	KCPM
18"	12.6
24"	13.5
30"	13.3
36"	12.4

Core ID # S01SB041



Borehole Depth	KCPM
18"	14.0
24"	14.4
30"	12.0
36"	11.8

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background

(#) = 100cm² wipe | SOP = Step Off Pad | Dose Rates in mrem/hr@30cm (unless otherwise noted)

△ = LAW | AS-# = Air Sample | GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr

ABC = Static Count | ⬠ = Soil Sample (Results Attached) | CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: Amy [illegible] Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

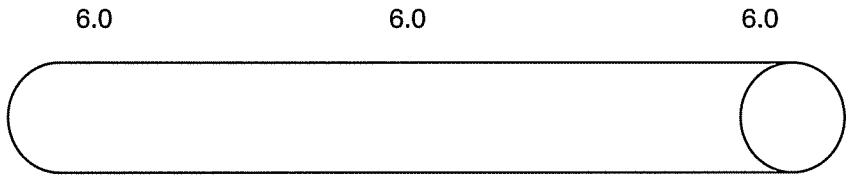
Instrument and Probe Type	Instrument Serial #	Air Sampler Serial #		Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / LBailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α	βγ
	Tranferable Contamination (dpm/100cm²)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#		
	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

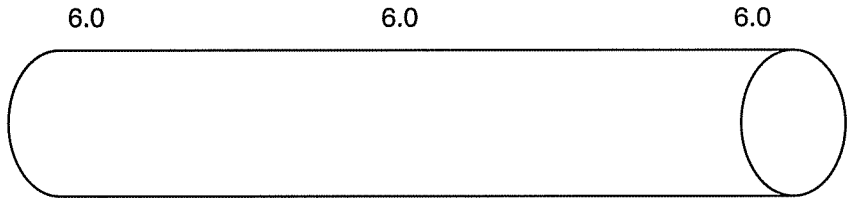
ABC		
	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB039



Borehole Depth	KCPM
18"	17.2
24"	23.0
30"	19.0
36"	12.6

Core ID # S01SB039 Duplicate



Borehole Depth	KCPM
18"	19.0
24"	21.0
30"	15.5
36"	13.5

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background
(#) = 100cm² wipe SOP = Step Off Pad Dose Rates in mrem/hr@30cm (unless otherwise noted)
(#) = LAW AS-# = Air Sample GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr
ABC = Static Count ⬠ = Soil Sample (Results Attached) CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: Amy Smith Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700
Purpose: Soil sampling using DPT rig			

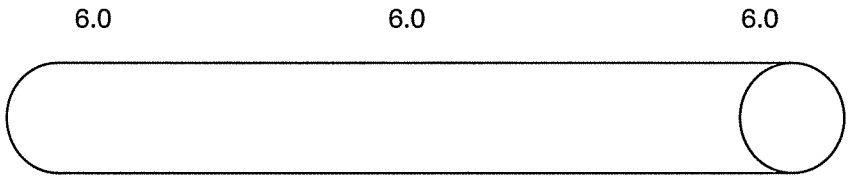
Instrument and Probe Type	Instrument Serial #		Air Sampler Serial #	Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / L Bailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α	β-γ
	Tranferable Contamination (dpm/100cm²)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#		
	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

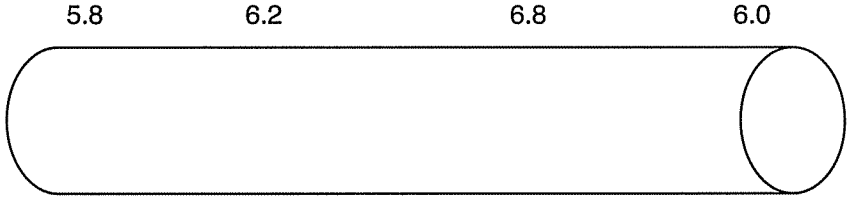
ABC		
	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB036



Borehole Depth	KCPM
18"	16.0
24"	14.4
30"	12.8
36"	12.2

Core ID # S01SB031



Borehole Depth	KCPM
18"	84.0
24"	43.0
30"	19.0
36"	14.0

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background

(#) = 100cm² wipe SOP = Step Off Pad Dose Rates in mrem/hr@30cm (unless otherwise noted)

△ = LAW AS-# = Air Sample GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr

ABC = Static Count ⬠ = Soil Sample (Results Attached) CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: [signature] Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

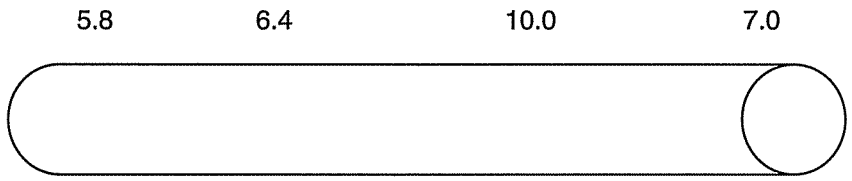
Instrument and Probe Type	Instrument Serial #	Air Sampler Serial #		Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / L Bailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α Tranferable Contamination (dpm/100cm²)	β-γ
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

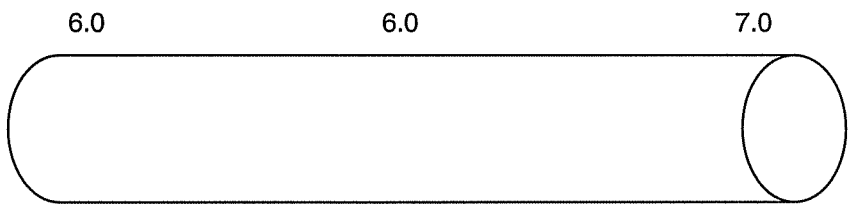
ABC	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB032



Borehole Depth	KCPM
18"	36.0
24"	100.0
30"	49.0
36"	21.0

Core ID # S01SB040



Borehole Depth	KCPM
18"	22.8
24"	46.0
30"	59.0
36"	23.3

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background
= 100cm² wipe SOP = Step Off Pad
LAW AS-# = Air Sample
ABC = Static Count = Soil Sample (Results Attached)

Dose Rates in mrem/hr@30cm (unless otherwise noted)
GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr
CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: Amy Shah Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

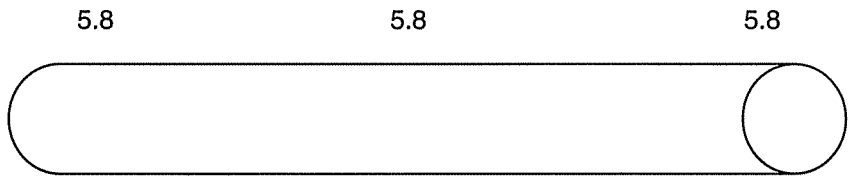
Instrument and Probe Type	Instrument Serial #	Air Sampler Serial #		Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / LBailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α Tranferable Contamination (dpm/100cm²)	βγ
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

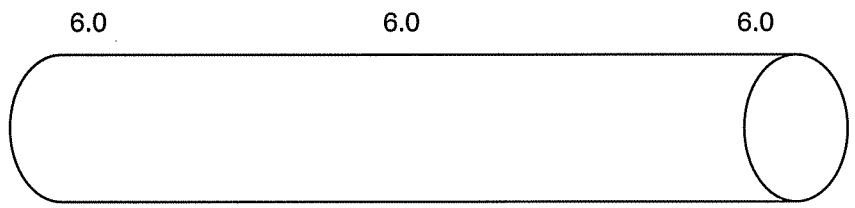
ABC	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB033



Borehole Depth	KCPM
18"	33.8
24"	24.0
30"	15.0
36"	15.0

Core ID # S01SB034



Borehole Depth	KCPM
18"	20.0
24"	13.5
30"	8.8
36"	7.6

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background
(#) = 100cm² wipe SOP = Step Off Pad Dose Rates in mrem/hr@30cm (unless otherwise noted)
(#) = LAW AS-# = Air Sample GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr
ABC = Static Count ⬠ = Soil Sample (Results Attached) CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: Amy Sutto Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

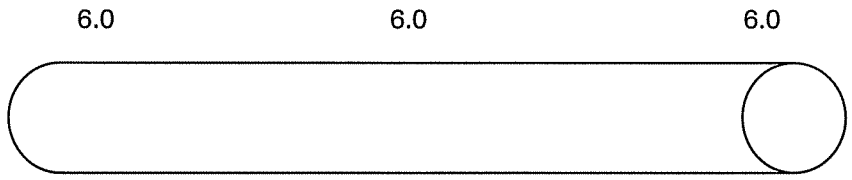
Instrument and Probe Type	Instrument Serial #		Air Sampler Serial #	Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / LBailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α	β-γ
	Tranferable Contamination (dpm/100cm²)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#		
	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

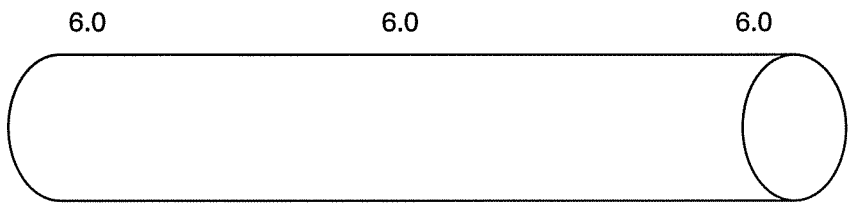
ABC		
	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB037



Borehole Depth	KCPM
18"	22.6
24"	13.0
30"	9.3
36"	8.7

Core ID # S01SB037 Duplicate



Borehole Depth	KCPM
18"	33.3
24"	14.5
30"	9.7
36"	9.2

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background
(#) = 100cm² wipe SOP = Step Off Pad Dose Rates in mrem/hr@30cm (unless otherwise noted)
△ = LAW AS-# = Air Sample GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr
ABC = Static Count ⬠ = Soil Sample (Results Attached) CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: [signature] Date: 1-22-07

Radiological Survey Form

Location: Indian Head - Site 1 - Thorium Spill Site	RWP#: N/A	Date: 1/17/07	Time: 1700

Purpose: Soil sampling using DPT rig

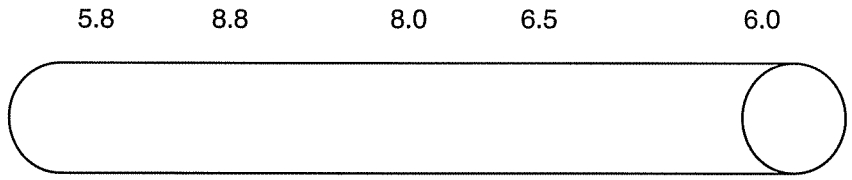
Instrument and Probe Type	Instrument Serial #		Air Sampler Serial #	Surveyor Print / Sign
Ludlum 2929 w/ 43-10-1	132806/PR138385	1	N/A	L. Bailey / L Bailey
Ludlum 2241 w/ 44-10	149400/PR066864	2	N/A	
Ludlum 2224 w/ 43-89	168594/PR127690	3	N/A	
N/A	N/A	4	N/A	
N/A	N/A	5	N/A	

#	α	β-γ
	Tranferable Contamination (dpm/100cm²)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

#		
	Tranferable Contamination (dpm/LAW)	
1		
2		
3		
4		
5		
6	N	A
7		
8		
9		
10		
11		
12		

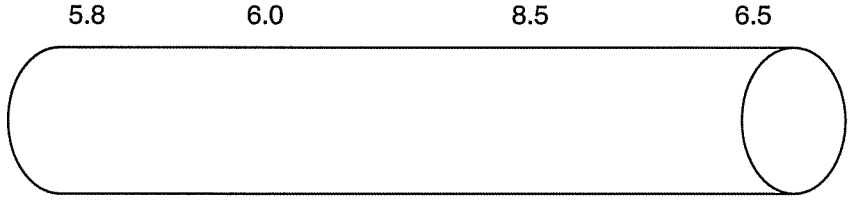
ABC		
	Static Count (dpm/100cm²)	
A		
B		
C		
D		
E		
F		
G	N	A
H		
I		
J		
K		
L		
M		
N		

Illustrations/Remarks: Core ID # S01SB021



Borehole Depth	KCPM
18"	83.1
24"	65.0
30"	19.0
36"	10.3

Core ID # S01SB020



Borehole Depth	KCPM
18"	50.0
24"	103.0
30"	33.8
36"	16.0

Smears taken on core sleeve, DPT rig, and work table all <MDA alpha and beta-gamma
Large Area Wipes taken on DPT rig ND above bkgd alpha and beta-gamma
Direct probe of DPT rig and work table ND above bkgd alpha and beta-gamma
All core and borehole readings in KCPM

Legend ND= No detectable activity above background

(#) = 100cm² wipe | SOP = Step Off Pad | Dose Rates in mrem/hr@30cm (unless otherwise noted)

(#) = LAW | AS-# = Air Sample | GA=General Area SD=Skin Dose (30cm) Dβ=mrad/hr

ABC = Static Count | ⬠ = Soil Sample (Results Attached) | CT=Contact(2.5cm) ED=Extremity Dose (5cm)

Reviewed by: [signature] Date: 1-22-07

APPENDIX C.8

2005 FIELD EQUIPMENT CALIBRATION

Environmental Restoration Group, Inc.
8809 Washington NE, Ste. 150
Albuquerque, NM 87113

ph: 505.298.4224
fax: 505.797-1404
web: www.ERGOffice.com

EQUIPMENT PACKING SLIP

Company Name: Tetra Tech NUS, Inc
Contact Name: Lawson Bailey
Contact Telephone: 803-649-7963 x6326

Order Number: 690
P.O. or Reference Number: PITT-N2144-1005485

Date Ordered: 11/21/2005
Date Shipped: 11/21/2005
Date of Delivery: 11/28/2005

Shipping Method: FedEx 2Day
Shipping Number: 1771-8058-0

Ship To Information:

Shawn Jorgensen
Tetra Tech NUS, Inc
Naval Support Activity, South Potomac Bldg 289,
Indian Head, MD 20640
301-744-2263

Billing Address:

Tetra Tech NUS - Pittsburgh
Accounts Payable
661 Andersen Dr., Foster Plaza 7
Pittsburgh, PA 15220

Equipment Enclosed:

Instrument	***Serial Number***
Ludlum 2224	168594
Ludlum 2241	148089
Ludlum 2929 & 43-10-1	132806 & PR138385
Ludlum 43-89	PR173339
Ludlum 44-10	PR112840
Eberline Cs-137	1698-03
Eberline Sr/Y-90	5442-05
The Source Th-230	1836-94

Special Instructions:

None

Environmental Restoration Group, Inc.
8809 Washington NE, Ste. 150
Albuquerque, NM 87113

ph: 505.298.4224
fax: 505.797-1404
web: www.ERGOffice.com

EQUIPMENT PACKING SLIP

Company Name: Tetra Tech NUS, Inc
Contact Name: Lawson Bailey
Contact Telephone: 803-649-7963 x6326

Order Number: 690
P.O. or Reference Number: PITT-N2144-1005485

Date Ordered: 11/21/2005
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Date of Delivery: 11/28/2005

Shipping Method: FedEx 2Day
Shipping Number: 1771-8058-0

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Shawn Jorgensen
Tetra Tech NUS, Inc
Naval Support Activity, South Potomac Bldg 289,
Indian Head, MD 20640
301-744-2263

Billing Address:
Tetra Tech NUS - Pittsburgh
Accounts Payable
661 Andersen Dr., Foster Plaza 7
Pittsburgh, PA 15220

Equipment Enclosed:

Instrument	***Serial Number***
Ludlum 2224	168594
Ludlum 2241	148089
Ludlum 2929 & 43-10-1	132806 & PR138385
Ludlum 43-89	PR173339
Ludlum 44-10	PR112840
Eberline Cs-137	1698-03
Eberline Sr/Y-90	5442-05
The Source Th-230	1836-94

Special Instructions:

None

Environmental Restoration Group, Inc.
8809 Washington NE, Ste. 150
Albuquerque, NM 87113

ph: 505.298.4224
fax: 505.797-1404
web: www.ERGOffice.com

EQUIPMENT PACKING SLIP

Company Name: Tetra Tech NUS, Inc
Contact Name: Lawson Bailey
Contact Telephone: 803-649-7963 x6326

Order Number: 690
P.O. or Reference Number: PITT-N2144-1005485

Date Ordered: 11/21/2005
Date Shipped: 11/21/2005
Date of Delivery: 11/28/2005

Shipping Method: FedEx 2Day
Shipping Number: 1771-8058-0

Ship To Information:
Shawn Jorgensen
Tetra Tech NUS, Inc
Naval Support Activity, South Potomac Bldg 289,
Indian Head, MD 20640
301-744-2263

Billing Address:
Tetra Tech NUS - Pittsburgh
Accounts Payable
661 Andersen Dr., Foster Plaza 7
Pittsburgh, PA 15220

Equipment Enclosed:

Instrument	***Serial Number***
Ludlum 2224	168594
Ludlum 2241	148089
Ludlum 2929 & 43-10-1	132806 & PR138385
Ludlum 43-89	PR173339
Ludlum 44-10	PR112840
Eberline Cs-137	1698-03
Eberline Sr/Y-90	5442-05
The Source Th-230	1836-94

Special Instructions:

None

Environmental Restoration Group, Inc.
8809 Washington NE, Ste. 150
Albuquerque, NM 87113

ph: 505.298.4224
fax: 505.797-1404
web: www.ERGOffice.com

EQUIPMENT PACKING SLIP

Company Name: Tetra Tech NUS, Inc
Contact Name: Lawson Bailey
Contact Telephone: 803-649-7963 x6326

Order Number: 693
P.O. or Reference Number: PITT-N2144-1005485

Date Ordered: 11/29/2005
Date Shipped: 11/29/2005
Date of Delivery: 11/30/2005

Shipping Method: FedEx Priority Overnight
Shipping Number: 1771-8058-0

Ship To Information:

Shawn Jorgensen
Tetra Tech NUS, Inc
Naval Support Activity, South Potomac Bldg 289,
Indian Head, MD 20640
301-744-2263

Billing Address:

Tetra Tech NUS - Pittsburgh
Accounts Payable
661 Andersen Dr., Foster Plaza 7
Pittsburgh, PA 15220

Equipment Enclosed:

Instrument	***Serial Number***
Ludlum 2241	149393
Ludlum 44-2	PR140739

Special Instructions:

6' cable included

Portable Instrument Check Log Sheet

Instrument Type: 2241 w/44-10 Instrument Number: 148089 Cal.Date: 11/21/05

Probe # PR112840

Radiation Detector Type: α β-γ ☒ γ Cal. Due: 11/21/06

Date/Time	Source Check	Battery Check	Condition	Zero	Bkgd.	Initials
11/29/05 / 1000	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	3501 1 min. int. count	LB
11/30/05 / 0705	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	4113 1 min. int. count	LB
12/01/05 / 0800	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	5413 1 min. int. count	LB
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By: Amy Smith Date: 12-7-05

Portable Instrument Check Log Sheet

Instrument Type: 2241 w/44-2 Instrument Number: 149393 Cal.Date: 11/29/05

Probe # PR140739

Radiation Detector Type: α β-γ ☒ γ Cal. Due: 11/29/06

Date/Time	Source Check	Battery Check	Condition	Zero	Bkgd.	Initials
11/30/05 / 1300	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	1161 1 min. int. count	LB
12/01/05 / 0800	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	1243 1 min. int. count	LB
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By: Amy Stuhl Date: 12-7-05

Portable Instrument Check Log Sheet

Instrument Type: 2224 w/43-89 Instrument Number: 168594 Cal.Date: 11/21/05

Probe # PR173339

Radiation Detector Type: ☒ α ☒ β-γ γ Cal. Due: 11/21/06

Date/Time	Source Check	Battery Check	Condition	Zero	Bkgd.	Initials
11/29/05 / 1250	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	α = 0 β = 148	LB
11/30/05 / 1300	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	α = 0 β = 153	LB
12/01/05 / 0730	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	α = 0 β = 144	LB
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By: Amy Smith Date: 12-7-05

Ludlum 2929 Pre-Operational Check Worksheet

Instrument # 132806	Cal. Expires: 11/21/06	Probe type:43-10-1	Probe #: 138385
α Source nuclide Th-230	Source # 1836-94	Instrument α eff.: .333	
β Source nuclide Sr/Y-90	Source # 5442-05	Instrument β eff.: .298	
High Voltage: 750			

Initial Background Check				Initial Source Check			
Trial 1 α	0.1 cpm	Trial 1 β	45.1 cpm	Trial 1 α	9938 cpm	Trial 1 β	1372 cpm
Trial 2 α	0.1 cpm	Trial 2 β	46.2 cpm	Trial 2 α	10051 cpm	Trial 2 β	1474 cpm
Trial 3 α	0.1 cpm	Trial 3 β	43.1 cpm	Trial 3 α	10029 cpm	Trial 3 β	1458 cpm
Average	0.1 cpm	Average	44.8 cpm	Average	10006 cpm	Average	1435 cpm

Initial Background Check -20% to +20% Range					Initial Source Check -20% to +20% Range				
Alpha	.08	To	.12	cpm	Alpha	8005	To	12007	cpm
Beta	35.8	To	53.8	cpm	Beta	1148	To	1722	cpm

Required Sample Count Time:	RCT Performing Initial Check:	Date:
1 min	LB	11/29/05

PRE-OPERATIONAL CHECKS

Date/Time	Bkgd (CPM)		Source Ck (CPM)		Comments	Performed By (Initial)
	α	β	α	β		
11/29/05/0830	0.1	47.4	1453	9902	MDA α = 11 dpm β = 152 dpm	LB
11/30/05/1320	0.1	36.1	1530	9877	MDA α = 11 dpm β = 79 dpm	LB
12/01/05/0815	0.1	43.5	1498	9898	MDA α = 11 dpm β = 85 dpm	LB

Reviewed By: [signature] Date: 12/7/05

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 44-2 Serial No.: PR 140739

Counter Mfg.: Ludlum Model: 2241 Serial No.: 149393

Counter Threshold Setting: 10 mV Geometry / Distance to source: 6-inches

Cable Length: ☐ 39 inch, ☐ 5 foot, ☑ Other: 6'

Source : ☐ Th230 @ 13,500 dpm sn: 4098-03 ☐ Tc99 @ 18,100 dpm sn: 4099-03

☑ Cs137 @ 6.5 µCi sn: 4097-03 ☐ Other:

Count Time: 1 minute(s)

High Voltage	Gross Source Counts	Background Counts
300	2375	
400	13816	
500	16434	
550	16905	2155
600	17040	
700	34144	
800	758178	

The calibration system conforms to the requirements of ANSI N323-1997

Recommended Operating Voltage: 550 volts

Calibrated By: [signature] Calibration Date: 11-29-05

Calibration Due: 11-29-06

Reviewed By: [signature] Date: 11/29/05

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2241 Serial No.: 149393

All Ranges Calibrated Electronically; Ludlum Pulser Generator S.N. 97743

Reset ☑ Audio ☑ Mechanical ☐

Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Threshold Setting: 10 mV

Reference Setting	Ratemeter	Instrument "As found reading"
400 Kcpm	400 Kcpm	+/- 10%
100 Kcpm	100 Kcpm	
40 Kcpm	40 Kcpm	
10 Kcpm	10 Kcpm	
4 Kcpm	4 Kcpm	
1 Kcpm	1 Kcpm	
400 cpm	400 cpm	
100 cpm	100 cpm	

Reference Setting	Integrated Counts (1-minute count)	Instrument "As found reading"
400 Kcpm	399009	+/- 10%
40 Kcpm	39884	
4 Kcpm	3988	
400 cpm	399	

The calibration system conforms to the requirements of ANSI N323-1997

Calibrated By: [signature] Calibration Date: 11-29-05

Calibration Due: 11-29-06

Reviewed By: [signature] Date: 11/29/05

ERG Form 1.02E

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2241 Serial No.: 148089

All Ranges Calibrated Electronically; Ludlum Pulser Generator S.N. 97743

Reset ☑ Audio ☑ Mechanical ☑

Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Threshold Setting: 10 mV

Reference Setting	Ratemeter	Instrument "As found reading"
400 Kcpm	400 Kcpm	+/- 10%
100 Kcpm	100 Kcpm	
40 Kcpm	40 Kcpm	
10 Kcpm	10 Kcpm	
4 Kcpm	4 Kcpm	
1 Kcpm	1 Kcpm	
400 cpm	400 cpm	
100 cpm	100 cpm	

Reference Setting	Integrated Counts (1-minute count)	Instrument "As found reading"
400 Kcpm	399966	+/- 10%
40 Kcpm	39938	
4 Kcpm	3998	
400 cpm	400	

The calibration system conforms to the requirements of ANSI N323-1997

Calibrated By: [signature] Calibration Date: 11/21/05

Calibration Due: 11/21/06

Reviewed By: [signature] Date: 11/21/06

ERG Form 1.02E

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 44-10 Serial No.: PR 112840

Counter Mfg.: Ludlum Model: 2241 Serial No.: 148089

Counter Threshold Setting: 10 mV Geometry / Distance to source: 6-inches

Cable Length: ☑ 39 inch, ☐ 5 foot, ☐ Other:

Source : ☐ Th230 @ 13,500 dpm sn: 4098-03 ☐ Tc99 @ 18,100 dpm sn: 4099-03

☑ Cs137 @ 6.5 µCi sn: 4097-03 ☐ Other:

Count Time: 1 minute(s)

High Voltage	Gross Source Counts	Background Counts
500	180	
600	7269	
700	38214	
800	64345	
900	76965	
1000	81459	
→ 1100	84638	9867
1200	84966	

The calibration system conforms to the requirements of ANSI N323-1997

Recommended Operating Voltage: 1100 volts

Calibrated By: [signature] Calibration Date: 11/21/05

Calibration Due: 11/21/06

Reviewed By: [signature] Date: 11/21/06

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-10-1 Serial No.: PR138385

Counter Mfg.: Ludlum Model: 2929 Serial No.: 132806

Alpha Threshold Setting: 170 mV

Beta Threshold Setting: 4 mV Beta Window: 50 mV

Alpha Source : ☑ Th230 @ 13,500 dpm sn: 4098-03 ☐ Other:

Beta Source: ☐ Tc99 @ 18,100 dpm sn: 4099-03 ☑ Other: Sr 1-90 #5443-05 4320 dpm @ 3-28-05

Geometry / Distance to source: In planchett

Cable Length: ☑ 39 inch, ☐ 5 foot, ☐ Other:

Count Time: 1 minute(s)

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts		POT Setting
	Alpha	Beta	Alpha	Beta	Alpha	Beta	
550	56	1037	4	66	0	1	2.24
600	2314	500	32	229	1	3	2.44
650	3729	322	64	562	1	13	2.64
700	4241	271	65	923	0	29	2.84
→ 750	4498	310	63	1346	1	57	3.06
800	4704	410	73	1653	2	74	3.28
850	4785	730	69	1681	1	89	3.48

The calibration system conforms to the requirements of ANSI N323-1997

Recommended Operating Voltage: 750 volts

Calibrated By: [signature] Calibration Date: 21NOV05

Calibration Due: 21NOV06

Reviewed By: [signature] Date: 11/21/06

TMA
Thermo Analytical Inc.

TMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-5416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02854
P.O.# 94-00186

Description of Standard:

Model No. DNS-11 Serial No. 1836-94 Isotope 230 Thorium

Electroplated on polished stainless steel disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

16,000 ± 480

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was

32,000 ± 959 (0.0144 μCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: Charles Lambom

Calibration technician: Arlene A Gutierrez Q.A. Representative: Kathy Burnham

Calibration date: 5/24/94 Reviewed date: 5-26-94

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-89 Serial No.: PR173339

Counter Mfg.: Ludlum Model: 2224 Serial No.: 168594

Alpha Threshold Setting: 120 mV

Beta Threshold Setting: 4 mV Beta Window: 30 mV

Alpha Source : ☑ Th230 @ 13,500 dpm sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 18,100 dpm sn: 4099-03 ☑ Other: Sr 1/-90 #5443-05 4320dpm@3.28.05

Geometry / Distance to source: Contact

Count Time: 1 minute(s)

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts		Sr 1/-90	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
450	0	1726	0	9	0	8	0	34
500	71	566	1	25	0	18	1	135
550	1306	335	4	593	4	100	26	527
→ 600	2152	578	11	1874	1	226	23	1117
625	2207	816	8	2454	2	327	39	1447

The calibration system conforms to the requirements of ANSI N323-1997

Recommended Operating Voltage: 600 volts

Calibrated By: [signature] Calibration Date: 11/21/05

Calibration Due: 11/21/06

Reviewed By: [signature] Date: 11/21/06

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2224 Serial No.: 168594

All Ranges Calibrated Electronically; Ludlum Pulser Generator S.N. 97743

Reset ☑ Audio ☑ Mechanical ☑

High Voltage 500v ☐ 1000v ☑ 1500v ☑

Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Alpha Threshold Setting: 120 mV

Beta Threshold Setting: 4 mV Beta Window: 30 mV

Reference Setting	Ratemeter	Instrument "As found reading"
400 Kcpm	400 Kcpm	+/- 10%
100 Kcpm	100 Kcpm	
40 Kcpm	40 Kcpm	
10 Kcpm	10 Kcpm	
4 Kcpm	4 Kcpm	
1 Kcpm	1 Kcpm	
400 cpm	400 cpm	
100 cpm	100 cpm	

Reference Setting	Integrated Counts (1-minute count)	Instrument "As found reading"
400 Kcpm	398522	+/- 10%
40 Kcpm	39851	
4 Kcpm	3985	
400 cpm	399	

The calibration system conforms to the requirements of ANSI N323-1997

Calibrated By: [signature] Calibration Date: 21NOV05

Calibration Due: 21NOV06

Reviewed By: [signature] Date: 11/21/06

ERG Form 1.02C

Certificate of Calibration

2 Channel Scaler Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2929 Serial No.: 132806

All Ranges Calibrated Electronically; Ludlum Pulser Generator S.N. 97743

Audio ☑ Mechanical ☑

High Voltage 500v ☑ 1000v ☑ 1500v ☑

Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Alpha Threshold Setting: 170 mV

Beta Threshold Setting: 4 mV Beta Window: 50 mV

Voltage setting: _____ volts = _____ on HV Dial (pot)

	Alpha Channel Digital Readout		Beta Channel Digital Readout	
Reference Setting	Integrated Counts (1-minute count)	Instrument "As found reading"	Integrated Counts (1-minute count)	Instrument "As found reading"
400 Kcpm	399132	+/-10%	398154	+/-10%
40 Kcpm	39846		39837	
4 Kcpm	3988		3990	
400 cpm	399		399	

The calibration system conforms to the requirements of ANSI N323-1997

Calibrated By: [signature] Calibration Date: 21NOV05

Calibration Due: 21NOV06

Reviewed By: [signature] Date: 11/21/06

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 ± 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 ± 174 (0.00197 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Q.A. Representative:

Calibration Date: 3-28-2005 Reviewed Date: 032805

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

APPENDIX C.9

2007 FIELD EQUIPMENT CALIBRATION

Portable Instrument Check Log Sheet

Instrument Type: 2224 w/43-89 Instrument Number: 168594 Cal.Date: 1/10/07

Probe # PR127690

Radiation Detector Type: ☒ α ☒ β-γ γ Cal. Due: 1/10/08

Date/Time	Source Check	Battery Check	Condition	Zero	Bkgd.	Initials
1/17/07 0740	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	α = 1 β = 95	LB
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By: Amy Smith Date: 1-22-07

Portable Instrument Check Log Sheet

Instrument Type: 2241 w/44-10 Instrument Number: 149400 Cal.Date: 1/10/07

Probe # PR066864

Radiation Detector Type: α β-γ ☒ γ Cal. Due: 1/10/08

Date/Time	Source Check	Battery Check	Condition	Zero	Bkgd.	Initials
1/17/07 0750	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A	3502 cpm	LB
	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A		LB
	☒ Sat. Unsat.	☒ Sat. Unsat.	☒ Sat. Unsat.	Sat. Unsat. ☒ N/A		LB
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By: Amy Sutherland Date: 1-22-07

Ludlum 2929 Pre-Operational Check Worksheet

Instrument # 132806	Cal. Expires: 1/10/08	Probe type:43-10-1	Probe #: 138385
α Source nuclide Th-230	Source # 5447-05	Instrument α eff.: 0.33	
β Source nuclide Sr/Y-90	Source # 5442-05	Instrument β eff.: 0.15	
High Voltage: 750			

Initial Background Check				Initial Source Check			
Trial 1 α	0.3 cpm	Trial 1 β	29.3 cpm	Trial 1 α	7001 cpm	Trial 1 β	1367 cpm
Trial 2 α	0.1 cpm	Trial 2 β	29.8 cpm	Trial 2 α	7030 cpm	Trial 2 β	1393 cpm
Trial 3 α	0.2 cpm	Trial 3 β	32.0 cpm	Trial 3 α	7094 cpm	Trial 3 β	1380 cpm
Average	0.23 cpm	Average	30.4 cpm	Average	7042 cpm	Average	1380 cpm

Initial Background Check -20% to +20% Range					Initial Source Check -20% to +20% Range				
Alpha	0.16	To	0.24	cpm	Alpha	5634	To	8450	cpm
Beta	24.3	To	36.5	cpm	Beta	1104	To	1652	cpm

Required Sample Count Time:	RCT Performing Initial Check:	Date:
1 min	LB	1/16/07

PRE-OPERATIONAL CHECKS

Date/Time	Bkgd (CPM)		Source Ck (CPM)		Comments	Performed By (Initial)
	α	β	α	β		
1/16/07 1545	0.2	33.4	7135	1341	MDA α = 13 dpm β = 151 dpm	LB
1/17/07 0740	0.2	32.0	7072	1364	MDA α = 13 dpm β = 148 dpm	LB

Reviewed By: Amy Smith Date: 1-22-07

Environmental Restoration Group, Inc.
8809 Washington NE, Ste. 150
Albuquerque, NM 87113

ph: 505.298.4224
fax: 505.797-1404
web: www.ERGOffice.com

EQUIPMENT PACKING SLIP

Company Name: Tetra Tech NUS
Contact Name: Lawson Bailey
Contact Telephone: 803-649-7963 x6326

Order Number: 943
P.O. or Reference Number: 1014126

Date Ordered: 1/11/2007
Date Shipped: 1/12/2007
Date of Delivery: 1/15/2007

Shipping Method: FedEx Priority Overnight
Shipping Number: 1771-8058-0

Ship To Information:

Shawn Jorgensen
Tetra Tech NUS
Naval Support Activity, South Potomac Bldg 289,
Indian Head, MD 20640
301-744-2263

Billing Address:

Tetra Tech NUS - Pittsburgh
Accounts Payable
661 Andersen Dr., Foster Plaza 7
Pittsburgh, PA 15220

Equipment Enclosed:

Instrument	***Serial Number***
Ludlum 2224	168594
Ludlum 2241	149400
Ludlum 2929 & 43-10-1	132806 & PR138385
Ludlum 43-89	PR127690
Ludlum 44-10	PR066864
Eberline Cs-137	5309-04
Eberline Sr/Y-90	5442-05
Eberline Th-230	5447-05

Special Instructions:

None

Certificate of Calibration

2 Channel Scaler Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2929 Serial No.: 132806

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: 97743 ☐ 201932 ☑

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ~~☐ Meter Zeroed.~~ ~~☐ Geotropism ck.~~ ~~☐ F/S Response ck.~~ ☑ Audio ck.

~~☐ THR/WIN ck.~~ High Voltage ck. ☑ 500v ☐ ~~1000v~~ ☑ 1500v ~~☐ Battery ck. (min 4.4 vdc).~~

Alpha Threshold.: 170 mV Beta Threshold.: 4 mV Beta Window.: 50 mV

Voltage setting: 750 volts = 3.08 on HV Dial (Pot.)

Instrument found within tolerance (+/- 10%) ☑ Yes ☐ No

Reference Setting	Alpha Channel Digital Readout		Beta Channel Digital Readout	
	Instrument "As Found Reading"	Integrated Counts (1-minute count)	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/-10%	399300	+/-10%	399316
40 Kcpm		39926		39936
4 Kcpm		3993		3994
400 cpm		400		400

Calibrated By: [signature] Calibration Date: 1/10/07

Calibration Due: 1/10/08

Reviewed By: [signature] Date: 1/10/07

ERG Form 1.02D

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-10-1 Serial No.: PR 138385

Counter Mfg.: Ludlum Model: 2929 Serial No.: 132806

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 170 mV Beta Threshold: 4 mV Beta Window: 50 mV

Geometry / Distance to source: In planchett Cable Length: ☑ 39 inch ☐ Other:

Alpha Source : ☑ Th230 @ 13,500 dpm (2/13/03) sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 18,100 dpm (2/13/03) sn: 4099-03 ☐ Other:

Count Time: 1 minute(s)

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts		Pot. Setting
	Alpha	Beta	Alpha	Beta	Alpha	Beta	
600	2082	578	2	117	2	7	2.48
650	3474	378	6	1006	1	15	2.68
700	4249	285	7	1908	3	38	2.88
→ 750	4481	321	2	2782	3	59	3.08
800	4711	385	9	3553	5	82	3.28

Comments: Recommended Operating High Voltage: 750 volts

Calibrated By: [signature] Calibration Date: 1/10/07

Calibration Due: 1/10/08

Reviewed By: [signature] Date: 1/10/07

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2224 Serial No.: 168594

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: ☐ 97743 ☑ 201932

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☑ Meter Zeroed ☑ Geotropism ck. ☐ F/S Response ck. ☑ Audio ck.

☐ ~~THR/WIN~~ ck. High Voltage ck. ☑ 500v ☑ 1000v ☑ 1500v ☑ Battery ck. (min 4.4 vdc)

Alpha Threshold.: 120 mV Beta Threshold.: 4 mV Beta Window.: 30 mV

~~Internal Calibration Date Reset~~ ☐ Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Reference Setting	Instrument "As Found Reading"	Instrument Meter Reading
400 Kcpm	+/-10%	400Kcpm
100 Kcpm		100Kcpm
40 Kcpm		40Kcpm
10 Kcpm		10Kcpm
4 Kcpm		4Kcpm
1 Kcpm		1Kcpm
400 cpm		400cpm
100 cpm		100cpm

Reference Setting	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/-10%	399339
40 Kcpm		39934
4 Kcpm		3993
400 cpm		399

Calibrated By: [signature] Calibration Date: 1/10/07

Calibration Due: 1/10/08

Reviewed By: [signature] Date: 1/10/07

ERG Form 1.02C

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-89 Serial No.: PR127690

Counter Mfg.: Ludlum Model: 2224 Serial No.: 168594

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 120 mV Beta Threshold: 4 mV Beta Window: 30 mV

Detector geometry to source: ☑ Face, ☐ Side, ☐ Below, ☐ Other:

Distance to source: ☑ Contact, ☐ 6 Inches, ☐ Other:

Alpha Source : ☑ Th230 @ 13,500 dpm (2/13/03) sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 18,100 dpm (2/13/03) sn: 4099-03 ☐ Other:

Count Time: 1 minute(s)

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
450	334	378	10	64	2	42
500	1906	833	122	1517	6	219
525	2119	551	68	2244	4	477
550	2265	919	123	2689	4	935

Comments: Recommended Operating High Voltage: 500 volts

Calibrated By: Calibration Date: 1/10/07

Calibration Due: 1/10/08

Reviewed By: Date: 1/10/07

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2241 Serial No.: 149400

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: ☐ 97743 ☑ 201932

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☑ Meter Zeroed ☐ ~~Geotropism ck.~~ ☑ F/S Response ck. ☑ Audio ck.

☐ ~~THR/WIN ck.~~ High Voltage ck.: ☑ 500v ☑ 1000v ☑ 1500v ☑ Battery ck. (min 4.4 vdc)

Threshold Setting: 10 mV

Instrument found within tolerance (+/- 10%) ☑ Yes ☐ No

Reference Setting	Instrument "As Found Reading"	Instrument Meter Reading
400 Kcpm	+/-10%	399 Kcpm
100 Kcpm		99 Kcpm
40 Kcpm		39.9 Kcpm
10 Kcpm		9.9 Kcpm
4 Kcpm		3.97 Kcpm
1 Kcpm		1.00 Kcpm
400 cpm		399 cpm
100 cpm		1.01 cpm

Reference Setting	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/- 10%	399336
40 Kcpm		39935
4 Kcpm		3993
400 cpm		399

Calibrated By: [signature] Calibration Date: 1/10/07

Calibration Due: 1/10/08

Reviewed By: [signature] Date: 1/10/07

ERG Form 1.02E

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 44-10 Serial No.: PR 066864

Counter Mfg.: Ludlum Model: 2241 Serial No.: 149400

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Counter Threshold Setting: 10 mV Cable Length: ☑ 39 inch, ☐ 5 foot, ☐ Other:

Detector geometry to source: ☐ Face, ☑ Side, ☐ Below, ☐ Other:

Distance to source: ☐ Contact, ☑ 6 Inches, ☐ Other:

Source : ☐ Th230 @ 13,500 dpm (2/13/03) sn: 4098-03 ☐ Tc99 @ 18,100 dpm (2/13/03) sn: 4099-03

☑ Cs137 @ 6.5 µCi (1/27/03) sn: 4097-03 ☐ Other:

Count Time: 1 minute(s)

High Voltage	Gross Source Counts	Background Counts
500	34708	
600	73520	
700	85909	
800	91826	
→ 900	92758	10757
1000	93448	
1100	93936	
1200	102217	

Comments: Recommended Operating High Voltage: 900 volts

Calibrated By: [signature] Calibration Date: 1/10/07

Calibration Due: 1/10/08

Reviewed By: [signature] Date: 1/10/07

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 ± 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 ± 174 (0.00197 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Q.A. Representative:

Calibration Date: 3-28-2005 Reviewed Date: 032805

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Gamma Standard

S.O.# 6126
P.O.# 1059

Description of Standard:

Model No. CS-7A Serial No. 5309-04 Isotope Cs-137

The source of gamma radiation is mounted on a 2.54 cm diameter PLASTIC disc, 3 mm thick and sealed in a PLASTIC RESIN.

Measurement Method:

The gamma ray emission rate was compared with a similar standard, which was calibrated by NIST S/N 2752-91. The comparison of relative gama ray emission rates was accomplished using a high resolution gamma-ray detector (nominal active volume 100 cm^3) and a multichannel pulse height analyzer.

Measurement Result:

The gamma ray activity of the standard on 8-30-2004 was 5.7 μCi.

The uncertainty of the measurement is 5 %, which is the sum of the uncertainty assigned to the NIST reference (2.2%), random counting error at the 99% confidence level, and the estimated upper limit of systematic errors.

Calibrated by: ART REUST Reviewed by: Deborah A. Garcia

Calibration Technician: Art Reust Q.A. Representative: Anthony W. Toth

Calibration Date: 8-30-2004 Reviewed Date: 8-31-04

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-11 Serial No. 5447-05 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 4001-02.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

10,800 ± 431

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

21,300 ± 850 (0.00958 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Q.A. Representative:

Calibration Date: 3-28-2005 Reviewed Date: 032805

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

APPENDIX D

ANALYTICAL DATA

TABLE D - 1

ANALYTICAL DATA
THORIUM - 232 CONCENTRATIONS
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

Reference Area Samples	Thorium - 232 Concentration pCi/g	Year Sampled
R01SB001	1.17	2005
R01SB002	1.17	2005
R01SB003	0.99	2005
R01SB004	3.10	2005
R01SB005	1.25	2005
R01SB006	1.02	2005
R01SB007	1.08	2005
R01SB008	1.25	2005
R01SB009	0.99	2005
R01SB010	1.06	2005
R01SB011	1.02	2005
R01SB012	1.23	2005
R01SB013	0.94	2005
R01SB014	1.24	2005
R01SB015	1.24	2005
R01SB016	1.10	2005
R01SB017	1.28	2005
R01SB018	1.18	2005
R01SB019	0.99	2005
R01SB020	1.32	2005
R01SB021	1.23	2005
R01SB022	1.18	2005
R01SB023	1.28	2005
R01SB024	1.05	2005
R01SB025	1.14	2005
R01SB026	1.28	2005
R01SB027	1.30	2005

Site 1 Samples	Thorium - 232 Concentration pCi/g	Year Sampled
S01SB001	0.52	2005
S01SB002	0.62	2005
S01SB003	0.64	2005
S01SB004	0.57	2005
S01SB005	0.59	2005
S01SB006	0.60	2005
S01SB007	0.50	2005
S01SB008	0.66	2005
S01SB009	0.60	2005
S01SB010	0.58	2005
S01SB011	4.57	2005
S01SB012	0.60	2005
S01SB013	0.68	2005
S01SB014	16.50	2005
S01SB015	0.53	2005
S01SB016	0.47	2005
S01SB017	0.51	2005
S01SB018	0.58	2005
S01SB019	0.42	2005
S01SB020	0.64	2005
S01SB021	0.66	2005
S01SB022	0.58	2005
S01SB023	14.30	2005
S01SB024	0.62	2005
S01SB025	0.62	2005
S01SB026	0.52	2005
S01SB027	0.52	2005
S01SB028	0.42	2007
S01SB029	0.70	2007
S01SB030	0.68	2007
S01SB031	3.53	2007
S01SB032	28.40	2007
S01SB033	1.79	2007
S01SB034	0.61	2007
S01SB035	0.66	2007
S01SB036	0.96	2007
S01SB037	1.06	2007
S01SB038	0.68	2007
S01SB039	3.67	2007
S01SB040	4.24	2007
S01SB041	0.72	2007

TABLE D - 2

ANALYTICAL DATA
NATURALLY OCCURRING RADIOLOGICAL MATERIAL (NORM) PARAMETERS
SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

Sample Name	S01SB0140101	S01SB0200102	S01SB0210102
Sample Location	S01SB014	S01SB020	S01SB021
Date Sampled	20051201	20070117	20070117
Matrix	Soil	Soil	Soil
Top of Sampled Interval Below Ground Surface (feet)	2	1.5	1.5
Bottom of Sampled Interval Below Ground Surface (feet)	2.5	2	2

Radiological Parameters (pCi/G)

ACTINIUM-228	11.5	12	12.5
BISMUTH-212	8.1	8.7	9.3
BISMUTH-214	0.51	0.96	0.6
LEAD-212	12.3	13.1	13.8
LEAD-214	0.46	0.84	0.57
POTASSIUM-40	6.9	8.4	6.3
RADIUM-224	13.6		
RADIUM-226	0.51	0.96	0.6
RADIUM-228	11.5		
THALLIUM-208	3.91	4.84	4.9
THORIUM-234	2.2 U	1.5 U	1.2 U

U - Not detected.

APPENDIX E

ANALYTICAL DATA VALIDATION MEMORANDA

APPENDIX E.1 - 2005 ANALYTICAL DATA VALIDATION MEMORANDA

APPENDIX E.2 - 2007 ANALYTICAL DATA VALIDATION MEMORANDUM

APPENDIX E.1

2005 ANALYTICAL DATA VALIDATION MEMORANDA

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**G. LATULIPPE**	**DATE:**	**JANUARY 16, 2006**
FROM:	**TERRI L. SOLOMON**	**COPIES:**	**DV FILE**

SUBJECT: **RADIOLOGICAL DATA VALIDATION – THORIUM-232**
CTO 005 NDW INDIAN HEAD
SAMPLE DELIVERY GROUP (SDG) – FL5020259

SAMPLES: 20/Soils/

R01SB0020201	R01SB0030201	R01SB0050201
R01SB0060201	R01SB0070201	R01SB0080201
R01SB0110201	R01SB0120201	R01SB0150201
R01SB0170201	R01SB0180201	R01SB0190201
R01SB0200201	R01SB0240201	R01SB0260201
R01SB0270201	R01SBDUP0101	S01SB0030101
S01SB0070101	S01SB0270101	

Overview

The sample set for NDW Indian Head, CTO 005, SDG FL4020259, consists of twenty (20) soil environmental samples. One field duplicate pair R01SB0200201 / R01SBDUP0101 was included within this SDG.

All samples were analyzed for Thorium-232 by Alpha Spectroscopy. The samples were collected on November 29 and 30, 2005 and analyzed by Severn Trent Laboratories under Naval Facilities Engineering Service Center (NFESC) Quality Assurance / Quality Control (QA/QC) criteria.

Summary

All nuclides were successfully analyzed. The findings offered in this report are based upon a general review of all available data. The data review was based on data completeness, holding times, laboratory method/preparation blanks, laboratory duplicate results, field duplicate results, laboratory control sample (LCS) results and detection limits.

Areas of concern with respect to data quality are listed below.

Major Problems

None

Minor Problems

None

Notes

Laboratory and field duplicate imprecision was calculated using a mean difference equation. A mean difference of > 3 would require data validation action.

Executive Summary

Laboratory Performance: None.

Other Factors Affecting Data Quality: None.

The data for these analyses were reviewed with reference to the NFESC document entitled "Navy Installation Restoration Chemical Data Quality Manual" (September 1999).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC Guidelines and the Quality Assurance Project Plan (QAPP)."

Terri L. Solomon

Tetra Tech NUS
Terri L. Solomon
Environmental Scientist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C - Support Documentation

Appendix A
Qualified Analytical Results

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0020201
samp_date	11/30/2005
lab_id	F5L020259013
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.17		

nsample	R01SB0030201
samp_date	11/30/2005
lab_id	F5L020259014
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.99		

nsample	R01SB0050201
samp_date	11/29/2005
lab_id	F5L020259007
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.25		

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0060201
samp_date	11/29/2005
lab_id	F5L020259003
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.02		

nsample	R01SB0070201
samp_date	11/29/2005
lab_id	F5L020259006
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.08		

nsample	R01SB0080201
samp_date	11/29/2005
lab_id	F5L020259001
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.25		

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0110201
samp_date	11/29/2005
lab_id	F5L020259004
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.02		

nsample	R01SB0120201
samp_date	11/30/2005
lab_id	F5L020259015
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.23		

nsample	R01SB0150201
samp_date	11/29/2005
lab_id	F5L020259008
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.24		

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0170201
samp_date	11/30/2005
lab_id	F5L020259012
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.28		

nsample	R01SB0180201
samp_date	11/29/2005
lab_id	F5L020259002
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.18		

nsample	R01SB0190201
samp_date	11/29/2005
lab_id	F5L020259005
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.99		

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0200201
samp_date	11/30/2005
lab_id	F5L020259010
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.12		

nsample	R01SB0240201
samp_date	11/30/2005
lab_id	F5L020259009
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.05		

nsample	R01SB0260201
samp_date	11/30/2005
lab_id	F5L020259017
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.28		

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0270201
samp_date	11/30/2005
lab_id	F5L020259016
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.3		

nsample	R01SBDUP0101
samp_date	11/30/2005
lab_id	F5L020259011
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	R01SB0200201

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.32		

nsample	S01SB0030101
samp_date	11/30/2005
lab_id	F5L020259020
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.64		

PROJ_NO: 2144

SDG: FL5020259 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0070101	nsample	S01SB0270101
samp_date	11/30/2005	samp_date	11/30/2005
lab_id	F5L020259019	lab_id	F5L020259018
qc_type	NM	qc_type	NM
units	PCI/G	units	PCI/G
Pct_Solids		Pct_Solids	
DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.5		

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.52		

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**G. LATULIPPE**	**DATE:**	**JANUARY 16, 2006**
FROM:	**TERRI L. SOLOMON**	**COPIES:**	**DV FILE**

SUBJECT: **RADIOLOGICAL DATA VALIDATION – THORIUM-232**
CTO 005 NDW INDIAN HEAD
SAMPLE DELIVERY GROUP (SDG) – F5L020283

SAMPLES: 20/Soils/

R01SB0010201	R01SB0040201	R01SB0090201
R01SB0100201	R01SB0130201	R01SB0140201
R01SB0160201	R01SB0210201	R01SB0220201
R01SB0230201	R01SB0250201	R01SBDUP0201
R01SBDUP0301	S01SB0010101	S01SB0080101
S01SB0120101	S01SB0160101	S01SB0170101
S01SB0180101	S01SB0190101	

Overview

The sample set for NDW Indian Head, CTO 005, SDG F5L020283, consists of twenty (20) soil environmental samples. Two field duplicate pairs R01SB0160201 / R01SBDUP0201 and R01SB0040201 / R01SBDUP0301 were included within this SDG.

All samples were analyzed for Thorium-232 by Alpha Spectroscopy. The samples were collected on November 30 and December 1, 2005 and analyzed by Severn Trent Laboratories under Naval Facilities Engineering Service Center (NFESC) Quality Assurance / Quality Control (QA/QC) criteria.

Summary

All nuclides were successfully analyzed. The findings offered in this report are based upon a general review of all available data. The data review was based on data completeness, holding times, laboratory method/preparation blanks, laboratory duplicate results, field duplicate results, laboratory control sample (LCS) results and detection limits.

Areas of concern with respect to data quality are listed below.

Major Problems

None

Minor Problems

Field duplicate imprecision, a mean difference > 3, was noted for sample pair R01SB0040201 / R01SBDUP0301. Positive results reported in the affected samples were qualified as estimated, "J".

Notes

None.

Executive Summary

Laboratory Performance: None.

Other Factors Affecting Data Quality: Field duplicate imprecision was noted for sample pair R01SB0040201 / R01SBDUP0301.

The data for these analyses were reviewed with reference to the NFESC document entitled "Navy Installation Restoration Chemical Data Quality Manual" (September 1999).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC Guidelines and the Quality Assurance Project Plan (QAPP)."

Terri L. Solomon

Tetra Tech NUS
Terri L. Solomon
Environmental Scientist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C - Support Documentation

Data Qualifier Key:

J - Positive result is considered estimated, "J", as a result of laboratory noncompliances.

Appendix A
Qualified Analytical Results

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0010201
samp_date	11/30/2005
lab_id	F5L020283014
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.17		

nsample	R01SB0040201
samp_date	11/30/2005
lab_id	F5L020283017
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.14	J	G

nsample	R01SB0090201
samp_date	11/30/2005
lab_id	F5L020283016
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.99		

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0100201
samp_date	11/30/2005
lab_id	F5L020283015
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.06		

nsample	R01SB0130201
samp_date	11/30/2005
lab_id	F5L020283008
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.94		

nsample	R01SB0140201
samp_date	11/30/2005
lab_id	F5L020283012
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.24		

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0160201
samp_date	11/30/2005
lab_id	F5L020283010
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.1		

nsample	R01SB0210201
samp_date	11/30/2005
lab_id	F5L020283019
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.23		

nsample	R01SB0220201
samp_date	11/30/2005
lab_id	F5L020283013
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.18		

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0230201
samp_date	11/30/2005
lab_id	F5L020283007
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.28		

nsample	R01SB0250201
samp_date	11/30/2005
lab_id	F5L020283009
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.14		

nsample	R01SBDUP0201
samp_date	11/30/2005
lab_id	F5L020283011
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	R01SB0160201

Parameter	Result	Val Qual	Qual Code
THORIUM-232	1.05		

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SBDUP0301
samp_date	11/30/2005
lab_id	F5L020283018
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	R01SB0040201

Parameter	Result	Val Qual	Qual Code
THORIUM-232	3.1	J	G

nsample	S01SB0010101
samp_date	11/30/2005
lab_id	F5L020283006
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.52		

nsample	S01SB0080101
samp_date	11/30/2005
lab_id	F5L020283001
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.66		

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0120101
samp_date	11/30/2005
lab_id	F5L020283004
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.6		

nsample	S01SB0160101
samp_date	11/30/2005
lab_id	F5L020283002
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.47		

nsample	S01SB0170101
samp_date	11/30/2005
lab_id	F5L020283005
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.51		

PROJ_NO: 2144

SDG: F5L020283 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0180101	nsample	S01SB0190101
samp_date	12/1/2005	samp_date	11/30/2005
lab_id	F5L020283020	lab_id	F5L020283003
qc_type	NM	qc_type	NM
units	PCI/G	units	PCI/G
Pct_Solids		Pct_Solids	
DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.58		

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.42		

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**G. LATULIPPE**	**DATE:**	**JANUARY 17, 2006**
FROM:	**TERRI L. SOLOMON**	**COPIES:**	**DV FILE**

SUBJECT: **RADIOLOGICAL DATA VALIDATION – THORIUM-232**
CTO 005 NDW INDIAN HEAD
SAMPLE DELIVERY GROUP (SDG) – F5L020288

SAMPLES: 20/Soils/

S01SB0020101	S01SB0040101	S01SB0050101
S01SB0060101	S01SB0090101	S01SB0100101
S01SB0110101	S01SB0130101	S01SB0140101
S01SB0150101	S01SB0200101	S01SB0210101
S01SB0220101	S01SB0230101	S01SB0240101
S01SB0250101	S01SB0260101	S01SBDUP0101
S01SBDUP0201	S01SBDUP0301	

Overview

The sample set for NDW Indian Head, CTO 005, SDG F5L020288, consists of twenty (20) soil environmental samples. Three field duplicate pairs S01SB0090101 / S01SBDUP0101, S01SB0250101 / S01SBDUP0201 and S01SB0230101 / S01SBDUP0301 were included within this SDG.

All samples were analyzed for Thorium-232 by Alpha Spectroscopy. The samples were collected on December 1, 2005 and analyzed by Severn Trent Laboratories under Naval Facilities Engineering Service Center (NFESC) Quality Assurance / Quality Control (QA/QC) criteria.

Summary

All nuclides were successfully analyzed. The findings offered in this report are based upon a general review of all available data. The data review was based on data completeness, holding times, laboratory method/preparation blanks, laboratory duplicate results, field duplicate results, laboratory control sample (LCS) results and detection limits.

Areas of concern with respect to data quality are listed below.

Major Problems

None.

Minor Problems

Laboratory duplicate imprecision, a mean difference > 3, was noted for sample S01SB0230101. Positive results reported for all samples were qualified as estimated, "J".

Field duplicate imprecision, a mean difference > 3, was noted for sample pair S01SB0230101 / S01SBDUP0301. Positive results reported in the affected samples were qualified as estimated, "J".

Notes

None.

Executive Summary

Laboratory Performance: None.

Other Factors Affecting Data Quality: Laboratory duplicate imprecision was noted for sample S01SB0230101. Field duplicate imprecision was noted for sample pair R01SB0040201 / R01SBDUP0301.

The data for these analyses were reviewed with reference to the NFESC document entitled "Navy Installation Restoration Chemical Data Quality Manual" (September 1999).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC Guidelines and the Quality Assurance Project Plan (QAPP)."

Terri L. Solomon

Tetra Tech NUS
Terri L. Solomon
Environmental Scientist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C - Support Documentation

Data Qualifier Key:

J - Positive result is considered estimated, "J", as a result of laboratory noncompliances.

Appendix A
Qualified Analytical Results

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0020101
samp_date	12/1/2005
lab_id	F5L020288011
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.62	J	F

nsample	S01SB0040101
samp_date	12/1/2005
lab_id	F5L020288006
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.57	J	F

nsample	S01SB0050101
samp_date	12/1/2005
lab_id	F5L020288012
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.59	J	F

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0060101
samp_date	12/1/2005
lab_id	F5L020288005
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.6	J	F

nsample	S01SB0090101
samp_date	12/1/2005
lab_id	F5L020288001
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.6	J	F

nsample	S01SB0100101
samp_date	12/1/2005
lab_id	F5L020288010
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.58	J	F

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0110101
samp_date	12/1/2005
lab_id	F5L020288018
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	4.57	J	F

nsample	S01SB0130101
samp_date	12/1/2005
lab_id	F5L020288003
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.68	J	F

nsample	S01SB0140101
samp_date	12/1/2005
lab_id	F5L020288020
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	16.5	J	F

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0150101
samp_date	12/1/2005
lab_id	F5L020288015
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.53	J	F

nsample	S01SB0200101
samp_date	12/1/2005
lab_id	F5L020288019
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.64	J	F

nsample	S01SB0210101
samp_date	12/1/2005
lab_id	F5L020288007
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.66	J	F

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0220101
samp_date	12/1/2005
lab_id	F5L020288014
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.58	J	F

nsample	S01SB0230101
samp_date	12/1/2005
lab_id	F5L020288016
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	14.3	J	FG

nsample	S01SB0240101
samp_date	12/1/2005
lab_id	F5L020288013
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.62	J	F

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0250101
samp_date	12/1/2005
lab_id	F5L020288008
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.62	J	F

nsample	S01SB0260101
samp_date	12/1/2005
lab_id	F5L020288004
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.52	J	F

nsample	S01SBDUP0101
samp_date	12/1/2005
lab_id	F5L020288002
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	S01SB0090101

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.59	J	F

PROJ_NO: 2144

SDG: F5L020288 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SBDUP0201	nsample	S01SBDUP0301
samp_date	12/1/2005	samp_date	12/1/2005
lab_id	F5L020288009	lab_id	F5L020288017
qc_type	NM	qc_type	NM
units	PCI/G	units	PCI/G
Pct_Solids		Pct_Solids	
DUP_OF:	S01SB0250101	DUP_OF:	S01SB0230101

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.62	J	F

Parameter	Result	Val Qual	Qual Code
THORIUM-232	0.99	J	FG

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**G. LATULIPPE**	**DATE:**	**JANUARY 31, 2006**
FROM:	**ERIN M. FAUST**	**COPIES:**	**DV FILE**

SUBJECT: **RADIOLOGICAL DATA VALIDATION – GAMMA SPECTROSCOPY**
CTO – 005 NDW INDIAN HEAD
SAMPLE DELIVERY GROUP (SDG) – F5L140103

SAMPLES: 2/Soil/

R01SB0080201 S01SB0140101

Overview

The sample set for CTO 005, NDW Indian Head, SDG F5L140103, consists of two (2) soil environmental samples.

Both samples were analyzed for gamma spectroscopy (actinium-228, bismuth-212, bismuth-214, lead-212, lead-214, potassium-40, radium-226, thallium-208 and thorium-234). The samples were collected by Tetra Tech NUS on November 29 and 31, 2005 and analyzed by Severn Trent Laboratories (STL) – St. Louis under Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria. All analyses were conducted using Department of Energy (DOE) method GA-01-R.

Summary

All analytes were successfully analyzed. The findings offered in this report are based upon a general review of all available data. The data review was based on data completeness, holding times, calibration data, laboratory blank analyses, laboratory duplicate results, laboratory control sample (LCS) results, detection limits and analyte quantitation.

Notes

Laboratory results were reported with an associated 2-sigma error (95% confidence level).

The reported activities summarized on the spreadsheets in Appendix A do not display the associated uncertainties.

Gamma Spectrometry data are analyzed with computer analysis software involving photopeak fitting algorithms, therefore, sample results and uncertainty were not verified.

Radium-224 and radium-228 were also detected and reported in sample S01SB0140101.

Executive Summary

Laboratory Performance: No laboratory-related issues affected data quality.

Other Factors Affecting Data Quality: None.

The data for these analyses were reviewed with reference to the NFESC document entitled "Navy IRCDQM" (September 1999).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC Guidelines and the Quality Assurance Project Plan (QAPP)."

Tetra Tech NUS
Erin M. Faust
Environmental Scientist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C - Support Documentation

APPENDIX A
QUALIFIED ANALYTICAL RESULTS

Data Validation Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues; e.g. chromatography,interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient $r < 0.995$
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

PROJ_NO: 2144

SDG: F5L140103 MEDIA: SOIL DATA FRACTION: RAD

nsample	R01SB0080201
samp_date	11/29/2005
lab_id	F5L140103002
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ACTINIUM-228	0.89	U	
BISMUTH-212	1.26	U	
BISMUTH-214	1.25		
LEAD-212	1.14		
LEAD-214	1.12		
POTASSIUM-40	6.2		
RADIUM-226	1.25		
THALLIUM-208	0.47		
THORIUM-234	1.1	U	

nsample	S01SB0140101
samp_date	12/1/2005
lab_id	F5L140103001
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ACTINIUM-228	11.5		
BISMUTH-212	8.1		
BISMUTH-214	0.51		
LEAD-212	12.3		
LEAD-214	0.46		
POTASSIUM-40	6.9		
RADIUM-224	13.6		
RADIUM-226	0.51		
RADIUM-228	11.5		
THALLIUM-208	3.91		
THORIUM-234	2.2	U	

APPENDIX E.2

2007 ANALYTICAL DATA VALIDATION MEMORANDUM

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**G. LATULIPPE**	**DATE:**	**MARCH 12, 2007**
FROM:	**TERRI L. SOLOMON**	**COPIES:**	**DV FILE**

SUBJECT: **RADIOCHEMICAL DATA VALIDATION – GAMMA SPECTROSCOPY, THORIUM-232**
CTO 005 NDW INDIAN HEAD
SAMPLE DELIVERY GROUP (SDG) – F7A230254

SAMPLES: 18/Soil/

S01SB0200102	S01SB0210102	S01SB0280302
S01SB0290202	S01SB0300302	S01SB0310102
S01SB0320202	S01SB0330102	S01SB0340102
S01SB0350102	S01SB0360102	S01SB0370102
S01SB0380202	S01SB0390102	S01SB0400202
S01SB0410102	S01SBDUP0102	S01SBDUP0202

Overview

The sample set for NDW Indian Head, CTO 005, SDG F7A230254, consists of eighteen (18) soil environmental samples. Two (2) field duplicate pairs (S01SB0390102 / S01SBDUP0102 and S01SB0370102 / S01SBDUP0202) are included within this SDG.

All samples with the exception of S01SB0200102 and S01SB0210102 were analyzed for Thorium-232 by alpha spectroscopy. Samples S01SB0200102 and S01SB0210102 were analyzed for gamma spectroscopy. The samples were collected on January 17, 2007 and analyzed by Severn Trent Laboratories under Naval Facilities Engineering Service Center (NFESC) Quality Assurance / Quality Control (QA/QC) criteria. Gamma spectroscopy analyses were conducted using Environmental Measurements Laboratory Procedures Manual (EML) method GA-01-R MOD. Thorium-232 analyses were conducted using EML method A-01-R MOD.

Summary

All analytes were successfully analyzed. The findings offered in this report are based upon a general review of all available data. The data review was based on data completeness, holding times, calibration data, laboratory method/preparation blanks, laboratory duplicate results, laboratory control sample (LCS) results, analytical yields, field duplicate results, detection limits and analyte quantitation.

Areas of concern with respect to data quality are listed below.

Minor Problems

- Field duplicate imprecision was noted for sample pair S01SB0390102 / S01SBDUP0102. The calculated mean difference was > 1.5 for Thorium-232. The positive results reported in the affected samples were qualified as estimated, "J".

Notes

Sample results with a total uncertainty greater than the result were qualified with a "U".

Executive Summary

Laboratory Performance: None.

Other Factors Affecting Data Quality: Field duplicate imprecision was noted for sample pair S01SB0390102 / S01SBDUP0102.

The data for these analyses were reviewed with reference to the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories " (January 2006).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the DoD QSM and the Quality Assurance Project Plan (QAPP)."

Terri L. Solomon

Tetra Tech NUS
Terri L. Solomon
Environmental Scientist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C - Support Documentation

Data Qualifier Key:

J - Positive result is considered estimated, "J", as a result of conflicting technical noncompliances.

APPENDIX A
QUALIFIED ANALYTICAL RESULTS

PROJ_NO: 2144

SDG: F7A230254 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0200102
samp_date	1/17/2007
lab_id	F7A230254001
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ACTINIUM-228	12		
BISMUTH-212	8.7		
BISMUTH-214	0.96		
LEAD-212	13.1		
LEAD-214	0.84		
POTASSIUM-40	8.4		
RADIUM-226	0.96		
THALLIUM-208	4.84		
THORIUM-234	1.5	U	

nsample	S01SB0210102
samp_date	1/17/2007
lab_id	F7A230254002
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ACTINIUM-228	12.5		
BISMUTH-212	9.3		
BISMUTH-214	0.6		
LEAD-210	-0.8	U	
LEAD-212	13.8		
LEAD-214	0.57		
POTASSIUM-40	6.3		
RADIUM-226	0.6		
THALLIUM-208	4.9		
THORIUM-234	1.2	U	

nsample	S01SB0280302
samp_date	1/17/2007
lab_id	F7A230254003
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	0.42		

PROJ_NO: 2144

SDG: F7A230254 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0290202	nsample	S01SB0300302	nsample	S01SB0310102
samp_date	1/17/2007	samp_date	1/17/2007	samp_date	1/17/2007
lab_id	F7A230254004	lab_id	F7A230254005	lab_id	F7A230254006
qc_type	NM	qc_type	NM	qc_type	NM
units	PCI/G	units	PCI/G	units	PCI/G
Pct_Solids		Pct_Solids		Pct_Solids	
DUP_OF:		DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	0.7		

Parameter	Result	Val Qual	Qual Code
THORIUM	0.68		

Parameter	Result	Val Qual	Qual Code
THORIUM	3.53		

PROJ_NO: 2144

SDG: F7A230254 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0320202
samp_date	1/17/2007
lab_id	F7A230254007REA
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	28.4		

nsample	S01SB0330102
samp_date	1/17/2007
lab_id	F7A230254008
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	1.79		

nsample	S01SB0340102
samp_date	1/17/2007
lab_id	F7A230254009
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	0.61		

PROJ_NO: 2144

SDG: F7A230254 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0350102
samp_date	1/17/2007
lab_id	F7A230254010
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	0.66		

nsample	S01SB0360102
samp_date	1/17/2007
lab_id	F7A230254011
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	0.96		

nsample	S01SB0370102
samp_date	1/17/2007
lab_id	F7A230254012
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	1.06		

PROJ_NO: 2144

SDG: F7A230254 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0380202
samp_date	1/17/2007
lab_id	F7A230254014
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	0.68		

nsample	S01SB0390102
samp_date	1/17/2007
lab_id	F7A230254015
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	1.56	J	G

nsample	S01SB0400202
samp_date	1/17/2007
lab_id	F7A230254016
qc_type	NM
units	PCI/G
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
THORIUM	4.24		

PROJ_NO: 2144

SDG: F7A230254 MEDIA: SOIL DATA FRACTION: RAD

nsample	S01SB0410102	nsample	S01SBDUP0102	nsample	S01SBDUP0202
samp_date	1/17/2007	samp_date	1/17/2007	samp_date	1/17/2007
lab_id	F7A230254018	lab_id	F7A230254017	lab_id	F7A230254013
qc_type	NM	qc_type	NM	qc_type	NM
units	PCI/G	units	PCI/G	units	PCI/G
Pct_Solids		Pct_Solids		Pct_Solids	
DUP_OF:		DUP_OF:	S01SB0390102	DUP_OF:	S01SB0370102

Parameter	Result	Val Qual	Qual Code
THORIUM	0.72		

Parameter	Result	Val Qual	Qual Code
THORIUM	3.67	J	G

Parameter	Result	Val Qual	Qual Code
THORIUM	0.66		

APPENDIX F

COORDINATES FOR SAMPLED LOCATIONS

TABLE F-1
COORDINATES[1] FOR SAMPLED LOCATIONS

SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

REFERENCE AREA SAMPLES

Sample Location	Northing	Easting
R01SB001	341597.8	1263954.9
R01SB002	341541.3	1263983.4
R01SB003	341575.5	1263946.9
R01SB004	341603.0	1263943.4
R01SB004	341603.0	1263943.4
R01SB005	341536.1	1263955.4
R01SB006	341550.1	1263937.7
R01SB007	341530.4	1263955.5
R01SB008	341553.4	1263929.6
R01SB008	341553.4	1263929.6
R01SB009	341606.9	1263951.8
R01SB010	341594.8	1263950.7
R01SB011	341543.6	1263940.3
R01SB012	341562.4	1263940.6
R01SB013	341552.3	1263956.5
R01SB014	341599.1	1263982.6
R01SB015	341549.3	1263950.1
R01SB016	341571.3	1263980.5
R01SB016	341571.3	1263980.5
R01SB017	341539.0	1263977.1
R01SB018	341550.7	1263932.9
R01SB019	341537.4	1263942.1
R01SB020	341534.9	1263967.7
R01SB020	341534.9	1263967.7
R01SB021	341594.5	1263943.9
R01SB022	341601.9	1263968.9
R01SB023	341544.7	1263971.0
R01SB024	341524.2	1263967.6
R01SB025	341564.1	1263975.2
R01SB026	341553.5	1263944.7
R01SB027	341565.8	1263937.6

(1) Coordinates based on Maryland State Plane Coordinate System [North American Datum (NAD 1983]

SITE 1 SAMPLES

Sample Location	Northing	Easting
S01SB001	336346.1	1258268.1
S01SB002	336376.4	1258310.1
S01SB003	336343.2	1258289.1
S01SB004	336363.0	1258335.8
S01SB005	336374.0	1258291.4
S01SB006	336353.9	1258328.4
S01SB007	336322.4	1258305.3
S01SB008	336350.9	1258297.6
S01SB009	336350.7	1258319.9
S01SB009	336350.7	1258319.9
S01SB010	336374.1	1258309.1
S01SB011	336383.5	1258327.2
S01SB012	336338.1	1258312.5
S01SB013	336361.2	1258318.3
S01SB014	336375.9	1258345.6
S01SB014	336375.9	1258345.6
S01SB015	336387.0	1258304.8
S01SB016	336355.6	1258301.3
S01SB017	336325.7	1258275.2
S01SB018	336347.0	1258321.9
S01SB019	336341.3	1258307.7
S01SB020	336374.6	1258327.6
S01SB020	336374.6	1258327.6
S01SB021	336369.6	1258323.8
S01SB021	336369.6	1258323.8
S01SB022	336387.3	1258285.6
S01SB023	336382.0	1258318.6
S01SB023	336382.0	1258318.6
S01SB024	336364.5	1258274.6
S01SB025	336370.0	1258308.4
S01SB025	336370.0	1258308.4
S01SB026	336360.3	1258316.2
S01SB027	336316.8	1258305.8
S01SB028	336355.2	1258311.1
S01SB029	336388.4	1258293.8
S01SB030	336396.9	1258298.8
S01SB031	336390.9	1258308.5
S01SB032	336385.8	1258321.6
S01SB033	336396.3	1258334.4
S01SB034	336381.6	1258338.0
S01SB035	336422.3	1258298.7
S01SB036	336410.9	1258318.9
S01SB037	336402.3	1258343.7
S01SB037	336402.3	1258343.7
S01SB038	336433.3	1258316.5
S01SB039	336425.6	1258329.8
S01SB039	336425.6	1258329.8
S01SB040	336417.7	1258343.9
S01SB041	336434.4	1258336.6

APPENDIX G

WILCOXON RANK SUM ANALYSIS

WILCOXON RANK SUM ANALYSIS

SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

Sample Source		Thorium - 232 Concentration pCi/g	Adjusted Concentration pCi/g	Rank	Adjusted Rank for Reference Area Samples	Adjusted Rank for Site Samples	t
S01SB019	SITE	0.42	0.42	1		1.5	
S01SB028	SITE	0.42	0.42	2		1.5	2
S01SB016	SITE	0.47	0.47	3		3	
S01SB007	SITE	0.5	0.5	4		4	
S01SB017	SITE	0.51	0.51	5		5	
S01SB001	SITE	0.52	0.52	6		7	
S01SB026	SITE	0.52	0.52	7		7	3
S01SB027	SITE	0.52	0.52	8		7	
S01SB015	SITE	0.53	0.53	9		9	
S01SB004	SITE	0.57	0.57	10		10	
S01SB010	SITE	0.58	0.58	11		12	
S01SB018	SITE	0.58	0.58	12		12	3
S01SB022	SITE	0.58	0.58	13		12	
S01SB005	SITE	0.59	0.59	14		14	
S01SB006	SITE	0.6	0.6	15		16	
S01SB009	SITE	0.6	0.6	16		16	3
S01SB012	SITE	0.6	0.6	17		16	
S01SB034	SITE	0.61	0.61	18		18	
S01SB002	SITE	0.62	0.62	19		20	
S01SB024	SITE	0.62	0.62	20		20	3
S01SB025	SITE	0.62	0.62	21		20	
S01SB003	SITE	0.64	0.64	22		22.5	
S01SB020	SITE	0.64	0.64	23		22.5	2
S01SB008	SITE	0.66	0.66	24		25.5	
S01SB021	SITE	0.66	0.66	25		25.5	3
S01SB035	SITE	0.66	0.66	26		25.5	
S01SB013	SITE	0.68	0.68	27		28	
S01SB030	SITE	0.68	0.68	28		28	3
S01SB038	SITE	0.68	0.68	29		28	
S01SB029	SITE	0.7	0.7	30		30	
S01SB041	SITE	0.72	0.72	31		31	
S01SB036	SITE	0.96	0.96	32		32	
S01SB033	SITE	1.79	1.79	33		33	
R01SB013	REF	0.94	1.94	34	34		
R01SB003	REF	0.99	1.99	35	36		
R01SB009	REF	0.99	1.99	36	36		3
R01SB019	REF	0.99	1.99	37	36		
R01SB006	REF	1.02	2.02	38	38.5		
R01SB011	REF	1.02	2.02	39	38.5		2
R01SB024	REF	1.05	2.05	40	40		
R01SB010	REF	1.06	2.06	41	41.5		
S01SB037	SITE	1.06	2.06	42		41.5	2
R01SB007	REF	1.08	2.08	43	43		
R01SB016	REF	1.1	2.1	44	44		
R01SB025	REF	1.14	2.14	45	45		
R01SB001	REF	1.17	2.17	46	46.5		
R01SB002	REF	1.17	2.17	47	46.5		2
R01SB018	REF	1.18	2.18	48	48.5		
R01SB022	REF	1.18	2.18	49	48.5		2
R01SB012	REF	1.23	2.23	50	50.5		
R01SB021	REF	1.23	2.23	51	50.5		2
R01SB014	REF	1.24	2.24	52	52.5		
R01SB015	REF	1.24	2.24	53	52.5		2
R01SB005	REF	1.25	2.25	54	54.5		
R01SB008	REF	1.25	2.25	55	54.5		2
R01SB017	REF	1.28	2.28	56	57		
R01SB023	REF	1.28	2.28	57	57		3
R01SB026	REF	1.28	2.28	58	57		
R01SB027	REF	1.3	2.3	59	59		
R01SB020	REF	1.32	2.32	60	60		
S01SB031	SITE	3.53	3.53	61		61	
S01SB039	SITE	3.67	3.67	62		62	
R01SB004	REF	3.1	4.1	63	63		
S01SB040	SITE	4.24	4.24	64		64	
S01SB011	SITE	4.57	4.57	65		65	
S01SB023	SITE	14.3	14.3	66		66	
S01SB014	SITE	16.5	16.5	67		67	
S01SB032	SITE	28.4	28.4	68		68	
				RANK SUM>>	**1290.5**	**1057**	

First Round and Second Round Sampling

WILCOXON RANK SUM ANALYSIS

SITE 1 - THORIUM SPILL
NSF-IH, INDIAN HEAD, MARYLAND

. VALUE = $$m(n+m+1)\frac{1}{2}+z\sqrt{\frac{nm}{12}[(n+m+1)-\sum_{j=1}^{g}\frac{t_j(t_j^2-1)}{(n+m)(n+m-1}]}$$

Where: g = the number of data groups of tied measurements.
t_j = the number of tied measurements in the jth group.
z = the (1-α) percentile of a standard norman distribution = 1.645 for α = 0.05

n = # of site samples = 41
m = # of background samples = 27
N = # of total samples n + m = 68

$$m(n+m+1)\frac{1}{2} = 918$$

$$z = 1.645$$

$$\frac{nm}{12} = 90$$

$$n+m+1 = 68.00$$

$$\sum_{j=1}^{g}\frac{t_j(t_j^2-1)}{(n+m)(n+m-1}] = 0.05481$$

$$918+1.645\sqrt{(90)[(68)-0.05481]} = 1046.64$$

CRITICAL VALUE = 1046.64

REFERENCE AREA RANK SUM = 1291.5 > CRITICAL VALUE = 1046.64

THE NULL HYPOTHESIS IS REJECTED.

t	$\frac{t_j(t_j^2-1)}{(n+m)(n+m-1}$
2	0.00134
3	0.00535
3	0.00535
3	0.00535
3	0.00535
2	0.00134
3	0.00535
3	0.00535
3	0.00535
2	0.00134
2	0.00134
2	0.00134
2	0.00134
2	0.00134
2	0.00134
2	0.00134
3	0.00535
∑=	0.05481

APPENDIX H

RESRAD MODELING RUNS

APPENDIX H.1

RESRAD MODELING RUN

DCGL = 1 pCi/g

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(1)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(2)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(1)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(2)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(3)
D-34	Food transfer factors:			
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(2,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(1,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(1,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(2,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(2,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(3,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(3,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.525E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Th-232	1.000E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.376E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions	
Area:	752.49 square meters
Thickness:	0.15 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g	
Th-232	1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.942E-01	9.035E-01	1.983E+00	4.636E+00	5.792E+00	3.466E+00	0.000E+00	0.000E+00
M(t):	1.577E-02	3.614E-02	7.932E-02	1.854E-01	2.317E-01	1.386E-01	0.000E+00	0.000E+00

Maximum TDOSE(t): 5.826E+00 mrem/yr at t = 25.44 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	5.237E+00	0.8989	7.714E-02	0.0132	0.000E+00	0.0000	4.357E-01	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	7.608E-02	0.013
Total	5.237E+00	0.8989	7.714E-02	0.0132	0.000E+00	0.0000	4.357E-01	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	7.608E-02	0.013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.826E+00	1.00(
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.826E+00	1.00(

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.925E-01	0.4884	8.008E-02	0.2032	0.000E+00	0.0000	6.373E-02	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	5.785E-02	0.146
Total	1.925E-01	0.4884	8.008E-02	0.2032	0.000E+00	0.0000	6.373E-02	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	5.785E-02	0.146

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.942E-01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.942E-01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	6.337E-01	0.7015	8.011E-02	0.0887	0.000E+00	0.0000	1.286E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	6.105E-02	0.067
Total	6.337E-01	0.7015	8.011E-02	0.0887	0.000E+00	0.0000	1.286E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	6.105E-02	0.067

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.035E-01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.035E-01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.605E+00	0.8093	8.093E-02	0.0408	0.000E+00	0.0000	2.305E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	6.686E-02	0.033
Total	1.605E+00	0.8093	8.093E-02	0.0408	0.000E+00	0.0000	2.305E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	6.686E-02	0.033

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.983E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.983E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	4.072E+00	0.8784	8.303E-02	0.0179	0.000E+00	0.0000	4.026E-01	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	7.791E-02	0.016
Total	4.072E+00	0.8784	8.303E-02	0.0179	0.000E+00	0.0000	4.026E-01	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	7.791E-02	0.016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.636E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.636E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	5.220E+00	0.9013	7.447E-02	0.0129	0.000E+00	0.0000	4.236E-01	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	7.362E-02	0.012
Total	5.220E+00	0.9013	7.447E-02	0.0129	0.000E+00	0.0000	4.236E-01	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	7.362E-02	0.012

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.792E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.792E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	3.228E+00	0.9313	3.084E-02	0.0089	0.000E+00	0.0000	1.767E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	3.057E-02	0.008
Total	3.228E+00	0.9313	3.084E-02	0.0089	0.000E+00	0.0000	1.767E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	3.057E-02	0.008

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.466E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.466E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00(
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00(

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.662E-01	1.650E-01	1.628E-01	1.550E-01	1.327E-01	5.496E-02	0.000E+00	0.000E+00
Th-232	Ra-228+D	1.000E+00	1.985E-01	5.601E-01	1.131E+00	2.138E+00	2.452E+00	1.451E+00	0.000E+00	1.586E-31
Th-232	Th-228+D	1.000E+00	2.953E-02	1.783E-01	6.890E-01	2.343E+00	3.207E+00	1.960E+00	0.000E+00	2.389E-34
Th-232	∑DSR(j)		3.942E-01	9.035E-01	1.983E+00	4.636E+00	5.792E+00	3.466E+00	0.000E+00	1.589E-31

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	6.343E+01	2.767E+01	1.261E+01	5.393E+00	4.316E+00	7.212E+00	*1.097E+05	*1.097E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 25.44 ± 0.05 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Th-232	1.000E+00	25.44 ± 0.05	5.826E+00	4.291E+00	5.826E+00	4.291E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.662E-01	1.650E-01	1.628E-01	1.550E-01	1.327E-01	5.496E-02	0.000E+00	0.000E+00
Ra-228	Th-232	1.000E+00	1.985E-01	5.601E-01	1.131E+00	2.138E+00	2.452E+00	1.451E+00	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	2.953E-02	1.783E-01	6.890E-01	2.343E+00	3.207E+00	1.960E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.000E+00	1.000E+00	9.999E-01	9.996E-01	9.989E-01	9.963E-01	9.890E-01	9.636E-01
Ra-228	Th-232	1.000E+00	0.000E+00	1.118E-01	2.903E-01	6.190E-01	7.831E-01	7.893E-01	7.835E-01	7.634E-01
Th-228	Th-232	1.000E+00	0.000E+00	1.845E-02	1.204E-01	5.091E-01	7.772E-01	7.893E-01	7.835E-01	7.634E-01

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.97 seconds

APPENDIX H.2

RESRAD MODELING RUN
DCGL = 2 pCi/g

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(1)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(2)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(1)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(2)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(3)
D-34	Food transfer factors:			
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(2,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(1,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(1,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(2,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(2,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(3,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(3,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.525E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Th-232	2.000E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.376E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions	
Area:	752.49 square meters
Thickness:	0.15 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g	
Th-232	2.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	7.883E-01	1.807E+00	3.966E+00	9.272E+00	1.158E+01	6.932E+00	0.000E+00	0.000E+00
M(t):	3.153E-02	7.228E-02	1.586E-01	3.709E-01	4.634E-01	2.773E-01	0.000E+00	0.000E+00

Maximum TDOSE(t): 1.165E+01 mrem/yr at t = 25.44 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.047E+01	0.8989	1.543E-01	0.0132	0.000E+00	0.0000	8.714E-01	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	1.522E-01	0.013
Total	1.047E+01	0.8989	1.543E-01	0.0132	0.000E+00	0.0000	8.714E-01	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	1.522E-01	0.013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.165E+01	1.00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.165E+01	1.00

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	3.850E-01	0.4884	1.602E-01	0.2032	0.000E+00	0.0000	1.275E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	1.157E-01	0.146
Total	3.850E-01	0.4884	1.602E-01	0.2032	0.000E+00	0.0000	1.275E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	1.157E-01	0.146

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.883E-01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.883E-01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.267E+00	0.7015	1.602E-01	0.0887	0.000E+00	0.0000	2.571E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	1.221E-01	0.067
Total	1.267E+00	0.7015	1.602E-01	0.0887	0.000E+00	0.0000	2.571E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	1.221E-01	0.067

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.807E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.807E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	3.210E+00	0.8093	1.619E-01	0.0408	0.000E+00	0.0000	4.609E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	1.337E-01	0.033
Total	3.210E+00	0.8093	1.619E-01	0.0408	0.000E+00	0.0000	4.609E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	1.337E-01	0.033

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.966E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.966E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	8.145E+00	0.8784	1.661E-01	0.0179	0.000E+00	0.0000	8.051E-01	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	1.558E-01	0.016
Total	8.145E+00	0.8784	1.661E-01	0.0179	0.000E+00	0.0000	8.051E-01	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	1.558E-01	0.016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.272E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.272E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.044E+01	0.9013	1.489E-01	0.0129	0.000E+00	0.0000	8.472E-01	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	1.472E-01	0.012
Total	1.044E+01	0.9013	1.489E-01	0.0129	0.000E+00	0.0000	8.472E-01	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	1.472E-01	0.012

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.158E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.158E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	6.456E+00	0.9313	6.168E-02	0.0089	0.000E+00	0.0000	3.534E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	6.113E-02	0.008
Total	6.456E+00	0.9313	6.168E-02	0.0089	0.000E+00	0.0000	3.534E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	6.113E-02	0.008

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.932E+00	1.00(
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.932E+00	1.00(

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.662E-01	1.650E-01	1.628E-01	1.550E-01	1.327E-01	5.496E-02	0.000E+00	0.000E+00
Th-232	Ra-228+D	1.000E+00	1.985E-01	5.601E-01	1.131E+00	2.138E+00	2.452E+00	1.451E+00	0.000E+00	1.586E-31
Th-232	Th-228+D	1.000E+00	2.953E-02	1.783E-01	6.890E-01	2.343E+00	3.207E+00	1.960E+00	0.000E+00	2.389E-34
Th-232	∑DSR(j)		3.942E-01	9.035E-01	1.983E+00	4.636E+00	5.792E+00	3.466E+00	0.000E+00	1.589E-31

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	6.343E+01	2.767E+01	1.261E+01	5.393E+00	4.316E+00	7.212E+00	*1.097E+05	*1.097E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 25.44 ± 0.05 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Th-232	2.000E+00	25.44 ± 0.05	5.826E+00	4.291E+00	5.826E+00	4.291E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	3.323E-01	3.301E-01	3.256E-01	3.100E-01	2.654E-01	1.099E-01	0.000E+00	0.000E+00
Ra-228	Th-232	1.000E+00	3.969E-01	1.120E+00	2.262E+00	4.275E+00	4.904E+00	2.902E+00	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	5.906E-02	3.567E-01	1.378E+00	4.686E+00	6.414E+00	3.921E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	2.000E+00	2.000E+00	2.000E+00	1.999E+00	1.998E+00	1.993E+00	1.978E+00	1.927E+00
Ra-228	Th-232	1.000E+00	0.000E+00	2.236E-01	5.806E-01	1.238E+00	1.566E+00	1.579E+00	1.567E+00	1.527E+00
Th-228	Th-232	1.000E+00	0.000E+00	3.689E-02	2.408E-01	1.018E+00	1.554E+00	1.579E+00	1.567E+00	1.527E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 1.02 seconds

APPENDIX H.3

RESRAD MODELING RUN

DCGL = 3 pCi/g

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(1)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(2)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(1)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(2)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(3)
D-34	Food transfer factors:			
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(2,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(1,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(1,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(2,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(2,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(3,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(3,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.525E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Th-232	3.000E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.376E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions	
Area:	752.49 square meters
Thickness:	0.15 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g	
Th-232	3.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.182E+00	2.710E+00	5.949E+00	1.391E+01	1.738E+01	1.040E+01	0.000E+00	0.000E+00
M(t):	4.730E-02	1.084E-01	2.380E-01	5.563E-01	6.950E-01	4.159E-01	0.000E+00	0.000E+00

Maximum TDOSE(t): 1.748E+01 mrem/yr at t = 25.44 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.571E+01	0.8989	2.314E-01	0.0132	0.000E+00	0.0000	1.307E+00	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	2.282E-01	0.013
Total	1.571E+01	0.8989	2.314E-01	0.0132	0.000E+00	0.0000	1.307E+00	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	2.282E-01	0.013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.748E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.748E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	5.775E-01	0.4884	2.402E-01	0.2032	0.000E+00	0.0000	1.912E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	1.735E-01	0.146
Total	5.775E-01	0.4884	2.402E-01	0.2032	0.000E+00	0.0000	1.912E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	1.735E-01	0.146

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.182E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.182E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.901E+00	0.7015	2.403E-01	0.0887	0.000E+00	0.0000	3.857E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	1.831E-01	0.067
Total	1.901E+00	0.7015	2.403E-01	0.0887	0.000E+00	0.0000	3.857E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	1.831E-01	0.067

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.710E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.710E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	4.814E+00	0.8093	2.428E-01	0.0408	0.000E+00	0.0000	6.914E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	2.006E-01	0.033
Total	4.814E+00	0.8093	2.428E-01	0.0408	0.000E+00	0.0000	6.914E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	2.006E-01	0.033

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.949E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.949E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.222E+01	0.8784	2.491E-01	0.0179	0.000E+00	0.0000	1.208E+00	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	2.337E-01	0.016
Total	1.222E+01	0.8784	2.491E-01	0.0179	0.000E+00	0.0000	1.208E+00	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	2.337E-01	0.016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.391E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.391E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.566E+01	0.9013	2.234E-01	0.0129	0.000E+00	0.0000	1.271E+00	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	2.209E-01	0.012
Total	1.566E+01	0.9013	2.234E-01	0.0129	0.000E+00	0.0000	1.271E+00	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	2.209E-01	0.012

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.738E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.738E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	9.684E+00	0.9313	9.253E-02	0.0089	0.000E+00	0.0000	5.301E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	9.170E-02	0.008
Total	9.684E+00	0.9313	9.253E-02	0.0089	0.000E+00	0.0000	5.301E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	9.170E-02	0.008

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.040E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.040E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.662E-01	1.650E-01	1.628E-01	1.550E-01	1.327E-01	5.496E-02	0.000E+00	0.000E+00
Th-232	Ra-228+D	1.000E+00	1.985E-01	5.601E-01	1.131E+00	2.138E+00	2.452E+00	1.451E+00	0.000E+00	1.586E-31
Th-232	Th-228+D	1.000E+00	2.953E-02	1.783E-01	6.890E-01	2.343E+00	3.207E+00	1.960E+00	0.000E+00	2.389E-34
Th-232	∑DSR(j)		3.942E-01	9.035E-01	1.983E+00	4.636E+00	5.792E+00	3.466E+00	0.000E+00	1.589E-31

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	6.343E+01	2.767E+01	1.261E+01	5.393E+00	4.316E+00	7.212E+00	*1.097E+05	*1.097E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 25.44 ± 0.05 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Th-232	3.000E+00	25.44 ± 0.05	5.826E+00	4.291E+00	5.826E+00	4.291E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	4.985E-01	4.951E-01	4.884E-01	4.650E-01	3.982E-01	1.649E-01	0.000E+00	0.000E+00
Ra-228	Th-232	1.000E+00	5.954E-01	1.680E+00	3.394E+00	6.413E+00	7.356E+00	4.353E+00	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	8.859E-02	5.350E-01	2.067E+00	7.029E+00	9.622E+00	5.881E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	3.000E+00	3.000E+00	3.000E+00	2.999E+00	2.997E+00	2.989E+00	2.967E+00	2.891E+00
Ra-228	Th-232	1.000E+00	0.000E+00	3.355E-01	8.709E-01	1.857E+00	2.349E+00	2.368E+00	2.350E+00	2.290E+00
Th-228	Th-232	1.000E+00	0.000E+00	5.534E-02	3.612E-01	1.527E+00	2.332E+00	2.368E+00	2.350E+00	2.290E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 1.10 seconds

APPENDIX H.4

RESRAD MODELING RUN
DCGL = 4 pCi/g

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(1)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(2)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(1)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(2)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(3)
D-34	Food transfer factors:			
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(2,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(1,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(1,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(2,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(2,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(3,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(3,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.525E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Th-232	4.000E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.376E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions

Area:	752.49 square meters
Thickness:	0.15 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Th-232	4.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.577E+00	3.614E+00	7.932E+00	1.854E+01	2.317E+01	1.386E+01	0.000E+00	0.000E+00
M(t):	6.306E-02	1.446E-01	3.173E-01	7.417E-01	9.267E-01	5.546E-01	0.000E+00	0.000E+00

Maximum TDOSE(t): 2.330E+01 mrem/yr at t = 25.44 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	2.095E+01	0.8989	3.086E-01	0.0132	0.000E+00	0.0000	1.743E+00	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	3.043E-01	0.013
Total	2.095E+01	0.8989	3.086E-01	0.0132	0.000E+00	0.0000	1.743E+00	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	3.043E-01	0.013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.330E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.330E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	7.700E-01	0.4884	3.203E-01	0.2032	0.000E+00	0.0000	2.549E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	2.314E-01	0.146
Total	7.700E-01	0.4884	3.203E-01	0.2032	0.000E+00	0.0000	2.549E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	2.314E-01	0.146

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.577E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.577E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	2.535E+00	0.7015	3.205E-01	0.0887	0.000E+00	0.0000	5.142E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	2.442E-01	0.067
Total	2.535E+00	0.7015	3.205E-01	0.0887	0.000E+00	0.0000	5.142E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	2.442E-01	0.067

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.614E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.614E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	6.419E+00	0.8093	3.237E-01	0.0408	0.000E+00	0.0000	9.219E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	2.674E-01	0.033
Total	6.419E+00	0.8093	3.237E-01	0.0408	0.000E+00	0.0000	9.219E-01	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	2.674E-01	0.033

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.932E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.932E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.629E+01	0.8784	3.321E-01	0.0179	0.000E+00	0.0000	1.610E+00	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	3.116E-01	0.016
Total	1.629E+01	0.8784	3.321E-01	0.0179	0.000E+00	0.0000	1.610E+00	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	3.116E-01	0.016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.854E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.854E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	2.088E+01	0.9013	2.979E-01	0.0129	0.000E+00	0.0000	1.694E+00	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	2.945E-01	0.012
Total	2.088E+01	0.9013	2.979E-01	0.0129	0.000E+00	0.0000	1.694E+00	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	2.945E-01	0.012

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.317E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.317E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.291E+01	0.9313	1.234E-01	0.0089	0.000E+00	0.0000	7.069E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	1.223E-01	0.008
Total	1.291E+01	0.9313	1.234E-01	0.0089	0.000E+00	0.0000	7.069E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	1.223E-01	0.008

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.386E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.386E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.662E-01	1.650E-01	1.628E-01	1.550E-01	1.327E-01	5.496E-02	0.000E+00	0.000E+00
Th-232	Ra-228+D	1.000E+00	1.985E-01	5.601E-01	1.131E+00	2.138E+00	2.452E+00	1.451E+00	0.000E+00	1.586E-31
Th-232	Th-228+D	1.000E+00	2.953E-02	1.783E-01	6.890E-01	2.343E+00	3.207E+00	1.960E+00	0.000E+00	2.389E-34
Th-232	∑DSR(j)		3.942E-01	9.035E-01	1.983E+00	4.636E+00	5.792E+00	3.466E+00	0.000E+00	1.589E-31

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	6.343E+01	2.767E+01	1.261E+01	5.393E+00	4.316E+00	7.212E+00	*1.097E+05	*1.097E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 25.44 ± 0.05 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Th-232	4.000E+00	25.44 ± 0.05	5.826E+00	4.291E+00	5.826E+00	4.291E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	6.646E-01	6.602E-01	6.512E-01	6.200E-01	5.309E-01	2.198E-01	0.000E+00	0.000E+00
Ra-228	Th-232	1.000E+00	7.939E-01	2.240E+00	4.525E+00	8.551E+00	9.808E+00	5.803E+00	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	1.181E-01	7.134E-01	2.756E+00	9.372E+00	1.283E+01	7.842E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	4.000E+00	4.000E+00	4.000E+00	3.999E+00	3.996E+00	3.985E+00	3.956E+00	3.855E+00
Ra-228	Th-232	1.000E+00	0.000E+00	4.473E-01	1.161E+00	2.476E+00	3.132E+00	3.157E+00	3.134E+00	3.054E+00
Th-228	Th-232	1.000E+00	0.000E+00	7.379E-02	4.816E-01	2.036E+00	3.109E+00	3.157E+00	3.134E+00	3.054E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.99 seconds

APPENDIX H.5

RESRAD MODELING RUN

DCGL = 5 pCi/g

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(1)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(2)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(1)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(2)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(3)
D-34	Food transfer factors:			
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(2,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(1,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(1,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(2,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(2,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(3,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(3,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.525E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Th-232	5.000E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.376E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions	
Area:	752.49 square meters
Thickness:	0.15 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g	
Th-232	5.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.971E+00	4.517E+00	9.915E+00	2.318E+01	2.896E+01	1.733E+01	0.000E+00	0.000E+00
M(t):	7.883E-02	1.807E-01	3.966E-01	9.272E-01	1.158E+00	6.932E-01	0.000E+00	0.000E+00

Maximum TDOSE(t): 2.913E+01 mrem/yr at t = 25.44 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	2.618E+01	0.8989	3.857E-01	0.0132	0.000E+00	0.0000	2.179E+00	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	3.804E-01	0.013
Total	2.618E+01	0.8989	3.857E-01	0.0132	0.000E+00	0.0000	2.179E+00	0.0748	0.000E+00	0.0000	0.000E+00	0.0000	3.804E-01	0.013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.544E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.913E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.913E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	9.625E-01	0.4884	4.004E-01	0.2032	0.000E+00	0.0000	3.187E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	2.892E-01	0.146
Total	9.625E-01	0.4884	4.004E-01	0.2032	0.000E+00	0.0000	3.187E-01	0.1617	0.000E+00	0.0000	0.000E+00	0.0000	2.892E-01	0.146

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.971E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.971E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	3.169E+00	0.7015	4.006E-01	0.0887	0.000E+00	0.0000	6.428E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	3.052E-01	0.067
Total	3.169E+00	0.7015	4.006E-01	0.0887	0.000E+00	0.0000	6.428E-01	0.1423	0.000E+00	0.0000	0.000E+00	0.0000	3.052E-01	0.067

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.517E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.517E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	8.024E+00	0.8093	4.046E-01	0.0408	0.000E+00	0.0000	1.152E+00	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	3.343E-01	0.033
Total	8.024E+00	0.8093	4.046E-01	0.0408	0.000E+00	0.0000	1.152E+00	0.1162	0.000E+00	0.0000	0.000E+00	0.0000	3.343E-01	0.033

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.915E+00	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.915E+00	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	2.036E+01	0.8784	4.151E-01	0.0179	0.000E+00	0.0000	2.013E+00	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	3.895E-01	0.016
Total	2.036E+01	0.8784	4.151E-01	0.0179	0.000E+00	0.0000	2.013E+00	0.0868	0.000E+00	0.0000	0.000E+00	0.0000	3.895E-01	0.016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.318E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.318E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	2.610E+01	0.9013	3.724E-01	0.0129	0.000E+00	0.0000	2.118E+00	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	3.681E-01	0.012
Total	2.610E+01	0.9013	3.724E-01	0.0129	0.000E+00	0.0000	2.118E+00	0.0731	0.000E+00	0.0000	0.000E+00	0.0000	3.681E-01	0.012

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.896E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.896E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	1.614E+01	0.9313	1.542E-01	0.0089	0.000E+00	0.0000	8.836E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	1.528E-01	0.008
Total	1.614E+01	0.9313	1.542E-01	0.0089	0.000E+00	0.0000	8.836E-01	0.0510	0.000E+00	0.0000	0.000E+00	0.0000	1.528E-01	0.008

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.733E+01	1.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.733E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	1.662E-01	1.650E-01	1.628E-01	1.550E-01	1.327E-01	5.496E-02	0.000E+00	0.000E+00
Th-232	Ra-228+D	1.000E+00	1.985E-01	5.601E-01	1.131E+00	2.138E+00	2.452E+00	1.451E+00	0.000E+00	1.586E-31
Th-232	Th-228+D	1.000E+00	2.953E-02	1.783E-01	6.890E-01	2.343E+00	3.207E+00	1.960E+00	0.000E+00	2.389E-34
Th-232	∑DSR(j)		3.942E-01	9.035E-01	1.983E+00	4.636E+00	5.792E+00	3.466E+00	0.000E+00	1.589E-31

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	6.343E+01	2.767E+01	1.261E+01	5.393E+00	4.316E+00	7.212E+00	*1.097E+05	*1.097E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 25.44 ± 0.05 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Th-232	5.000E+00	25.44 ± 0.05	5.826E+00	4.291E+00	5.826E+00	4.291E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	8.308E-01	8.252E-01	8.140E-01	7.750E-01	6.636E-01	2.748E-01	0.000E+00	0.000E+00
Ra-228	Th-232	1.000E+00	9.924E-01	2.800E+00	5.656E+00	1.069E+01	1.226E+01	7.254E+00	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	1.476E-01	8.917E-01	3.445E+00	1.172E+01	1.604E+01	9.802E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Th-232	Th-232	1.000E+00	5.000E+00	5.000E+00	4.999E+00	4.998E+00	4.994E+00	4.982E+00	4.945E+00	4.818E+00
Ra-228	Th-232	1.000E+00	0.000E+00	5.591E-01	1.452E+00	3.095E+00	3.916E+00	3.947E+00	3.917E+00	3.817E+00
Th-228	Th-232	1.000E+00	0.000E+00	9.223E-02	6.020E-01	2.546E+00	3.886E+00	3.947E+00	3.917E+00	3.817E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 1.14 seconds