SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY

RE: 0503-N

January 24, 2005

Fed Ex Tracking # 7921 8864 8219

U.S. Nuclear Regulatory Commission
ATTN: Mr. Myron Fliegel, Senior Project Manager
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
And Safeguards, NMSS
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

Subject: Sequoyah Fuels Corporation, Doçket – 40-8027
Response to Request For Additional Information – Reclamation Plan – Radiation Protection and Erosion Protection (TAC L52528)

Dear Mike,

Your letter dated 12/22/04 requested additional information on the Reclamation Plan with respect to radiation protection and erosion protection, or a schedule to provide the information, within 30 days of the date of the letter. Please find enclosed a partial response to your request. Several of the items require additional fieldwork or analyses requiring those items to be submitted separately.

RP1A – D are affected by changes to the cell design negotiated with the State of Oklahoma and the Cherokee Nation recently. Additionally, some fieldwork may be required to fully respond to your request. The changes will be incorporated into the model and new radon calculations will be submitted in April, 2005 with the information necessary to fully respond to these items.

Responses to RP2A and E will be developed in concert with the modeling RAIs on the Ground Water Corrective Action Plan due in March, 2005. Responses to both of these items and RP3A, D, and E will be submitted together in March.

SW7 and SW9 will be submitted in February. This information will be provided as an updated erosional stability document reflecting the current disposal cell design. It will compare the method used in Appendix C with Nelson's method in NRC Guidance (NUREG-1623).

NMSS01

If you have any questions, don't hesitate to call me at (918) 489-5511, ext. 14.

Sincerely,

John H. Ellis
President

Enclosure

XC: Elaine Brummett, NRC
Jill Caverly, NRC
Rita Ware, EPA
Alvin Gutterman, MLB
Julian Fite, CN
Jim Barwick, OAG
Saba Tahmassebi, ODEQ

Enclosure

Sequoyah Fuels Corporation
Reclamation Plan Review

Partial Response to Request for Additional Information

Sequoyah Fuels Corporation
Reclamation Plan Review
Request for Additional Information

Radiation Protection (RP)

RP1 Radon Barrier Design

The NRC staff reviewed the Reclamation Plan, revision 2 (February 2004), Section 3 "Facility Decommissioning and Surface Reclamation," and Appendix D, "Radon Emanation" of Appendix C. The latter contained four radon flux model outputs (calculated long-term flux estimates) to justify the cover design for radon attenuation. The most conservative model used the 10,000-year radium (Ra-226) value because thorium (Th-230) in-growth provides a higher value at that time than at the regulatory design period of 1000 years. Because of the minimal characterization data for some material, the conservative model used the 95 percent upper confidence-interval source term value. The resulting flux was 16.04 pCi/m2/s. The NRC staff modified this model by using 5-feet for layer D at 10 pCi/g Ra-226, layer B at 120 pCi/g, and a porosity of 0.46 for layers A-D and 0.44 for the cover. The resulting flux was over 40 pCi/m2/s.

Sequoyah Fuels Corporation (SFC) used a few very conservative assumptions, but other assumptions were not justified so the uncertainty cannot be assessed. If the responses to any of the comments below indicate that material volume (i.e., layer thickness in the cell) or activity estimates could be significantly impacted, a revised radon flux model should be provided to the NRC.

E BASIS: The SFC flux models assume that cover Ra-226 and Th-230 values are at background. Page 5-2 (Section 5.1.3) of the Reclamation Plan states that the borrow soils would have Ra-226 levels within 5 pCi/g of background values. Criterion 6 (5), Appendix A, to 10 CFR 40, requires background radiation levels in cover materials, so some demonstration of compliance will be needed.

REQUEST: SFC should commit to using only soils with radiation levels at background for cover materials, and indicate what measurements of U-nat, Ra-226, and Th-230 will be done for confirmation.

Response:

Section 5.1.3 will be modified as follows:

"The on-site borrow areas planned for disposal cell cover material have been chosen to provide the physical properties desired for the cover, including a moisture retention zone for evapotranspiration and material to attenuate emanating radon. These borrow areas have been selected to provide soils that are of similar radiological characteristics to native soils in the site area. ~~This means that borrow area soils would have a radium-226 activity concentration within 5 pCi/g of background values on site, analogous to site soil cleanup criteria for uranium mill sites in 40 CFR 192.~~"

The borrow areas are in unimpacted areas where knowledge of process, routine environmental sampling, and special surveys demonstrate that the radiological conditions are not distinguishable from background.

F BASIS: Appendix D, Attachment III, discusses depleted uranium. However, it is our understanding that any depleted uranium will be removed from the site.

REQUEST: SFC should indicate if any depleted uranium will be disposed on site.

Response:

SFC has never proposed to dispose of the DUF_4 slag onsite. In the discussion of depleted uranium in Appendix D, Attachment III, SFC states that this material is assumed to be removed from site prior to reclamation. The DUF_4 slag was not discussed in the Reclamation Plan as a waste destined to be disposed in the disposal cell. However, the reduction plant will be deconstructed and placed into the cell along with drummed trash collected from this facility. The building debris and trash do contain residual depleted uranium as surface contamination which will not be removed prior disposal in the cell. Both of these materials are included in Attachment III under items 6 and 13, and were intended to be disposed onsite.

G BASIS: In order for NRC to evaluate the accuracy and precision of the SFC soil characterization data and the reliability of the Status Survey Plan, we must review your soil procedures. Note that the procedures can be separate from the Reclamation Plan.

REQUEST: Provide the procedures for soil sampling, preparation, and radionuclide analysis.

Response:

The procedures for soil sampling during site characterization activities are described in Appendix A of both the Site Characterization Plan and RFI Workplan which are included with this response as Attachments 1 and 2. The soil was prepared for analysis by drying and grinding the soil sample, then acid leaching an aliquot of the prepared soil; these preparation techniques were carried out in accordance with laboratory-specific procedures. The references for the analytical methods used, are:

Total uranium:	ASTM D 5174, "Standard Test Method for Trace Uranium in Water by Pulsed-Laser Phosphorimetry", ASTM International.
Th-230:	NAS/DOE 3004/RP, "Isotopic Thorium by Alpha Spectroscopy", National Academy of Sciences, DOE Methods for Evaluating Environmental and Waste Management Samples.
Ra-226:	903.0, "Alpha-Emitting Radium Isotopes", U.S. Environmental Protection Agency, Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA 600/4-80-032.

Soil sampling for the final status survey will be conducted in accordance with SFC Environmental Department Instruction EDI-304, Soil and Sediment Sampling. This procedure employs a surface soil sampling technique equivalent to those in Attachments 1 and 2. Surface soil samples will be collected from 0.0 – 0.5 foot interval. Each sample will be collected by hand auger, mixed in a stainless steel bucket, an aliquot placed into a sample container, and labeled. Chain-of-custody will be conducted in accordance with Sequoyah Facility Operating Procedure G-108, Chain-of-Custody, which was in use during the characterization activity. The preparation and analysis of soil samples for the final status survey is described in the response to RP3 C.

RP2 Benchmark Dose Modeling and Cleanup Levels

The NRC staff reviewed the Reclamation Plan, revision 2 (February 2004), Section 3 "Facility Decommissioning and Surface Reclamation," and portions of Appendix D "Site Characterization Plan," and Appendix G, "Radium Benchmark Dose Calculations." SFC used a resident farmer scenario to model (calculate) the radium benchmark dose as the first step to derive cleanup limits for uranium (U-nat) and thorium (Th-230), according to Criterion 6(6) of Appendix A to Part 40.

B BASIS: Page 2 of Appendix G states that the disposal cell may (emphasis added) be designed to yield an exposure rate comparable to background. Criterion 6(1) of Appendix A to 10 CFR 40 requires that direct gamma exposure to the wastes be reduced to background levels. Page 5-1 of the Reclamation Plan indicates that calculations show that the gamma radiation exposure will be reduced to essentially background by 10 feet of cover.

REQUEST: Revise page 2 of Appendix G to be consistent with the regulations and page 5-1 of the Reclamation Plan.

Response:

Page 2 of Appendix G will be revised as follows:

"... ~~It is expected that some of the excluded~~ Pathways, such as exposure rate from the disposal cell, ~~may be~~ have been addressed by design; for example, ~~the disposal cell may be designed to yield an exposure rate comparable to background~~ direct gamma exposure rate from the disposal cell will be reduced to background levels by the placement of waste in the cell and design of the cell cover."

C BASIS: The Reclamation Plan proposes the use of Subsurface Soil Criteria. The NRC guidance (H 2.2.3 (7)) indicates that the subsurface soil standard is to be used for small areas of deep excavation. Large areas at that contamination level could result in doses higher than the 5 pCi/g radium standard.

REQUEST: Indicate the size of the area where subsurface criteria will be used, and why the resulting potential dose would be protective.

Response:

Application of the subsurface soil cleanup levels is described in the Reclamation Plan at Section 3.2.2 (page 3-10, 1st paragraph). The subsurface soil cleanup levels will be applied to the footprint of ponds 2 and 4, and Clarifier A Basin. The respective surface areas are approximately 5, 4, and 5 acres (20000, 16000, and 20000 m^2). These areas individually comprise less than 10 percent of the planned protected area and less than three percent of the impacted area. The site characterization indicates that the contaminated soil in these areas is confined to the clay liners.

These footprints are currently about 5, 18, and 5 feet below ground level, respectively. The clay liners remaining after remediation will be two feet or less in thickness. The remediated areas will then be covered with clean soil. The final site contour will leave these areas approximately the same minimum depth below ground surface. The combination of thickness of cover, small source term (low concentration times small area), and immobility of radionuclides of concern in the clay will result in a potential dose that is not distinguishable from background (an insignificant fraction of the benchmark dose).

D BASIS: Page 4 of Attachment 1 to Appendix G states that the basic radiation dose limit is 100 mrem/yr as stated in 10 CFR 20.1403(e). That section applies to license termination under restricted conditions; it does not apply to facilities decommissioning under Part 40, Appendix A (see 10 CFR 20.1401(a)).

REQUEST: Correct page 4 of 27 in Attachment 1 to Appendix G.

Response:

Page 4 of 27 in Attachment 1 to Appendix G will be revised as follows:

"The basic radiation dose limit is ~~the effective dose equivalent from external radiation plus the committed effective dose equivalent from internal radiation. The radiation dose limit is~~ used to derive the site-specific cleanup criteria (i.e. the derived concentration guideline levels, DCGLs). The applicable value is ~~from Title 10 Code of Federal Regulations, Part 20, Section 1403(e)~~ the Radium Benchmark Dose derived for the site.

The basic radiation dose limit is not meaningful for Ra-226 since its concentration limit is used for the derived dose limit; hence, the RESRAD default value of 25 mrem/y is used in the Ra-226 dose assessment. The value used in the derivation of site specific cleanup criteria for natural uranium and Th-230 is the Radium Benchmark Dose."

F BASIS: Criterion 6(6) states that the Radium Benchmark Dose approach is to be used to derive structure surface cleanup limits, but no calculations or limits were provided in Appendix G or in the final status survey plan.

REQUEST: Provide justified cleanup limits for structure surface cleanup or provide data indicating all levels are approximately background, or below accepted detection limits.

Response:

There will be only one structure remaining at the site after decommissioning is completed. That structure is the current Administration Building which was constructed for office and warehouse space. This Administration Building was erected outside the restricted area in 1991 and occupied in mid-1992, only months before the permanent shutdown of the Sequoyah Facility. The structure has been surveyed routinely for contamination, and no radioactive material or contamination has ever been found in the structure.

Surface activity limits will not be derived for the Administration Building. NUREG-1620, Appendix H, Section H2.2.3 (8) will be used as applicable guidance. Otherwise the surface activity limits will default to those provided in Source Materials license SUB-1010, Chapter 1 for the Sequoyah Facility.

G BASIS: Page 3-9 of the Reclamation Plan states that cleanup levels for U-nat and Th-230 were selected based on the as low as reasonably achievable (ALARA) principle, however, there is no discussion of how the principle was applied. In fact, the selected Th-230 levels are equivalent (based on 1000 years of decay) to the Ra-226 standards to which ALARA should then be applied. The guidance in NUREG-1620, Appendix H indicates that the cleanup level should be less than 14 pCi/g for surface Th-230.

REQUEST: Indicate how the proposed soil cleanup levels are ALARA. If part of the ALARA approach is that the land will be owned and under perpetual surveillance by the federal government which would limit exposures, indicate if the Department of Energy has agreed to accept the land within the proposed long-term care boundary.

Response:

SFC used the radium benchmark dose approach to derive guideline values for cleanup. The cleanup levels (CL) selected for natural uranium and Th-230 are well below the derived concentration guideline levels. In effect, the dose from uranium if left at the CL is only 20% of the radium benchmark dose, and the dose from Th-230 would be 25% of the benchmark dose at the outset and limited to the benchmark dose value at its peak. In addition, the cleanup levels for all three radionuclides will be applied with no background subtracted further driving down the concentrations that are attributable to operations at the Facility after cleanup. (See the Reclamation Plan at Section 3.2.2, page 3-10.

NRC procedures for review of decommissioning land areas provide an approach for evaluating soil cleanup against the ALARA principle (NUREG-1620 Section 5.2.2 (3)). The approach recognizes that compliance with the ALARA requirement at the end of decommissioning can be demonstrated by satisfying the predetermined concentration guidelines. If the licensee's final survey results meet the self-imposed concentration limits, the licensee has met the ALARA requirement (NUREG-1727 Section 7, ALARA Analysis, Evaluation Findings, Evaluation Criteria). The approach provides a calculation to determine whether it is feasible to further reduce the levels of residual radioactivity to levels below those necessary to meet the benchmark dose limit (NUREG-1727 Appendix D). That calculation with inputs taken from the SFC reclamation plan is provided as Attachment 3 to this response. As shown by that calculation, any reduction below the CL cannot be justified on the ALARA principle.

Finally, SFC has made contact with the Department of Energy (DOE) regarding transfer of the site. The DOE has indicated a willingness to take title to the Gore site as shown in a letter from Jessie Hill Roberson, Assistant Secretary for Environmental Management, department of Energy, to Mr. John H. Ellis, President, Sequoyah Fuels Corporation, dated June 5, 2003. The letter is attached to this response.

Thus, remediating to the cleanup levels proposed without subtracting natural background certainly satisfies the ALARA requirement. Institutional control of the site will further reduce any potential doses that might result from unauthorized activities on the site after reclamation.

H BASIS: Part of establishing soil cleanup levels is the appropriate establishment of background levels. Appendix D, Section 4.1.1, indicates that 31 soil samples were collected and analyzed, but that additional sampling will be required for Th-230 and Ra-226 because of problems with two analytical labs. The staff cannot approve of cleanup levels without evaluating the proposed background values, since background is part of the regulations in Criterion 6(6).

REQUEST: Provide the background radiological data for the surface and subsurface soil. Discuss how the sample locations are geochemically representative of the contaminated areas and why two samples are from 12 miles away instead of at the fence line (indicate unit of length on Figure 21), why the variation in sample results is acceptable, and how all these processes/procedures are the same or very similar to those in the final status survey plan.

Response:

Eighteen of the 31 background soil samples were retrieved from archive and forwarded to a commercial laboratory for determination of natural uranium, Th-230, and Ra-226 concentrations. Thirteen of the 31 samples no longer exist due to complete sample loss during laboratory analysis. Four samples were later excluded from consideration as background samples; two because they were not surface soils and two (HA307 and HA308) for anthropogenic influences as described below. Analysis results for the remaining 14 background samples retrieved are provided in the table included in Attachment 4 to this response.

The sample strategy for background soils was developed considering applicable NRC guidance for site characterization and EPA requirements for RCRA Facility Investigations (RFI). Locations near the facility fenceline were not considered because these properties were potentially impacted due to Facility operations. The background soil sample locations were selected to represent the three main soil series encountered in the Industrial Area at the Facility. Potential sample locations were tentatively identified by SFC's consulting agronomist or SFC's staff hydrogeologist from aerial photos in the Sequoyah County Soil Survey which was compiled by the USDA Soil Conservation Service. The potential sample locations were inspected by SFC personnel. The sample locations were subsequently selected based on owner permission, land use and management, vegetation cover, absence of debris, accessibility, and soil suitability based upon soil characterization. Sample locations were selected such that anthropogenic influences were minimized. Drainages, paved surfaces, railroads, and agricultural (cropland) areas were avoided. The locations used for the RFI were approved by EPA's onsite contractor prior to sampling. The RFI background soil samples were collected on April 20 and 21, 1995. The remaining background samples were collected in October and November 1995 in support of site characterization for decommissioning.

The NRC completed a routine, unannounced inspection of the Facility February 27 through March 2, 1995 (IR 40-8027/95-01). The inspection included a hydrogeologist from NMSS. The inspection report concluded that the licensee's choice of locations and rationale for background sampling were reasonable.

Sample locations HA307 and HA308 are not included in the table of background soil sample results in Attachment 4. These locations were originally selected in conjunction with an EPA evaluation of SFC's ammonium nitrate fertilizer application program.[1] These soil sample locations may not satisfy the condition for background sample locations with minimum anthropogenic influences. Note however that the EPA concluded the "application of ... fertilizer did not affect the soil within the fertilizer application areas or surrounding off-site farmlands".

The procedures for collection of background soil samples are described in the response to RP1G and Attachments 1 and 2. Sample results are comparable to the naturally occurring radionuclides in soil, and the variability of results is within the expected variability of the analysis. The variability is considered acceptable for the sample set.

The legend of Figure 21 has been revised to reflect the applicable unit of length. The revised figure is included in Attachment 4 to this response.

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[1] U.S. EPA, "Evaluation of Ammonium Nitrate Fertilizer Application Program, Sequoyah Fuels Corporation, Gore, Oklahoma", June 1997, prepared by PRC Environmental Management, Inc., Dallas, TX.

RP3 Final Status Survey Plan

The NRC staff primarily reviewed the Reclamation Plan, revision 2 (February 2004), Attachment B "Final Status Survey" and Attachment C "Quality Assurance Program." Site decommissioning and the final status survey plan should follow the guidance in NUREG-1620, Section 5 and relevant portions of NUREG-1575 (MARRSIM). Also, in finalizing the plan, the licensee should consider that items will be inspected during decommissioning as described in Inspection Procedure 45678.

B BASIS: The discussion in Attachment B, page 5, titled "Direct and Removable Measurements," is confusing. Removable activity measurements are performed by doing swipes of the surface and counting the activity on the swipe. However, there is no mention of doing swipes. Page 11 states that the cleanup level is 2000 dpm/100 cm^2, for total (direct) gross alpha and gross beta/gamma, but there is no mention of how this value was derived, and what value will be used for removable activity.

REQUEST: Revise page 5 to indicate what measurements are planned (this can be based on NUREG-1575), and what cleanup limits are proposed based on the method described in Appendix H of NUREG-1620.

Response:

Removable activity measurements will not be performed for the final status survey. Surface activity limits will not be derived for the Administration Building. NUREG-1620, Appendix H, Section H2.2.3 (8) will be used as applicable guidance. Otherwise the surface activity limits will default to those provided in Source Materials license SUB-1010, Chapter 1 for the Sequoyah Facility. The Reclamation Plan, Attachment B "Final Status Survey", pages 5 and 11 will be revised as follows:

Page 5:

2.6.1 Direct ~~and Removable~~ Measurements

Direct ~~and removable~~ measurements will only be made of structural surfaces. Direct ~~and removable~~ measurements will be limited to alpha and beta/gamma measurements. The types of instruments used for direct ~~and removable~~ measurements and their typical performance characteristics are provided in Table 2-3.

Page 11:

The CL_W is 2000 dpm/100 cm^2 total gross alpha (fixed plus removable) and total gross beta/gamma (fixed plus removable), measured independently.

Also, the cleanup level (CL) will be applied as the total activity concentration (background will not be subtracted from the measurement result before comparison to the CL).

See RP2, Item F for additional discussion.

C BASIS: Attachment B, page 5, Table 2-4, indicates soil radionuclide analytical methods with detection limits but no references are provided.

REQUEST: Provide the reference for each of the analytical methods to be used.

Response:

The references for the analytical methods to be used are:

Total uranium:	ASTM D 5174, "Standard Test Method for Trace Uranium in Water by Pulsed-Laser Phosphorimetry", ASTM International.
Th-230:	Th-01-RC, "Thorium in Urine", U.S. Department of Energy, Environmental Measurements Laboratory Procedures Manual, HASL-300, DE91-010178.
Ra-226:	903.1, "Radium-226 in Drinking Water Radon Emanation Technique", U.S. Environmental Protection Agency, Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA 600/4-80-032.

The soil will be prepared for the analytical method by drying and grinding the soil sample, then acid leaching an aliquot of the prepared soil. These preparation techniques are carried out in accordance with laboratory-specific procedures.

Surface Water Hydrology and Erosion Protection

SW8 Allowable Stress

The vegetation established on the top of the cell will play a major role in preventing erosion. Please provide details regarding the type of vegetation expected to volunteer to the top slope. Discuss your reasons for selecting "mixed grasses" on p. B-6 of Appendix C and the corresponding characteristic variables (h, M). There is no explanation or reference to another section of the reclamation plan where detailed information regarding the vegetation may have been provided. Also, please correct the typo in the value of C_e (given as 1.14, which is actually the value of C_e^2 used to calculate allowable shear strength).

Response:

Vegetation will be established according to the plan outlined in the 2004 Technical Specifications for the disposal cell (Attachment A of the Reclamation Plan). Allowing plant species to "volunteer" on the cover surface is not acceptable. Due to the importance of establishing selected species and discouraging unwanted species, a selected list of species to be seeded and species to be transplanted are provided in the Technical Specifications. The mixed grasses used in the calculations on page B-6 reflects a mixture of native grass species from the list in the Technical Specifications. More explanation of the selection of parameters will be provided in the updated erosional stability document.

The equation near the top of page B-6 should read $C_e^2 = 1.14$, as noted in the comment above.

SW10 Potential Ponding

Appendix C, Drawing No. 5, "Current Facilities and Disposal Cell Layout" shows the proposed topography of the site near the cell. The topography of site adjacent to cell on the west side shows the elevation of 540' intersecting the toe of the embankment in a manner that may cause areas of ponding against the toe if the area is not graded away from cell. Please either show that water will not pond against the toe of the cell or address the effects of such ponding.

Response:

The 540-foot contour shown on Drawing 5 does not indicate ponding on the west side of the disposal cell. This contour actually indicates drainage away from the toe of the disposal cell (as planned).

SW11 East Side of Cell

Appendix C, Drawing No. 5, "Current Facilities and Disposal Cell Layout" shows the proposed topography of the site near the cell. The proposed topography of the site adjacent to cell along the east side at elevation 570' is an area of concern. This area directs the flow around the cell toward the north and south but SFC did not analyze this area for the potential for erosion. Please provide an assessment of the potential for erosive flow velocities in this area (to the northwest of the OG&E substation) from the overland areas east of the site and discuss the need for additional erosion protection in this area.

Response:

This will be explained in more detail in the updated erosional stability document. The area north of the OG&E substation is an area of exposed sedimentary rock that may be processed and used for cover material. The drainage area above the 540-foot contour that would drain to the north or south is approximately 1.5 acres.

SW12 Embankment Toe Apron

Appendix C, Drawing No. 7, "Typical Disposal Cell Cross Section and Details" does not provide details on the embankment toes nor have they been discussed in the text. Please provide dimensions and justification for dimensions of the toes. Lateral flow from drainage areas east of the cell should be considered in addition to the sheet flow from the top and sides of the cell in your discussion.

Response:

The detail at the toe of the disposal cell cover has been modified as outlined in the 2004 Technical Specifications (Attachment A of the Reclamation Plan). The 20-foot wide perimeter apron is clearly shown on Drawings 5 and 7, and was included in the design as an additional margin of erosion protection beyond the rock mulch-protected slope.

SW13 Vegetative Cover

Please provide information on the vegetation that is expected to volunteer at the site. No information regarding characteristics of the vegetative cover has been supplied or referenced in Appendix C. Information should include species expected and characteristics of each including root penetration, density, growing season, and expected length of life. The type of vegetation that is expected to volunteer at the site is important for consideration because root penetration (among other characteristics) may eventually affect the performance of the cover and gully initiation.

Response:

As mentioned in the response to Comment SW8 above, the plan for revegetation is outlined in the 2004 Technical Specifications.

SW14 Stream 005

Please provide an assessment of the potential for the tributary on the western side of site (stream 005) to erode towards the cell. Currently, a headcut appears to be migrating upstream. Therefore, the erosion potential at the upstream end due to runoff from the cell should be addressed. An analysis of the discharge in the tributary should include all overland flow from on and around the cell. If you determine that rock armoring of the stream is necessary to prevent erosion reaching the cell, provide details of the proposed armoring and the analysis to support it.

Response:

This question was previously documented by NRC as Comment G2, and addressed in SFC response to G2.

SW15 Rip Rap Filter Layer

The use of a filter layer for rip rap proposed for the side slope was not addressed. NRC guidance in NUREG-1623, Appendix D, Section 2.1.1, states that filter or bedding is recommended for cell side slopes and toes where rip rap is used. Please either revise the design to include a filter layer or provide justification for opting not to.

Response:

The particle-size distribution of the erosion protection layer is outlined in the 2004 Technical Specifications, and is essentially rock with a median size of roughly three inches. The erosion protection layer will be a rock mulch with filter compatibility between the underlying cover material and overlying topsoil, so that a filter layer is not required.

SW16 Rock Gradation and Durability Testing

Please provide information on rock gradation. If the maximum rock size will be greater than 6 inches, either increase the thickness of the rip rap layer or provide justification for a layer thickness less than the maximum rock size. Also, provide information and specifications on testing procedures for rock durability and construction specifications for rock placement.

Response:

The particle-size distribution layer of the erosion protection layer is outlined in the 2004 Technical Specifications, as outlined in the response to Comment SW15 above.

Attachment 1

Site Characterization Plan
January 28, 1994

APPENDIX A
SOIL SAMPLING QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

SOIL SAMPLING QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This Quality Assurance Plan will be used during soil investigations at the Sequoyah Facility. It presents the technical methods used during a soils investigation to achieve adequate quality assurance (QA) and quality control (QC) during implementation of the soils investigation. The procedural elements of the QA Plan are to be followed throughout all phases of the soils investigation. The goals of the QA Plan are to insure that all information, data, and interpretations resulting from the investigation are technically sound, valid and properly documented. The scope of the QA Plan may change depending on the actual field conditions encountered during the investigation. If significant changes to the QA Plan are required, the Facility representative and appropriate regulatory agency will be notified as soon as possible of the change.

The QA Plan presents the technical methodology and rationale for soils investigations. Specific procedures for soil/rock sampling and drilling, physical and chemical testing, field data documentation, equipment decontamination, site safety, abandonment procedures, site reclamation, and sample packaging, handling and chain-of-custody control are included in the QA Plan.

2.0 SOIL SAMPLING PROCEDURES

Activities which will occur during soil sampling are summarized as follows:

- pre-arrangement with laboratories
- assembly and preparation of sampling equipment and supplies (including equipment decontamination)
- soil sampling
  - site reconnaissance to determine sample sites
  - determination of grid size and boundaries, if applicable
  - vertical and horizontal control survey
  - determination of sample equipment type
  - equipment decontamination
- sample preservation and shipment
  - sample preparation
  - sample labeling
- completion of sample records
- completion of chain-of-custody records
- sample shipment

Detailed soil sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment to be used will be assembled and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared. A list of typical equipment used during soil sampling events is presented on Table 1.

2.1.1 Equipment Check

This activity includes the verification that all equipment are in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated according to the manufacturer's specifications prior to field use. This applies to the equipment for making on-site measurements of organic vapors, soil conductivity, soil pH, and geophysical instruments. Calibration records or logs will be maintained for each piece of field measurement equipment used on-site. Calibration of equipment will be made between a task specific predetermined number of soil borings and wells.

2.1.3 Sampling Equipment Cleaning

All portions of sampling and test equipment which will contact the soil samples will be thoroughly cleaned before use.

The procedure for <u>initial</u> equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse with dilute 0.1 normal nitric acid;
- rinse thoroughly with tap water;
- rinse thoroughly with distilled or deionized water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned, appropriate preservatives added, and sealed by the laboratory before shipping.

2.1.4 Soil Sampling Procedures

Special care will be exercised to prevent contamination of the extracted samples during the sampling activities. The two primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the sample through insufficient cleaning of equipment or personnel between sample locations.

To prevent such contamination, all sampling equipment will be thoroughly cleaned before and between uses at different sampling locations in accordance with Section 2.1.3. In addition to the use of properly cleaned equipment, three further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different sample is obtained; and
- sample collection activities will proceed progressively from background (clean) areas to the downgradient (impacted) areas or from areas least affected by releases to areas progressively more affected by releases.
- Personnel handling the environmental samples will be minimized and only pre-designated personnel will be involved in sample handling.

The following paragraphs present procedures for the several activities which comprise soil sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record.

3.0 SAMPLING METHODS

3.1 Unconsolidated Soils

3.1.1 Continuous Tube Sampling System

The primary sampling methodology that will be used in unconsolidated soils will be a continuous tube sampling system. This sampling method typically uses a 5.5 foot steel split-barrel sampling tube that is 3.5 inches or 4.0 inches in diameter. This device is usually referred to as a CME sampler. The continuous sampler has a threaded cutting shoe which mounts on the base of the sample tube and a threaded retrieval head which mounts onto the top of the sample tube. A sample retainer can be used in sandy or gravelly soils to improve recovery. The continuous sampler is mounted within the lead hollow-stem auger flight and is adjusted so the cutting head or shoe is even with the auger cutting bits or extends to as much as 0.5 feet below the bit. The continuous sampler is mounted on a drilling rod and does not rotate as the auger is rotated and hydraulically pushed into the subsurface. No drilling fluids are used during sampling with the continuous tube system. The hollow-stem augers are advanced in 5-foot increments. Once the augers have been advanced over a 5-foot interval, the continuous sampler is removed from the borehole (augers remain in position) and the sampling barrel is split open to expose the 5-foot long sample. A properly decontaminated sampler will be used for each sample interval. Once the sample is exposed it will be measured and described by the on-site hydrogeologist. Samples will be retained or submitted for chemical or physical tests.

Another type of continuous sampler consists of a hollow four or five foot long tube of carbon steel. Disposable acetate liners are available to use with the tube. The tube sampler is threaded on both ends but is not split length wise. The tube has a beveled cutting head on one end. Typically, the tube is pushed into the soil and then withdrawn. The soil sample is then removed from the acetate liner.

3.1.2 Shelby Tube Samples

This sampling method will be employed in clay or silt soils where undisturbed soil samples are required for physical tests. Shelby tubes can be used with auger drilling or air/rotary drilling techniques. The shelby tube sampler (ASTM D-1587-83) consists of a 3-inch diameter thin wall (16 gauge) steel tube (24 to 36 inches in length). The bottom of the tube or bit is sharpened so that the bevel is on the outside of the tube. The inside diameter of the bit is slightly less than that of the tube. The basic principle of operation is to hydraulically push the Shelby tube into the undisturbed soil in one continuous 2-foot stroke without rotation. To increase adhesion, the samples should be manually rotated to break off the soil at the bottom of the tube after the sample is allowed to sit approximately 1-minute. The samples containing the soil should be carefully removed from the hole to minimize disturbance to the sample. The ends of the sample tube will be sealed to prevent loss of moisture. The shelby tube will be stored to minimize jarring or shocks until analytical and/or physical testing of the sample is conducted.

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This sampling method will be used in unconsolidated soils if the continuous sampler is not available or is unable to obtain satisfactory soil recovery. The split-spoon sampler (ASTM D-1586-84) performs satisfactorily in all types of soil and must be driven with a 140-pound hammer falling 30 inches until either 18 inches have been penetrated or 100 blows applied. The sampler is threaded on both ends and split lengthwise. When assembled, the two halves are held together by the shoe at one end and the head at the other end. A space is provided for a sampler retainer. The lengths of all drill rod used should be measured and recorded on the Drill Rod and Auger Length verification form in Appendix F. The drill rod and augers should be measured to insure that the exact depth of the soil sample is precisely known.

3.1.4 Stainless Steel Hand Trowels or Spoons

This soil sample collection method enables samples to be collected from shallow trenches or holes. The method of operation is to use the trowel or spoon to scrape soil off the sidewall of the trench/hole and into either clean stainless steel mixing bowls or directly into the sample container. Alternatively, the trowel or spoon alone can be utilized to collect very shallow (0-6") soil samples.

3.1.5 Hand or Bucket Auger

This sampling method may be used to actually collect a sample or auger to a depth to be sampled further by either a shelby tube or split spoon sampler. The auger is hand rotated in a downward twisting motion approximately 6-inches into the soil. No drilling fluids are used during drilling. The auger is then pulled out of the borehole and the soil in the bucket is either emptied directly into sample container or into a stainless steel mixing bowl for further mixing or compositing with other soils and then transferred into the sample container.

3.2 Consolidated Rock

3.2.1 Double-Tube Corebarrel

A double-tube corebarrel is the preferred sampling method in consolidated rock formations. A hollow diamond or carbide bit which is typically 3.125 inches outside diameter and typically 2.2-inches inside diameter cuts at least a 2-inch core approximately 5 to 10 feet long. Upon coring 5 or 10 feet, the corebarrel is brought to the surface and split open. The core is subsequently removed, and described by the hydrogeologist. All core samples will be labeled, packaged, and placed in water-proof core boxes for temporary storage and reference.

3.3 Drilling Methods

3.3.1 Hollow-Stem Auger

This is the preferred method of drilling through unconsolidated soils. No drilling fluids are used during hollow-stem auger drilling. The different hollow stem augers that may be used at the site are between 6.875-inches to 8.25-inches outside diameter and 3.25-inches to 4.25-inches inside diameter. In this method, the augers are hydraulically pushed and rotated in 5-foot intervals with sampling occurring by lowering equipment through the center of the augers.

3.3.2 Air Rotary

Air rotary drilling involves the use of circulating air to remove the drill cuttings and maintain an open borehole as drilling progresses. The use of air-rotary drilling techniques is best suited for use in hard rock formations. The air from the compressor on the rig must be filtered to ensure that the oil from the compressor is not introduced into the soil or groundwater system. The air rotary drilling method will be the primary drilling method used in hard rock formations. Steel or PVC surface casing may be advanced to assist in borehole stabilization.

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Water rotary is the second preferred method of drilling in hard rock formations. Water rotary involves the introduction of water into the borehole through the drill pipe and subsequent circulation of water back up to the hole to remove drill cuttings. No borehole stabilization additives such as bentonite or revert will be used. Water used in this drilling method will be obtained from a local municipal water system to ensure that the water is potable water. Steel or PVC surface casing may be advanced to assist in borehole stabilization.

3.3.4 Hand or Bucket Auger

This drilling method is used when drilling shallow borings (generally 5 feet or less) through unconsolidated soils. Typically, the hand auger is 4-inches in inside diameter and 4.25 inches outside diameter and the auger bucket is six (6) inches long. In this method, the auger is hand rotated into the ground in six (6)-inch intervals. No drilling fluids are used. The auger is then removed from the borehole and the soil removed from the bucket. The auger is cleaned and then reinserted into the borehole and hand rotated until another six (6)-inches of soil has been removed. A stainless steel hand auger will be used at all times.

3.3.5 Shovel, Backhoe, and/or Post-hole Digger

These boring methods may be used for shallow soils borings (0-5 feet) in unconsolidated soils. In all of these methods a borehole and/or trench is excavated slightly deeper than the anticipated sample interval. The actual soil sample is then collected directly from the sidewall of the borehole or trench. The shovel, backhoe, and post-hole digger will be properly decontaminated prior to and between use.

3.4 Sampling Procedures

The sampling procedures common to undisturbed sampling and disturbed sampling are described in this section. A summary of the procedures are listed below:

- Sampler Preparation
- Drilling Fluid Composition
- Sample Interval
- Sample Identification
- Extruding Sample from Tubes
- Sample Collection and Management

3.4.1 Sampler Preparation

All samplers must be thoroughly clean, free of dents and nicks. The sample tubes should not be lubricated. Any defects in the thin-wall tube or cutting head, split-spoon sampler, or continuous-tube sampler may constitute reasons for the sampling system to be discarded or replaced.

3.4.2 Drilling Fluid Composition

All borings will be advanced using techniques which require no drilling additives. In situations where wet rotary is the preferred method, only potable water will be used. A sample of the potable water used in drilling may be analyzed for the same chemical parameters as the groundwater or soil samples analytical list to insure that no impact occurred from the drilling fluid.

3.4.3 Sample Interval

All borings will be sampled continuously to the designated target depth unless specific sample intervals of interest were previously determined.

3.4.4 Sample and Drill Hole Identification

Each sample shall be identified by drill hole number and by consecutive sample number. The consecutive sample number should correspond to the sample numbers recorded on the borehole logs.

3.4.5 Extruding Sample from Shelby Tubes

The use of hydraulically activated sample jacks is the preferred method for extruding soil samples from the shelby tubes in the field and laboratory. Mechanical sample jacks can be used when hydraulic pressure is not available. The bottom end of the sample should be trimmed, so that the sample ejection jack piston fits flat on the sample surface. The sample should be extruded in one continuous uniform stroke onto clean aluminum foil. The first 1-inch of the sample (where it contacted the extruder) should be trimmed and discarded. The site hydrogeologist shall designate one "clean" person to handle <u>only</u> the tubes and samples. This person must wear clean surgical gloves and change them after handling each sample.

3.4.6 Sample Collection and Management

Samples shall first be prepared by removing (by trimming with a clean stainless steel knife) the outer layer of soil that had contacted the sampling tube/equipment. This outer layer of soil will be discarded. Samples will then be obtained by cutting the entire length of each core section in half with a clean stainless steel knife. Equal parts of each core will be removed and then handled in incremental sections as described in the site specific data collection plans.

3.4.7 Soil Packaging and Handling

Soil samples collected will be double wrapped first in cellophane then in aluminum foil and finally in plastic tube wrap, then, labeled, and placed in water-proof core boxes. Selected samples may be split in order to conduct the various chemical or physical tests. All samples for the chemical tests will be placed in clean laboratory supplied glass jars and properly labeled. Samples for physical tests will be placed in plastic, glass, or cloth containers and properly labeled. All samples that will be analyzed will have a chain-of-custody form completed.

3.4.8 Physical Testing of Soil Samples

Selected samples of the various lithological units encountered during test drilling may be subject to selected physical testing to identify soil characteristics important to site characterization and assessment. These physical tests may include the following methods:

- Particle size distribution (sieve: ASTM D-1140, Hydrometer ASTM D-2217)
- Saturated vertical hydraulic conductivity (ASTM D-2434 or ASTM D-479)
- Atterberg Limits (ASTM D-4318)
- Visual Classification (ASTM D-1587, and ASTM D-1588)
- Porosity (Density ASTM D-2216, specific gravity ASTM D-854)
- Unified Soil Classification (ASTM D-2487)
- Moisture Content (ASTM D-2216)

3.4.9 Soil Sample Description and Logging

Immediately upon retrieval, all recovered samples will be scanned for the presence of volatile organic compounds utilizing portable air monitoring photoionization instruments such as an organic vapor analyzer (OVA) or an HNU.

All recovered samples will be described and logged by the site hydrogeologist at the drill rig. Description will include amount of recovery; interval thickness, depth of lithology change; color according to the Munsel Color chart; grain size distribution; macro-features and physical characteristics; and type according to the Uniform Soil Classification System (ASTM D2488). All descriptions will be recorded on a soil boring log. Selected samples of each recovered soil interval will be placed in jars; appropriately labeled as to the test boring, sample number, and sample depth and stored on-site.

3.4.10 Sample Preservation

Soil samples for laboratory analysis will be properly prepared for transportation by refrigeration in ice filled chests. Refrigeration is the only preservation requirement for soil samples according to SW-846 recommendations. The preservatives, sample containers, and holding times listed in Table 2 will be followed during soil sample collection.

3.4.11 Container and Labels

Containers and appropriate container lids (teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. A label will be firmly attached to the container side (not lid). The following information will be legibly and indelibly written on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,

- sample collector's initials,
- preservatives used,
- type of sample,
- sample analysis.

3.4.12 Sample Shipment

Typically, the concentration, volume shipped, and type of constituents potentially present in the soils from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous materials. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,
- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample; and
  - date of shipment;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram. Radioactive materials have additional shipping requirements that will be followed.

3.4.13 Chain-Of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicater. One copy of this form will be maintained at the site, and the other two copies will be shipped with the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses.

A copy of a sample chain of custody form is shown in Appendix F.

3.4.14 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (sample number)
- sample location map or detailed sketch
- date and time of sampling;
- sampling method;
- field observations of
    - sample appearance,
    - sample odor
- weather conditions;
- sampler's identification;
- sample analysis; and
- any other information which is significant.

Soil sampling information will be recorded on the appropriate records and forms described in Section 7.0.

3.4.15 Analytical Methods

Soil samples will be analyzed using the appropriate EPA-approved methodology. The EPA methodology will typically be those methods described in SW-846 or other approved analytical methods.

The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules,
2. Specification of adherence to accepted test methods,
3. Equipment inspection and servicing schedules,
4. The regular use of standard or spiked sample analyses, (at least 10% of all analyses will consist of standard or spiked samples with a minimum of one QC sample per matrix),
5. Operator or analyst training procedures and schedules,
6. A program of continuous review of results, procedures, and compliance with the QA/QC program, and
7. Documentation of compliance with the program.

3.5 <u>Equipment Decontamination</u>

All equipment coming into contact with soils or groundwater will be properly cleaned prior to use. Drilling equipment (i.e. augers, drill rod, sampling equipment, etc.) which contacts the borehole will be cleaned using a hot water pressure washer between boreholes. All sampling equipment will be pressure washed and then rinsed with deionized water prior to use. All sampling equipment and the drill rig will be cleaned with the high pressure hot water washer between borings.

All decontamination will be conducted in an area designated by SFC. All wash water will be collected and managed in accordance with state and federal regulations. All protective clothing and wastes generated by the drilling or soil sampling programs will be containerized for proper disposal.

4.0 BOREHOLE AND MONITORING WELL ABANDONMENT

4.1 Borehole Abandonment

All borings will be plugged and abandoned in accordance with Oklahoma Water Resources Board (OWRB) rules. Plugging and abandonment is typically accomplished by pressure grouting a cement grout mix through a tremie line. The grout will consist of a mix ratio of one (1) ninety-four (94) pound bag of portland cement and approximately 6 gallons of water. All grout will be pumped through a tremie line that extends to the bottom of the boring. The grout mix will then be circulated to about four-feet from surface. If subsidence of the grout mix is noted, additional grout will be placed in the borehole to bring it to a level of approximately four (4) feet from ground level. The remaining four (4) feet is then backfilled with clean compacted soil. The boring location will then be surveyed for horizontal and vertical coordinates. All borehole abandonments are to be recorded on OWRB multi-purpose reports as well as Facility log books and records.

4.2 Site Reclamation

All drilling activities will be conducted in such a manner as to minimize any disturbance to the ground surface in the drilling area. A minimum number of vehicles will be brought to each drill site. All soil cuttings generated during drilling activities will be managed in accordance with state and federal regulations. Steps will be taken to minimize or prevent the discharge of drilling fluids or developed groundwater on the ground surface. Any accidental discharges will be cleaned up. Steps will be taken to minimize rutting of the off-road ground surface by vehicles by typically placing 3/4" plywood on the off-road ground and driving the vehicles on the plywood during periods of heavy precipitation and high ground moisture.

5.0 DOCUMENTATION OF FIELD DATA

Certain records will be maintained in logbooks and on field forms for sampling events and for daily activities. Some or all of the following forms will be used as appropriate to record the data generated at the site. These forms are:

- Borehole Abandonment Record
- Core Boring Field Report
- Chain-of-Custody Form
- Boring Record
- Drillers Log Summary
- Sample Labels
- Photographic Log and Labels
- Drill Rod and Auger Length Verification Form
- OWRB Multi-Purpose Report

Site safety, field measurements, and site activities data will be kept in the field log book. Examples of all field forms are presented in Appendix F. The field log book will be a bound book with consecutively numbered pages that will be suitable for submission as evidence in legal proceedings. The log book will become part of the permanent file for the site investigation. The log book will be used and maintained on a daily basis and all entries will be in ink.

6.0 SITE SAFETY PLAN

A Site Safety Plan will be prepared for use during hydrogeological field investigations. The Site Safety Plan will assess hazards at the site and will be prepared so as to present negligible hazards to site personnel and property owners. Environmental monitoring at the site will be performed in accordance with the Site Safety Plan.

7.0 DATA EVALUATION AND REPORTING PROCEDURES

Results and conclusions will require the review and assessment of the analytical results. Anomalous and unanticipated results may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the analytical results. All data review and reporting procedures will be in accordance with the Data Management Plan.

Table 1: List of Equipment and Supplies for Soil Sampling

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. Laboratory sample containers
25. Stainless steel bowls
26. Stainless steel spoons, trowels, or knifes
27. Bucket augers
28. Split spoons or Shelby tubes
29. Continuous tube samplers
30. Portland cement
31. Bentonite powder
32. Shovel
33. pH meter
34. PID organic vapor meter
35. 0.1 normal nitric acid
36. Potable water (for decon)

Attachment 2

Final RCRA Facility Investigation Workplan
October 31, 1994

APPENDIX A
SOIL SAMPLING QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

SOIL SAMPLING QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This Quality Assurance Plan will be used during soil investigations at the Sequoyah Facility. It presents the technical methods used during a soils investigation to achieve adequate quality assurance (QA) and quality control (QC) during implementation of the soils investigation. The procedural elements of the QA Plan are to be followed throughout all phases of the soils investigation. The goals of the QA Plan are to insure that all information, data, and interpretations resulting from the investigation are technically sound, valid and properly documented. The scope of the QA Plan may change depending on the actual field conditions encountered during the investigation. If significant changes to the QA Plan are required, the Facility representative and appropriate regulatory agency will be notified as soon as possible of the change.

The QA Plan presents the technical methodology and rationale for soils investigations. Specific procedures for soil/rock sampling and drilling, physical and chemical testing, field data documentation, equipment decontamination, site safety, abandonment procedures, site reclamation, and sample packaging, handling and chain-of-custody control are included in the QA Plan.

2.0 SOIL SAMPLING PROCEDURES

Activities which will occur during soil sampling are summarized as follows:

- pre-arrangement with laboratories
- assembly and preparation of sampling equipment and supplies (including equipment decontamination)
- soil sampling
  - site reconnaissance to determine sample sites
  - determination of grid size and boundaries, if applicable
  - vertical and horizontal control survey
  - determination of sample equipment type
  - equipment decontamination
- sample preservation and shipment
  - sample preparation
  - sample labeling
- completion of sample records
- completion of chain-of-custody records
- sample shipment

Detailed soil sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment to be used will be assembled and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared. A list of typical equipment used during soil sampling events is presented on Table 1.

2.1.1 Equipment Check

This activity includes the verification that all equipment are in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated according to the manufacturer's specifications prior to field use. This applies to the equipment for making on-site measurements of organic vapors, soil conductivity, soil pH, and geophysical instruments. Calibration records or logs will be maintained for each piece of field measurement equipment used on-site. Calibration of equipment will be made between a task specific predetermined number of soil borings and wells.

2.1.3 Sampling Equipment Cleaning

All portions of sampling and test equipment which will contact the soil samples will be thoroughly cleaned before use.

The procedure for initial equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse with dilute 0.1 normal nitric acid;
- rinse thoroughly with tap water;
- rinse thoroughly with distilled or deionized water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned, appropriate preservatives added, and sealed by the laboratory before shipping.

2.1.4 Soil Sampling Procedures

Special care will be exercised to prevent contamination of the extracted samples during the sampling activities. The two primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the sample through insufficient cleaning of equipment or personnel between sample locations.

To prevent such contamination, all sampling equipment will be thoroughly cleaned before and between uses at different sampling locations in accordance with Section 2.1.3. In addition to the use of properly cleaned equipment, three further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different sample is obtained; and
- sample collection activities will proceed progressively from background (clean) areas to the downgradient (impacted) areas or from areas least affected by releases to areas progressively more affected by releases.
- Personnel handling the environmental samples will be minimized and only pre-designated personnel will be involved in sample handling.

The following paragraphs present procedures for the several activities which comprise soil sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record.

3.0 SAMPLING METHODS

3.1 Unconsolidated Soils

3.1.1 Continuous Tube Sampling System

The primary sampling methodology that will be used in unconsolidated soils will be a continuous tube sampling system. This sampling method typically uses a 5.5 foot steel split-barrel sampling tube that is 3.5 inches or 4.0 inches in diameter. This device is usually referred to as a CME sampler. The continuous sampler has a threaded cutting shoe which mounts on the base of the sample tube and a threaded retrieval head which mounts onto the top of the sample tube. A sample retainer can be used in sandy or gravelly soils to improve recovery. The continuous sampler is mounted within the lead hollow-stem auger flight and is adjusted so the cutting head or shoe is even with the auger cutting bits or extends to as much as 0.5 feet below the bit. The continuous sampler is mounted on a drilling rod and does not rotate as the auger is rotated and hydraulically pushed into the subsurface. No drilling fluids are used during sampling with the continuous tube system. The hollow-stem augers are advanced in 5-foot increments. Once the augers have been advanced over a 5-foot interval, the continuous sampler is removed from the borehole (augers remain in position) and the sampling barrel is split open to expose the 5-foot long sample. A properly decontaminated sampler will be used for each sample interval. Once the sample is exposed it will be measured and described by the on-site hydrogeologist. Samples will be retained or submitted for chemical or physical tests.

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3.3.4 Hand or Bucket Auger

This drilling method is used when drilling shallow borings (generally 5 feet or less) through unconsolidated soils. Typically, the hand auger is 4-inches in inside diameter and 4.25 inches outside diameter and the auger bucket is six (6) inches long. In this method, the auger is hand rotated into the ground in six (6)-inch intervals. No drilling fluids are used. The auger is then removed from the borehole and the soil removed from the bucket. The auger is cleaned and then reinserted into the borehole and hand rotated until another six (6)-inches of soil has been removed. A stainless steel hand auger will be used at all times.

3.3.5 Shovel, Backhoe, and/or Post-hole Digger

These boring methods may be used for shallow soils borings (0-5 feet) in unconsolidated soils. In all of these methods a borehole and/or trench is excavated slightly deeper than the anticipated sample interval. The actual soil sample is then collected directly from the sidewall of the borehole or trench. The shovel, backhoe, and post-hole digger will be properly decontaminated prior to and between use.

3.4 Sampling Procedures

The sampling procedures common to undisturbed sampling and disturbed sampling are described in this section. A summary of the procedures are listed below:

- Sampler Preparation
- Drilling Fluid Composition
- Sample Interval
- Sample Identification
- Extruding Sample from Tubes
- Sample Collection and Management

3.4.1 Sampler Preparation

All samplers must be thoroughly clean, free of dents and nicks. The sample tubes should not be lubricated. Any defects in the thin-wall tube or cutting head, split-

3.4.6 Sample Collection and Management

Samples shall first be prepared by removing (by trimming with a clean stainless steel knife) the outer layer of soil that had contacted the sampling tube/equipment. This outer layer of soil will be discarded. Samples will then be obtained by cutting the entire length of each core section in half with a clean stainless steel knife. Equal parts of each core will be removed and then handled in incremental sections as described in the site specific data collection plans.

3.4.7 Soil Packaging and Handling

Soil samples collected will be double wrapped first in cellophane then in aluminum foil and finally in plastic tube wrap, then, labeled, and placed in water-proof core boxes. Selected samples may be split in order to conduct the various chemical or physical tests. All samples for the chemical tests will be placed in clean laboratory supplied glass jars and properly labeled. Samples for physical tests will be placed in plastic, glass, or cloth containers and properly labeled. All samples that will be analyzed will have a chain-of-custody form completed.

3.4.8 Physical Testing of Soil Samples

Selected samples of the various lithological units encountered during test drilling may be subject to selected physical testing to identify soil characteristics important to site characterization and assessment. These physical tests may include the following methods:

- Particle size distribution (sieve: ASTM D-1140, Hydrometer ASTM D-2217)
- Saturated vertical hydraulic conductivity (ASTM D-2434 or ASTM D-479)
- Atterberg Limits (ASTM D-4318)
- Visual Classification (ASTM D-1587, and ASTM D-1588)
- Porosity (Density ASTM D-2216, specific gravity ASTM D-854)
- Unified Soil Classification (ASTM D-2487)
- Moisture Content (ASTM D-2216)

3.4.9 Soil Sample Description and Logging

Immediately upon retrieval, all recovered samples will be scanned for the presence of volatile organic compounds utilizing portable air monitoring photoionization instruments such as an organic vapor analyzer (OVA) or an HNU.

All recovered samples will be described and logged by the site hydrogeologist at the drill rig. Description will include amount of recovery; interval thickness, depth of lithology change; color according to the Munsel Color chart; grain size distribution; macro-features and physical characteristics; and type according to the Uniform Soil Classification System (ASTM D2488). All descriptions will be recorded on a soil boring log. Selected samples of each recovered soil interval will be placed in jars; appropriately labeled as to the test boring, sample number, and sample depth and stored on-site.

3.4.10 Sample Preservation

Soil samples for laboratory analysis will be properly prepared for transportation by refrigeration in ice filled chests. Refrigeration is the only preservation requirement for soil samples according to SW-846 recommendations.

3.4.11 Container and Labels

Containers and appropriate container lids (teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. A label will be firmly attached to the container side (not lid). The following information will be legibly and indelibly written on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,

- sample collector's initials,
- preservatives used,
- type of sample,
- sample analysis.

3.4.12 Sample Shipment

Typically, the concentration, volume shipped, and type of constituents potentially present in the soils from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous materials. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,
- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample; and
  - date of shipment;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram. Radioactive materials have additional shipping requirements that will be followed.

3.4.13 Chain-Of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicater. One copy of this form will be maintained at the site, and the other two copies will be shipped with the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses.

A copy of a sample chain of custody form is shown in Appendix F.

3.4.14 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (sample number)
- sample location map or detailed sketch
- date and time of sampling;
- sampling method;
- field observations of
  - sample appearance,
  - sample odor
- weather conditions;
- sampler's identification;
- sample analysis; and
- any other information which is significant.

Soil sampling information will be recorded on the appropriate records and forms described in Section 7.0.

3.4.15 Analytical Methods

Soil samples will be analyzed using the appropriate EPA-approved methodology. The EPA methodology will typically be those methods described in SW-846 or other approved analytical methods.

The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules,
2. Specification of adherence to accepted test methods,
3. Equipment inspection and servicing schedules,
4. The regular use of standard or spiked sample analyses,
5. Operator or analyst training procedures and schedules,
6. A program of continuous review of results, procedures, and compliance with the QA/QC program, and
7. Documentation of compliance with the program.

3.5 Equipment Decontamination

All equipment coming into contact with soils or groundwater will be properly cleaned prior to use. Drilling equipment (i.e. augers, drill rod, sampling equipment, etc.) which contacts the borehole will be cleaned using a hot water pressure washer between boreholes. All sampling equipment will be pressure washed and then rinsed with deionized water prior to use. All sampling equipment and the drill rig will be cleaned with the high pressure hot water washer between borings.

All decontamination will be conducted in an area designated by SFC. All wash water will be collected and managed in accordance with state and federal regulations. All protective clothing and wastes generated by the drilling or soil sampling programs will be containerized for proper disposal.

4.0 BOREHOLE AND MONITORING WELL ABANDONMENT

4.1 Borehole Abandonment

All borings will be plugged and abandoned in accordance with Oklahoma Water Resources Board (OWRB) rules. Plugging and abandonment is typically accomplished by pressure grouting a cement grout mix through a tremie line. The grout will consist of a mix ratio of one (1) ninety-four (94) pound bag of portland cement and approximately 6 gallons of water. All grout will be pumped through a tremie line that extends to the bottom of the boring. The grout mix will then be circulated to about four-feet from surface. If subsidence of the grout mix is noted, additional grout will be placed in the borehole to bring it to a level of approximately four (4) feet from ground level. The remaining four (4) feet is then backfilled with clean compacted soil. The boring location will then be surveyed for horizontal and vertical coordinates. All borehole abandonments are to be recorded on OWRB multi-purpose reports as well as Facility log books and records.

4.2 Site Reclamation

All drilling activities will be conducted in such a manner as to minimize any disturbance to the ground surface in the drilling area. A minimum number of vehicles will be brought to each drill site. All soil cuttings generated during drilling activities will be managed in accordance with state and federal regulations. Steps will be taken to minimize or prevent the discharge of drilling fluids or developed groundwater on the ground surface. Any accidental discharges will be cleaned up. Steps will be taken to minimize rutting of the off-road ground surface by vehicles by typically placing 3/4" plywood on the off-road ground and driving the vehicles on the plywood during periods of heavy precipitation and high ground moisture.

5.0 DOCUMENTATION OF FIELD DATA

Certain records will be maintained in logbooks and on field forms for sampling events and for daily activities. Some or all of the following forms will be used as appropriate to record the data generated at the site. These forms are:

- Borehole Abandonment Record
- Core Boring Field Report
- Chain-of-Custody Form
- Boring Record
- Drillers Log Summary
- Sample Labels
- Photographic Log and Labels
- Drill Rod and Auger Length Verification Form
- OWRB Multi-Purpose Report

Site safety, field measurements, and site activities data will be kept in the field log book. Examples of all field forms are presented in Appendix F. The field log book will be a bound book with consecutively numbered pages that will be suitable for submission as evidence in legal proceedings. The log book will become part of the permanent file for the site investigation. The log book will be used and maintained on a daily basis and all entries will be in ink.

6.0 SITE SAFETY PLAN

A Site Safety Plan will be prepared for use during hydrogeological field investigations. The Site Safety Plan will assess hazards at the site and will be prepared so as to present negligible hazards to site personnel and property owners. Environmental monitoring at the site will be performed in accordance with the Site Safety Plan.

7.0 DATA EVALUATION AND REPORTING PROCEDURES

Results and conclusions will require the review and assessment of the analytical results. Anomalous and unanticipated results may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the analytical results. All data review and reporting procedures will be in accordance with the Data Management Plan.

Table 1: List of Equipment and Supplies for Soil Sampling

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. Laboratory sample containers
25. Stainless steel bowls
26. Stainless steel spoons, trowels, or knifes
27. Bucket augers
28. Split spoons or Shelby tubes
29. Continuous tube samplers
30. Portland cement
31. Bentonite powder
32. Shovel
33. pH meter
34. PID organic vapor meter
35. 0.1 normal nitric acid
36. Potable water (for decon)

Attachment 3

ALARA Assessment
Calculation for Soil Cleanup Levels

Attachment 3

ALARA Assessment
Calculation for Soil Cleanup Levels

$$\frac{Conc}{CL} = \frac{\text{Cost}_T}{\$2000 \times P_D \times 0.01 \times F \times A} \times \frac{r+\lambda}{1-e^{-(r+\lambda)N}}$$

Inputs and Assumptions:

Cost_T = Total cost of remedial action: $1,429,787.

Cost_R –	$1,418,000 (Rec Plan, Table 7-1, Item 7.
Cost_{WD} –	The cost of waste disposal (placement of soil in onsite disposal cell) is included in the cost of remediation, Cost_R.
Cost_{Acc} –	$11,787; remediation as described for Cost_R, 4.2 x 10^{-8} accident/h, and $3,000,000 per fatality (NUREG-1727, Table D.2).
Cost_{TF} –	There will be no increase in the chance for traffic fatalities due to the fact that there will be no offsite shipments of waste material.
Cost_{WDose} –	The cost of worker dose is not included.
Cost_{PDose} –	There will be no change in public dose for this alternative since there is no offsite shipment of radioactive materials.
Cost_{Other} –	No other cost impacts are anticipated for this alternative.

$2000 =	Value in dollars of a person-rem.
P_D =	Population density for the critical group scenario in people/m^2; 0.0004 person/m^2. (NUREG-1727, Table D.2)
0.01 =	Annual dose to an average member of the critical group from residual radioactivity at the Cleanup Level (rem); i.e. fraction of the benchmark dose attributed to cleanup level = $\frac{100 pCi/g}{540 pCi/g} \times 0.054\, rem/y$.
F =	Fraction of the residual radioactivity removed by the remediation action. All residual activity is assumed remediated to the DCGL.
A =	Area being evaluated in square meters (m^2); the area of the benchmark dose calculation. (Rec Plan, Appendix G)
r =	Monetary discount rate in units of yr^{-1}; 0.03/y. (NUREG-1727, Table D.2)
λ =	Radiological decay constant for the radionuclide in units of yr^{-1}; input of zero since this parameter is overwhelmed by the monetary discount rate for each radionuclide of concern.
N =	Number of years over which the collective dose will be calculated; the design period of 1000 years. (NUREG-1727, Table D.2)
Conc =	The average concentration of residual radioactivity in the area that will be considered ALARA.

CL = The Cleanup Level for contaminated soil (Rec Plan, Table 3-1).

$$\frac{Conc}{CL} = \frac{\$1{,}429{,}787}{\$2000 \times \left(4 \times 10^{-4}\right) \times 0.01 \times 1 \times 263{,}120} \times \frac{0.03+0}{1-e^{-(0.03+0)1000}} = 20$$

This ratio will be the same for U-total, Th-230, and Ra-226 since the dose and the remediation technique for the respective CLs are assumed to be equivalent. Thus remediating to the cleanup levels certainly satisfies the ALARA requirement.

Attachment 4

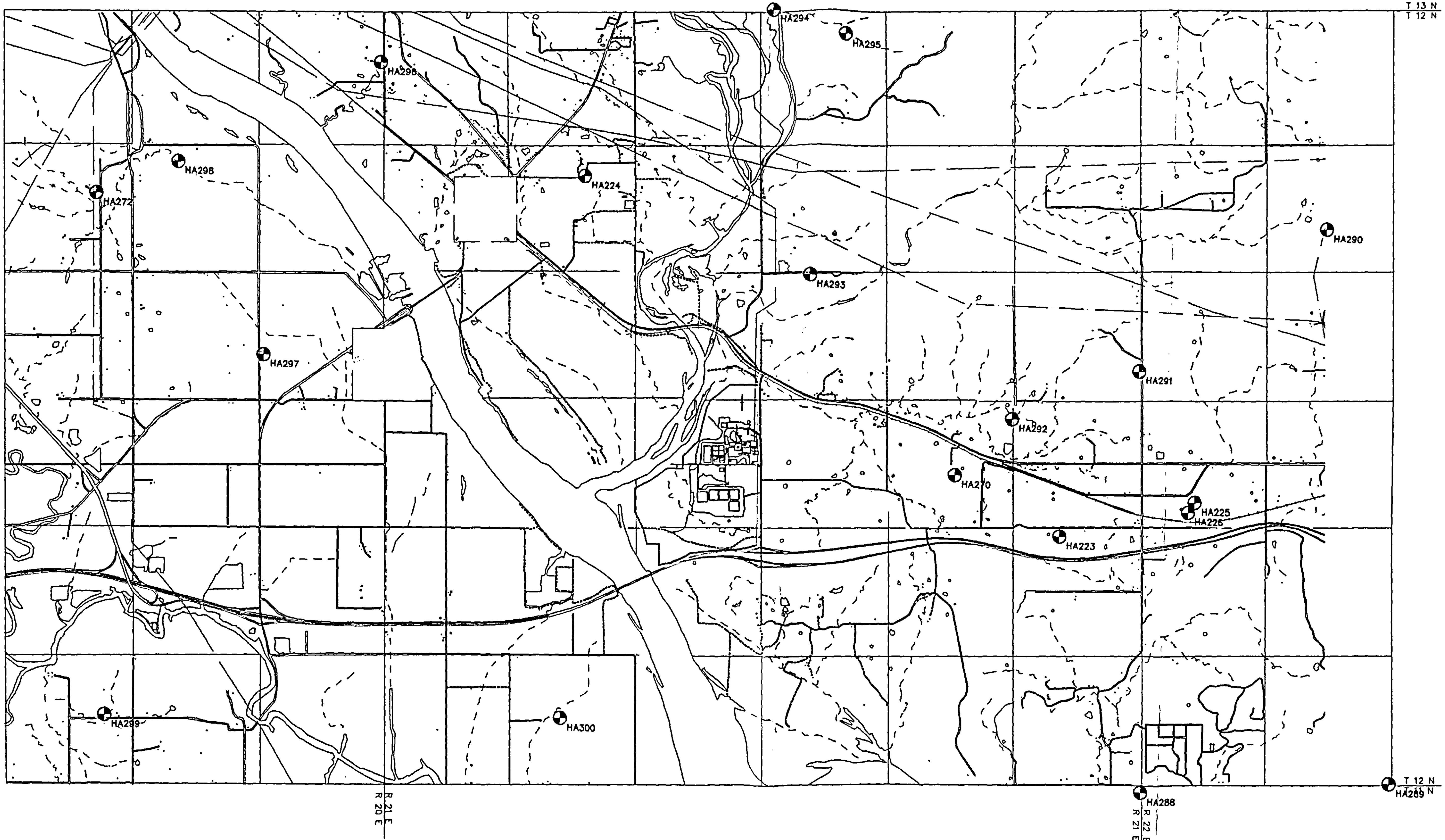
Background Soil Sample Analyses

Attachment 4

Background Soil Sample Analyses
Sample collection 1995
Sample analysis 2005

Location	Depth, ft Top	Depth, ft Bottom	U-total pCi/g			Th-230 pCi/g			Ra-226 pCi/g		
HA288	0	0.5	2.62	±	0.06	1.13	±	0.358	1.39	±	0.403
HA289	0	0.5	2.53	±	0.05	0.915	±	0.319	0.920	±	0.361
HA290	0	0.5	1.85	±	0.03	0.593	±	0.277	0.693	±	0.289
HA291	0	0.5	2.66	±	0.04	0.597	±	0.271	0.867	±	0.345
HA292	0	0.5	2.08	±	0.04	0.550	±	0.265	0.733	±	0.324
HA292 DUP	0	0.5	1.77	±	0.03	0.629	±	0.264	1.11	±	0.361
HA293	0	0.5	2.19	±	0.05	0.980	±	0.375	1.44	±	0.476
HA294	0	0.5	2.21	±	0.04	0.753	±	0.289	0.968	±	0.353
HA295	0	0.5	2.29	±	0.04	1.02	±	0.352	0.937	±	0.360
HA296	0	0.5	2.13	±	0.04	0.434	±	0.223	1.09	±	0.390
HA297	0	0.5	2.26	±	0.05	0.469	±	0.239	1.00	±	0.317
HA298	0	0.5	2.55	±	0.05	0.942	±	0.384	1.70	±	0.460
HA299	0	0.5	2.09	±	0.04	0.968	±	0.416	0.735	±	0.341
HA300	0	0.5	0.81	±	0.01	0.388	±	0.191	0.653	±	0.320

	U-total	Th-230	Ra-226
Average	2.1	0.7	1.0
Standard deviation	0.5	0.2	0.3
Count	14	14	14
Upper 95% confidence interval	2.4	0.9	1.2
% error at 95% CI	11	17	16



HA307 & HA308 ARE LOCATED APPROXIMATELY
12 MILES WEST OF MAIN PROCESSING PLANT.

0 2000 4000 8000
FEET

SEQUOYAH FUELS CORPORATION SITE CHARACTRIZATION REPORT	
TITLE: BACKGROUND SAMPLE LOCATIONS	
PREPARED BY: SFC	FILENAME: SFC0040A
REVIEWED BY: RM	FIGURE NO. 21
DATE: 01/21/05	