SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY

Sequoyah Fuels Corporation

Docket - 40-8027

Response to

Second Request for Additional Information

Ground Water Monitoring Plan

December 30, 2004

NMSS01

SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY

RE: 0456-N

December 30, 2004

Certified Mail – Return Receipt Requested
Receipt # 7004 1160 0004 4865 8798

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, Docket – 40-8027
Response to Second Request For Additional Information – Ground Water Monitoring Plan (TAC L52529)

Dear Mike,

This letter provides the Sequoyah Fuels Corporation response to the remaining 3 items in your second request for additional information (RAI) concerning the proposed Ground Water Monitoring Plan (GWMP). Items 1, 2 and 6 included in this response all concern monitoring locations and characterization.

In general, we reduced the number or changed the location of monitoring points in some of the shale units from those that you suggested in item 1. We have retained several wells that reside in the cell footprint or other areas requiring cleanup based upon the understanding that we may abandon and plug these wells prior to the onset of reclamation. These wells are identified in Tables 4 and 5, and noted on the drawings.

We will rename the plume monitoring points as "compliance monitoring points", and remove the "point of compliance" language from the GWMP consistent with item 2. We have retained the seeps, drains, and surface water monitoring as proposed in the January 2004 revision to the GWMP. In addition, we have specified the "corrective action monitoring" locations in the GWMP. The compliance monitoring locations will continue to be sampled annually while the corrective action monitoring locations will be monitored quarterly. Table 4 in the GWMP has been revised to reflect these changes.

Item 6 required additional characterization fieldwork which has been completed and the results are included in the enclosed materials. Two additional wells will be added to the southwest of Pond 2 for more complete monitoring of the 95A plume. These wells are included in Table 4 as compliance monitoring points.

Enclosed is our response to your specific comments, and revised figures and tables which reflect the changes to the proposed monitoring system summarized above. We intend to incorporate these revisions and submit a revised Final GWMP on March 1, 2005. Please review this material and provide any comments that you may have to us at your earliest convenience.

If you have any questions or wish to discuss our proposed changes to the GWMP, don't hesitate to call me at (918) 489-5511, ext. 13.

Sincerely,

John H. Ellis

John H. Ellis
President

XC: Bill Von Till, NRC
Rita Ware, EPA
Alvin Gutterman, MLB
Julian Fite, CN
Jim Barwick, OAG
Saba Tahmassebi, ODEQ

Enclosure 1

Sequoyah Fuels Corporation Response
Ground Water Monitoring Plan
Second Request for Additional Information

Sequoyah Fuels Corporation Response
Ground Water Monitoring Plan
Second Request for Additional Information

1. We conclude that your proposed compliance monitoring well coverage is inadequate to monitor the movement of existing groundwater contaminant plumes and to monitor areas downgradient of the plumes. In addition, a groundwater divide that trends east to west through the center of the facility's main process building has been observed yet Sequoyah Fuels Corporation (SFC) has not proposed adequate coverage in the flow directions to the north, south, and west of the divide. The ground water monitoring plan (GWMP) must include sufficient monitoring points to adequately define the plumes and their movement.

   It has been demonstrated through site characterization that preferential flow occurs at the site and sampling points at seeps and drainage outfalls are necessary to account for this phenomena. Therefore, all seeps, outfalls, and recovery trenches must either be added to the compliance monitoring network as part of the GWMP or SFC must provide justification for not including them. Trench recovery rates should be recorded and reported in monitoring reports along with estimated seep discharge rates. A map should be provided that illustrates all proposed sampling points along with drainage outfalls, and plumes for uranium, nitrate, arsenic, and fluoride.

   Based on the above, we conclude that additional sampling locations are needed. SFC can propose to use existing monitoring wells (where available) or install new wells. If SFC disagrees with the need to include any of the locations identified, it should provide, for each such location, justification showing that the specific layer will be adequately monitored without that monitoring point.

Response:

SFC has reviewed NRC's request regarding the need for additional sampling locations to monitor the movement of existing groundwater contamination plumes and to monitor areas downgradient of the plumes. SFC has considered NRC's comments, revised our proposed monitoring schedule and provided justification for the monitoring of each specific unit.

<u>Terrace/Shale 1</u>

SFC originally proposed that 6 wells be used to monitoring the Terrace/Shale 1 unit (MW007, MW010, MW031, MW040, MW042, AND MW087). NRC suggested that an additional 22 wells be used to monitor the Terrace/Shale 1 aquifer.

Thirteen of the wells suggested by NRC are in either the footprint of the proposed disposal cell or in areas were soil will be removed as part of the cleanup effort. These wells are MW008, MW014, MW019, MW025, MW035, MW036, MW053, MW054, MW075, MW077, MW079, MW080, and MW086. None of these wells were originally proposed since they could only be monitored for a year or two and were not providing any meaningful trend information. Based on conversations with NRC staff, it is understood that

these wells could be monitored until the soil cleanup and cell construction requires them to be abandoned. SFC agrees that these 13 wells will be added to the monitoring program and will be monitored until they have to be abandoned for cell construction or soil excavation.

Table 5 lists all the wells to be plugged and indicates which wells will be plugged immediately upon approval of this plan and which wells will be plugged at a later date. Some wells will continue to be used to monitor groundwater recovery efforts. Many of the wells are under the footprint of the proposed location for the onsite waste disposal cell or are in areas where contaminated soil will be excavated. These wells will be plugged and abandoned prior to construction of the cell or removal of contaminated soil. A revised Table 5 is attached.

In addition to the 13 wells in the cell footprint, NRC suggested another nine wells. SFC concurs that six of these wells might provide useful information. These six wells are MW045, MW049, MW056, MW062, MW070 and MW073.

The three remaining wells that were proposed by the NRC (MW021, MW072 and MW083) are redundant with other proposed wells and would not provide any useful additional information. MW070 and MW073, which are in the Groundwater Monitoring Plan, provide sufficient up-gradient information making MW072 and MW083 redundant. Likewise, MW007 will provide the same information as that which could be obtained from MW021. MW021, MW072 and MW083 that were proposed by NRC are not included on Figure 17. The location of these wells is shown on Figure 8 of the Groundwater Monitoring Plan.

Figure 17 shows the original 6 wells that were proposed, the additional six wells that will be monitored long term and the 13 wells that will be monitored until the cleanup and cell construction requires them to be abandoned. Different symbols have been used on the drawings to indicate if a well will be used for short term or long term monitoring. This labeling convention is used on all drawings included in this response. The 3 wells that were proposed that are deemed redundant and unnecessary are not included on Figure 17 but their location is shown on Figure 8 of the Groundwater Monitoring Plan. The wells shown on Figure 17 been grouped by those that will be used for long term monitoring and those that will be used on a short term basis until either soil excavation or cell construction requires their closure.

Shale 2

Three wells were originally proposed to monitor Shale 2 (MW048, MW050A, and MW121A). NRC suggested an additional 13 wells should be included. The additional wells suggested by NRC included six existing wells and seven new wells.

The existing wells that were suggested to be added to the Shale 2 monitoring program include wells MW042A, MW047A, MW057, MW058, MW062A and MW067. We concur that wells MW042A, MW047A and MW062A could provide additional information. However, we believe that the other proposed existing well locations are not necessary. MW057 and

MW058 are not necessary, as MW121A would provide the same information as could be obtained from these wells. MW121A would be located at the edge of the aquifer and within the fluoride, Arsenic and uranium plumes. MW057 and MW058 are located such that they would provide essentially the same information. MW067 is also not necessary since it would provide the same information as would be supplied by MW050A.

The first new well location suggested by NRC is redundant with MW062A as it is inside the arsenic plume but outside the uranium and fluoride plumes. The second proposed new well location will not provide any significant information that would not be obtained from wells MW121A and MW048. The third proposed new well location is also redundant with MW121A.

Well MW052A will be used to monitor the fourth suggested new well location suggested by NRC. This well is completed across the 2 and 3 Shale layers but would be adequate to monitor any movement in the northwest direction for both of these aquifers.

The fifth and sixth suggested new well locations are within the cell/soil cleanup area. Monitor wells MW018A and MW014A will be used to monitor the suggested locations until contaminated soil excavation and cell construction activities requires these wells to be abandoned. Both of these wells are completed across both the 2 and 3 shale layers and therefore would monitor both layers. Data from these wells were used to identify the uranium plumes in these areas and therefore are appropriate to monitor any changes that might occur to these areas.

Monitor well MW081A will be used as an up-gradient well in the area for the seventh new well location suggested by NRC. While this well is completed across several of the shale layers it should provide an adequate evaluation of any changes to up-gradient water quality.

Figure 18 shows the location of monitoring wells to be used on a long term and short term basis for evaluation of groundwater contamination.

Shale 3

SFC originally proposed that six locations be used to monitor the Shale 3 layer (MW007A, MW089A, MW122A, MW123A, and MW127A). NRC suggested that an additional seven existing locations and five new locations be used for monitoring.

The seven existing locations that were suggested by NRC for inclusion in the monitoring program include monitoring wells 2303A, 2346, 2224A (005 Collection Trench), MW049A, MW084A, MW086A and MW115A. We concur that monitor wells 2346, 2224A (005 Collection Trench), MW084A, MW086A and MW115A would provide additional information. MW084A and MW086A will be monitored until cell construction and soil cleanup required these wells to be abandoned.

The other two suggested wells, 2303A and MW049A, are not necessary and would be redundant with MW127A and 2224A (005 Collection Trench) since they are in the same general area and in the same plume.

Five new locations were suggested. The first suggested new well location is not necessary. Upon review of this request it was concluded that MW124A should be moved to the northwest and would best meet the objectives of the NRC request for the well near the first suggested well location and the original purpose for MW124A.

Similarly, it is proposed that MW123A be moved to the southwest near the edge of the shale unit. This will meet the monitoring objectives of the second proposed new well location and the original purpose for MW123A.

The third proposed new well location is not necessary since the proposed well is outside the plumes in the northwest direction and down gradient from MW089A which is also outside of the contaminant plumes. An additional well further to the northwest would not supply any additional information.

The fourth proposed new well location is near the location of MW014A. This well is part of the proposed monitoring system for Shale 2. As stated above, MW014A was completed across Shale 2 and Shale 3. This well was used to identify the plume in both layers and is therefore appropriate to use to monitor changes in both layers. It should be noted that this well will be abandoned when cell construction begins.

The fifth proposed new well location is near existing monitoring well MW050A which was proposed for Shale 2 monitoring. Since this well is completed across Shale 2 and 3 and was originally used to identify the uranium plume in this area it is appropriate to use this well to monitor Shale 3 as well as Shale 2.

Figure 19 shows the location of the monitoring wells to be sampled in Shale 3. Location 2224A (005 Collection Trench) is shown on Figure 22.

Shale 4

Nine locations were originally proposed to monitor Shale layer 4 (MW059A, MW062A, MW095A, MW096A, MW110A, MW112A, MW125A, MW126A, AND MW128A). In addition, NRC has suggested that an additional 7 existing groundwater locations and 5 surface water (drainage) sampling locations be added to the monitoring system.

NRC suggested monitoring locations including monitoring wells MW097A, MW099A, MW107, MW111A, MW114A and 2247 (MW095A Collection Trench). Of these locations we concur that locations MW097A, MW107, MW108, MW111A and 2247 (MW095A Collection Trench) would provide additional information. MW114A is not necessary since it is literally a few feet from MW111A. Additionally, MW099A is redundant with MW096A. SFC determined that MW099A would be a more effective well to monitor the groundwater conditions in this area and has decided to use this well instead of MW096A, as originally proposed in the Groundwater Monitoring Plan.

SFC determined during the evaluation of the arsenic plume near MW095A (see response to RAI-6) that an additional well should be installed in Shale 4 south of MW095A to determine the extent of the arsenic plume in that direction and to monitor the effectiveness of the 95A recovery trench. MW129A has been added to satisfy this need.

Given that SFC has added MW107 and MW108, the new well MW128A that was originally proposed is no longer needed and this new well not be constructed.

Drainage sampling locations 2241, 2242, 2243, 2244, and 2245 are included in the Groundwater Monitoring Plan as revised in January 2004 and will be retained.

Figure 20 shows the location of the monitoring wells to the sampled in Shale 4. The recovery systems and surface water locations are shown on Figure 22.

Shale 5

Three wells (MW007B, MW059B and MW105B) were originally proposed for Shale 5 monitoring. NRC suggested an additional three existing wells (MW090B, MW098B and MW100B) be monitored and two new wells (STA04 and MW128B) be constructed and monitored. In addition, one drainage sampling location (2241) was identified as part of the Shale 5 monitoring. We concur that all of these locations would provide additional information and the existing wells that were identified will be monitored and new wells will be constructed at the two locations indicated. The monitoring well locations are shown on Figure 21. The drainage sampling location is shown on Figure 22.

Corrective Action / Drainage / Surface Water

SFC has installed three groundwater recovery trenches that will be monitored. These locations are 2224A (005 Collection Trench), 2247 (MW095A Collection Trench) and 2248 (MW010 Collection Trench). In addition, a short trench was installed in the bottom of the 005 Drainage down gradient of 2224A and is identified as 2224B (005 Monitor Trench). The locations of the collection trenches and the 005 Monitor Trench is shown on Figure 22. SFC will also monitor the seeps, drainages and surface water locations shown on Figure 22.

Monitoring Schedule

Table 4 from the Groundwater Monitoring Plan has been revised to reflect the changes made in response to this request for additional information from NRC. A revised copy of Table 4 is attached and includes both the long term and short term monitoring locations to be sampled. Sampling frequencies and parameters to be analyzed for are also included in Table 4. Wells not included in Table 4 will be plugged and abandoned after approval of the Groundwater Monitoring Plan is received. Table 5 shows the wells that we plan to plug abandon as the Reclamation Plan is implemented. Table 4 supercedes the monitoring schedules provided in Tables 4 and 5 from earlier submittals of the Groundwater Monitoring Plan.

2. All sampling points must be named "compliance monitoring points". This was stated in item 2 of our October 31, 2003 Request for Additional Information. Point of compliance wells will be established for the reclamation cell at a later date but is not part of the GWMP for existing contamination.

Response:

10 CFR Part 40, Appendix A, Criterion 7A states that "the licensee shall establish and implement a compliance monitoring program. The purpose of the compliance monitoring program is to determine that hazardous constituent concentrations in groundwater continue to comply with the standards set by the Commission. In conjunction with a corrective action program, the licensee shall establish and implement a corrective action monitoring program. The purpose of the corrective action monitoring program is to demonstrate the effectiveness of the corrective actions." NUREG-1620 section 4.4 outlines the staff's guidance for compliance monitoring programs. In order to protect human health and the environment from groundwater contamination, ground water monitoring plans must be able to detect contamination prior to any potential exposure, monitor corrective action performance, and monitor plume movement over time and distance.

Consistent with our understanding of Criterion 7A and the staff's guidance in NUREG-1620 section 4.4, SFC has designated all monitoring points used to monitor contaminant plume movement over time and distance prior to any potential exposure as "Compliance Monitoring" points, and all locations used to monitor the effectiveness of corrective actions as "Corrective Action Monitoring" points. SFC has retained the potential exposure monitoring locations in the GWMP and has designated these as "Seep and Drainage Monitoring" points. In this revision, SFC dropped all mention of "point of compliance" monitoring which is covered in the Reclamation Plan. See Table 4.

6. As stated in item 1 of our October 31, 2003 Request for Additional Information, groundwater contamination as a result of facility operations has not been fully characterized. SFC has satisfied some of the original concerns, however, the following concerns have not been addressed:

   a. arsenic down-gradient of MW095A in the shallow bedrock has not been adequately delineated, and

   b. further delineation is needed down gradient of MW50A in Shale 2.

Response:

a. SFC has completed an additional evaluation to complete the characterization of the arsenic plume down gradient of MW095A in the shallow bedrock. Lithology and completion logs from groundwater monitoring wells and two investigation trenches have been used to better understand the hydrogeological conditions in this area. Figure No. RAI6-1 shows the location of MW095A and other monitoring wells in the area, the MW095A Collection Trench, MW095A Recovery Pit, seep/drainage sample locations, Unit 4 Shale Boundary and other physical features. Two cross sections have been prepared to illustrate the hydrogeological conditions in this area. The locations of these cross sections (A-A' and B-B') are shown on Figure RAI6-1.

Cross Section A-A' is shown in Figure RAI6-2. Unit 4 Shale is a continuous, water-bearing unit from the Pond 2 area to just downgradient from monitor well MW095A where it is eroded away. Underlying Unit 4 Shale is Unit 4 Sandstone which is dry and acts as a barrier to downward migration of groundwater contained in Shale 4. Unit 4 Sandstone is also continuous from the Pond 2 area westward under 001 drainage. The 001 drainage is eroded into the surface of Unit 4 Sandstone, and acts as a hydraulic barrier to further westward movement of emerging groundwater from Shale 4. Unit 4 Sandstone is underlain by Shale 5, the next deeper water-bearing unit, which is continuous throughout the site.

Arsenic contamination in the groundwater originating from the Pond 2 area has been transported through Unit 4 Shale to the 001 Drainage down gradient from MW095A. Contaminated groundwater from the Unit 4 Shale discharges to the colluvium deposits at the extent of the shale and exits the ground near the 001 Drainage. The emerging groundwater flows across the surface of Unit 4 Sandstone into the 001 Drainage which flows intermittently to the Headwaters of the Robert S. Kerr Reservoir.

Three monitoring wells are located immediately down gradient from MW095A. STA03 is completed into the Unit 4 Shale close to, but not quite as deep as, MW095A. STA04 and STA05 are both completed into Unit 5 Shale. Arsenic analyses for samples collected from STA03 are above the MCL (0.05 mg/l) on an average basis, while analyses of samples from STA04 and STA05 are below the MCL. Analyses of water samples collected from the seep (Sample Location 2245) located north of STA04 and the Port Road Bridge are below the MCL on an average basis, but are elevated above background. Individual samples collected from 2245, the seep north of the Port Road Bridge, exceed the MCL on some occasions. Average arsenic analyses for samples collected since January 1, 2001 from the sampling locations shown on Figure RAI6-1 are summarized in the following table:

Table 1 - Summary of Arsenic Analyses – Samples Collected Since 2001

Sample Location	Mean Value (mg/l)	Sample Location	Mean Value (mg/l)
MW057A	5.14	STA03	0.069
MW059A	1.32	STA04	0.006
MW092A	0.012	STA05	0.006
MW093A	0.037	2245 (seep)	0.025
MW095A	0.080	2246 (001 Drainage)	0.015
MW097A	0.011	2247 (95A Trench)	0.099
STA02	0.006	2247A (95A Pit)	0.079

As seen from the data, arsenic concentrations decrease from the source (Pond 2) to the exposure point (2245) as the contaminated water moves toward the 001 Drainage. A downward trend has been observed since January 2003 in the arsenic concentrations at sample location 2245. This downward trend is attributed to the groundwater recovery system installed in this area. Figure 1 shows that the concentrations have decreased from greater than the MCL (0.05 mg/l) to less than 0.01 mg/l at 2245.

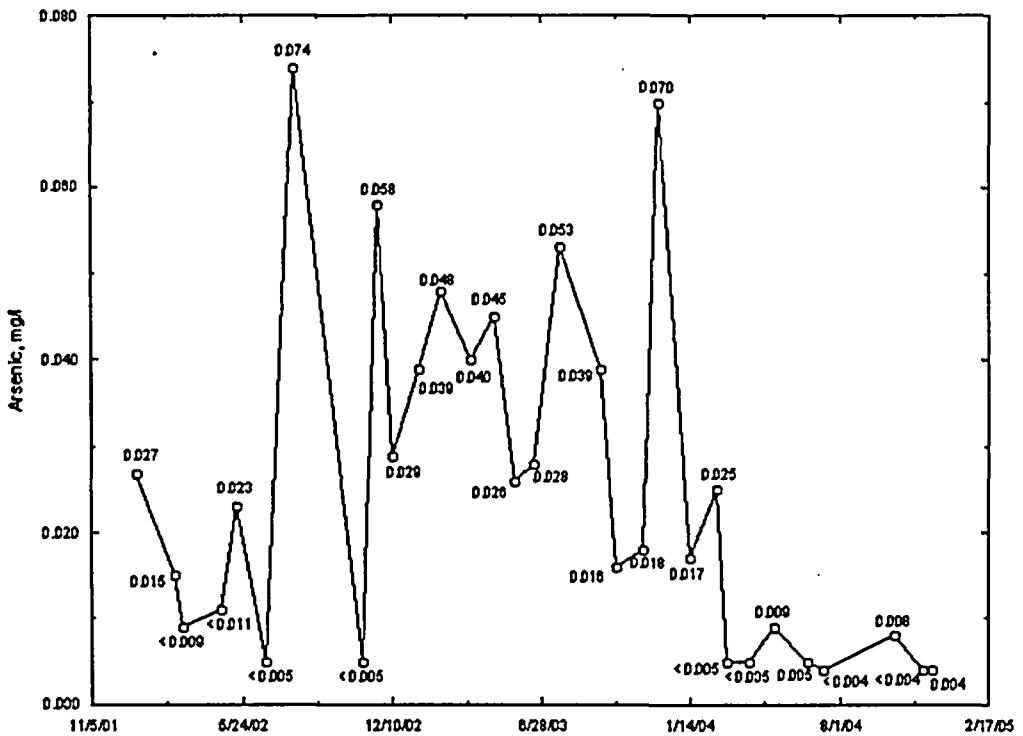


Figure 1 – As Analyses at Port Road Bridge Seep (2245)

Adequate monitoring locations are available to track the progression of the arsenic plume to the west of Pond 2 without installing any new wells. STA04 has been added to the GWMP to provide adequate monitoring down gradient of MW095A in the next lower groundwater unit.

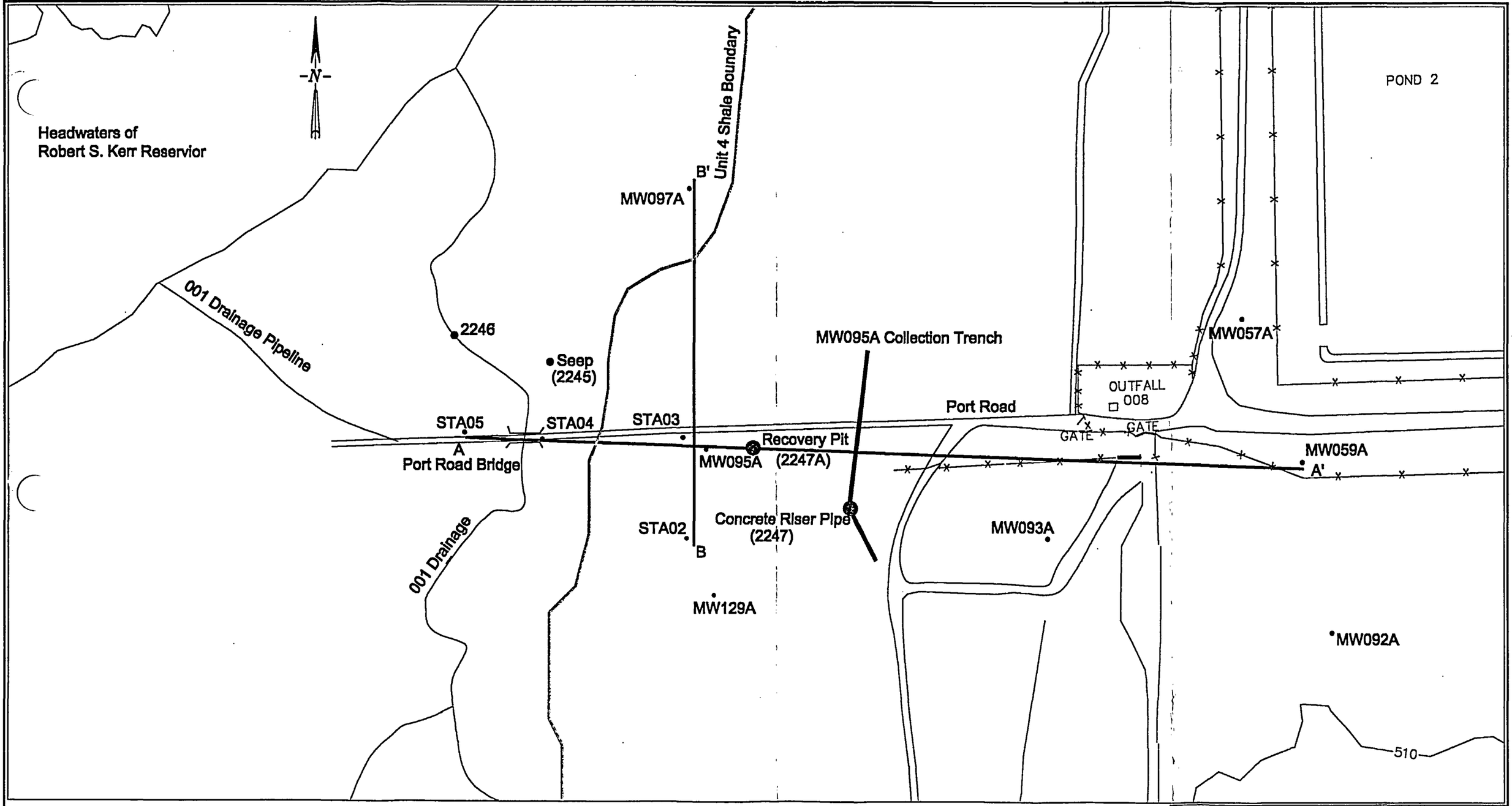
Figure RAI6-3, Cross Section B-B', defines the plume boundary to the north but not the south. This cross section shows that Unit 4 Shale has eroded away to the north. Visual observations during the trenching operations verified that no water is present in Shale 4 north of the collection trench installed in this area. After reviewing the physical data and trenching observations to the south, Shale 4 continues beyond the extent of the collection trench and no wells are completed in this unit immediately to the south. STA02 which is located south of the affected area is not completed in Unit 4 Shale. Sample results from MW092A and MW093A indicate that arsenic could be present beyond the south end of the collection system. Therefore, SFC has determined that an additional well should be completed in the Unit 4 Shale south of

MW095A. Monitoring Well MW129A will be installed and added to the GWMP to bound the arsenic impact to groundwater in this area.

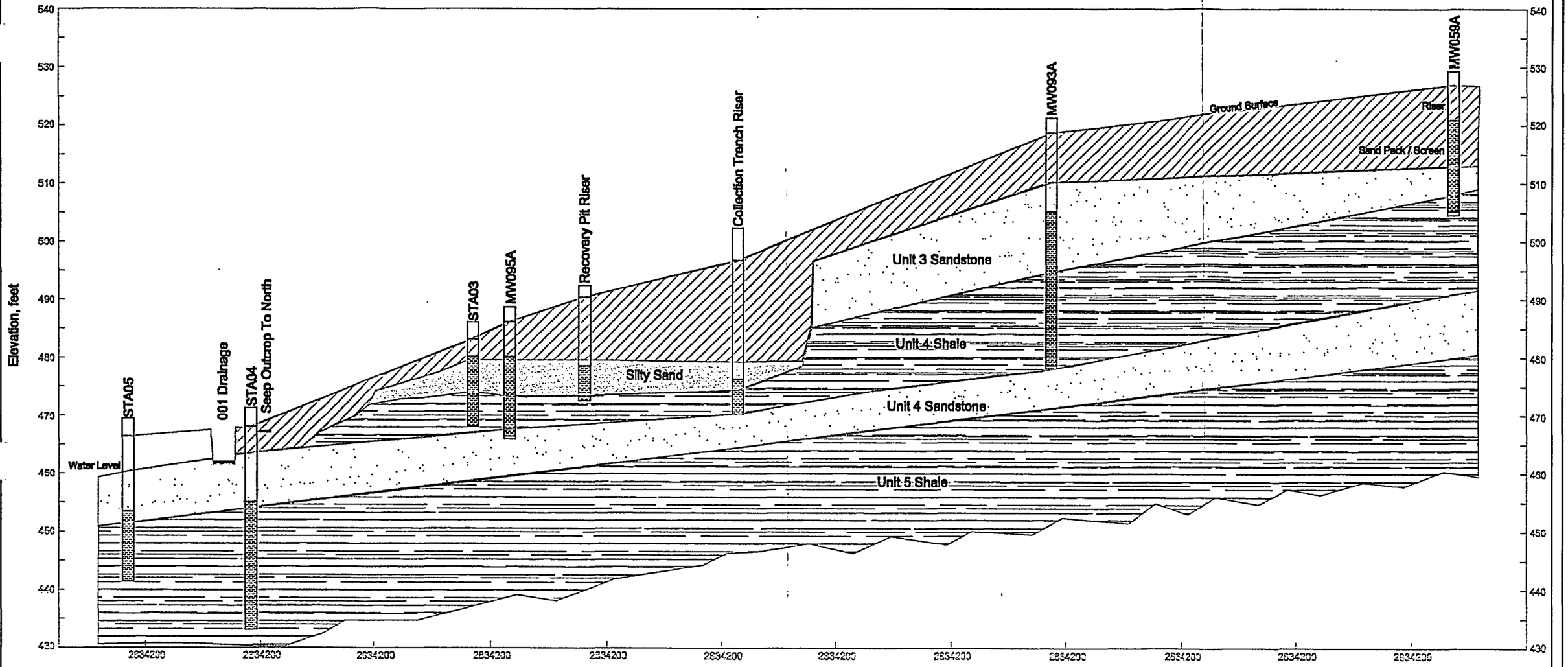
b. SFC has completed an investigation of the northwest area of the Facility to further delineate uranium contamination in the groundwater down gradient of MW050A. Two investigation trenches were excavated, one to the north and one to the west of MW050A. A report titled "Investigation of Uranium in Groundwater – Northwest Area of Sequoyah Facility" is included as Enclosure 3 to this submittal. From that investigation, SFC determined the following:

   - No free water was encountered in geological strata situated above Unit 4 Shale in either trench.
   - The lack of free water in geological strata above Unit 4 Shale indicates that, the extent of horizontal transport of potential contamination is less than previously predicted.
   - In light of this new information, downward movement of contamination to Unit 4 Shale is expected, primarily during high precipitation events.
   - Horizontal transport will be in the Unit 4 Shale which ultimately discharges to the 007 Drainage.

   Refer to Enclosure 3 for details of the investigation.



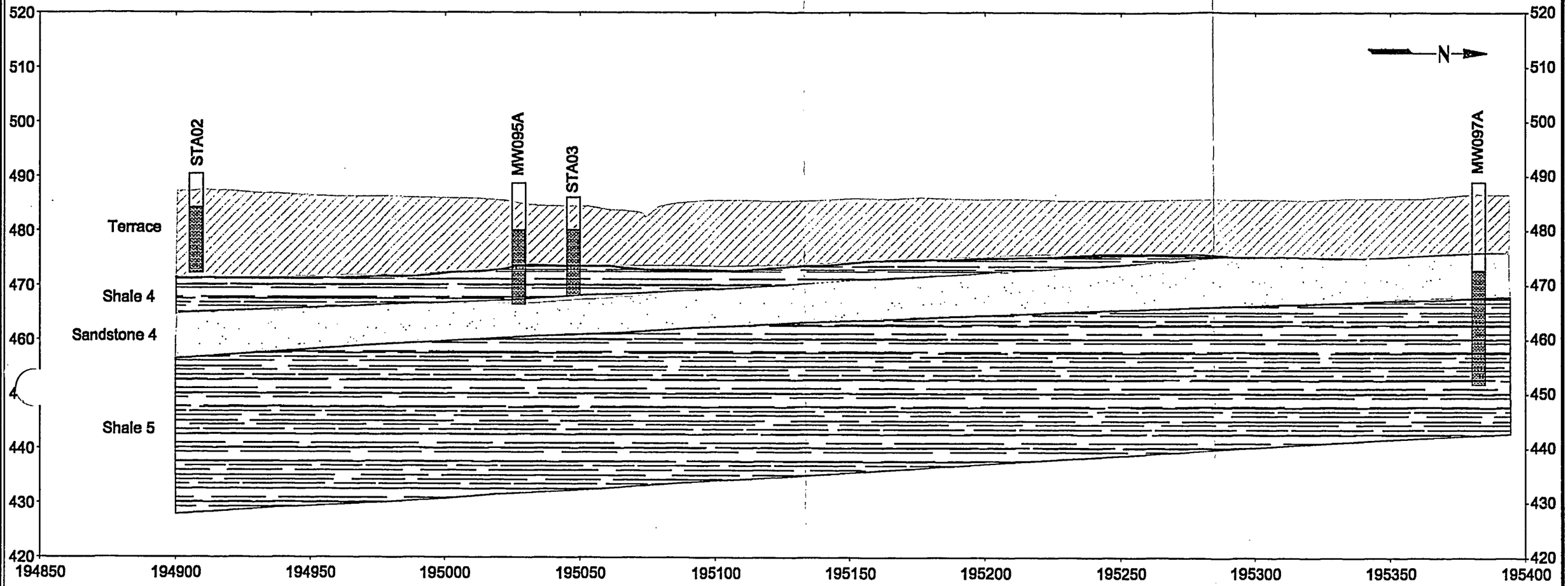
SEQUOYAH FUELS CORPORATION	
Groundwater Monitoring Plan	
Title: Monitoring Well MW095A Arsenic Impact Area Evaluation	
PREPARED BY: SCM	Filename: MW095A_As_Impact_Eval.dwg
Reviewed by: SCM	Figure No. RAI6-1
Date: 13 Dec 2004	



Cross Section Looking North

SEQUOYAH FUELS CORPORATION
Monitor Well MW095A Area Arsenic Evaluation

Title: Cross Section A - A'	
Prepared By: SCM	Filename: CrossSectionA_A.dwg
Reviewed by: SCM	Figure No. RAI6-2
Date: 17 Dec 2004	



Looking West

SEQUOYAH FUELS CORPORATION

Monitor Well MW095A Area Arsenic Evaluation

Title: Cross Section B - B'	
PREPARED BY: SCM	Filename: CrossSectionB_B_final.dwg
Reviewed by: SCM	Figure No. RAI6-3
Date: 17 Dec 2004	

Enclosure 2

Ground Water Monitoring Plan
Revised Tables and Figures

Table 4
Groundwater Monitoring Plan
Sampling and Analysis Schedule

Monitor ID	Location	Groundwater Unit Monitored	Parameters Analyzed
Background Quality Monitoring (Annual Sampling Frequency)			
MW007	Northeast of Main Process Building	Terrace / Shale 1	See Note 1
MW070	NE of DUF4 Building Near Property Boundary	Terrace / Shale 1	See Note 1
MW073	East of OG&E Substation Near Property Line	Terrace / Shale 1	See Note 1
MW007A	Northeast of Main Process Building	Shale 3	See Note 1
MW110A	East of Facility	Shale 4	See Note 1
MW007B	Northeast of Main Process Building	Shale 5	See Note 1
Compliance Monitoring (Annual Sampling Frequency)			
MW008[2]	Between MPB and Administration Building	Terrace / Shale 1	U, NO3(N), F, As
MW010[2]	Southwest of Main Process Building	Terrace / Shale 1	U, NO3(N), F, As
MW014[2]	South of Bechtel Building	Terrace / Shale 1	U, NO3(N), F, As
MW019[2]	South of Loading Dock	Terrace / Shale 1	U, NO3(N), F, As
MW025[2]	SX Yard North of SX Building	Terrace / Shale 1	U, NO3(N), F, As
MW035[2]	North of Pond 1 Spoils Pile	Terrace / Shale 1	U, NO3(N), F, As
MW036[2]	West of Sanitary Lagoon on Pond 1 Spoils Pile	Terrace / Shale 1	U, NO3(N), F, As
MW040	North of Basin 1 of Clarifier A	Terrace / Shale 1	U, NO3(N), F, As
MW042	South of Yellowcake Sump	Terrace / Shale 1	U, NO3(N), F, As
MW045	Northeast Corner of Pond 2	Terrace / Shale 1	U, NO3(N), F, As
MW049	South of Fluorisde Sludge Holding Basin 2 (North)	Terrace / Shale 1	U, NO3(N), F, As
MW053[2]	North of Sanitary Lagoon on Emergency Basin Bank	Terrace / Shale 1	U, NO3(N), F, As
MW054[2]	West of Pond 1 Spoils Pile at Base of Slope	Terrace / Shale 1	U, NO3(N), F, As
MW056	Northwest Corner of '86 Incident Sod Storage Area	Terrace / Shale 1	U, NO3(N), F, As
MW062	South of Fluoride Sludge Holding Basin1 (South)	Terrace / Shale 1	U, NO3(N), F, As
MW075[2]	South of Incinerator	Terrace / Shale 1	U, NO3(N), F, As
MW077[2]	NW of DUF4 Building Near Fence	Terrace / Shale 1	U, NO3(N), F, As
MW079[2]	NE of Bechtel Building on UF6 Cylinder Pad	Terrace / Shale 1	U, NO3(N), F, As
MW080[2]	West of DUF4 Building in Concrete Pad	Terrace / Shale 1	U, NO3(N), F, As
MW086[2]	NE Corner of Cooling Tower	Terrace / Shale 1	U, NO3(N), F, As
MW087	Old Contaminated Solid Waste Burial Area	Terrace / Shale 1	U, NO3(N), F, As
MW014A[2]	South of Bechtel Building	Shale 2, 3	U, NO3(N), F, As
MW018A[2]	Southwest Corner of MPB	Shale 2	U, NO3(N), F, As
MW042A	South of South Yellowcake Sump in Parking Lot	Shale 2	U, NO3(N), F, As

Table 4
Groundwater Monitoring Plan
Sampling and Analysis Schedule

Monitor ID	Location	Groundwater Unit Monitored	Parameters Analyzed
MW047A	Northwest Corner of Pond 2	Shale 2	U, NO3(N), F, As
MW048	West of Pond 2	Shale 2	U, NO3(N), F, As
MW050A[2]	North of Fluoride Basin No. 2	Shale 2, 3	U, NO3(N), F, As
MW052A	West of Fluoride Sludge Holding Basin 2 (North)	Shale 2	U, NO3(N), F, As
MW081A	N of DUF4 Building Near Perimeter Fence	Shale 2	U, NO3(N), F, As
MW121A[3]	Southwest of Pond 2	Shale 2	U, NO3(N), F, As
2346	Southwest of Pond 6	Shale 3	U, NO3(N), F, As
MW084A[2]	SW of Misc Digestion on YC Pad	Shale 3	U, NO3(N), F, As
MW086A[2]	NE Corner of Cooling Tower	Shale 3	U, NO3(N), F, As
MW089A	Northwest of Fluoride Holding Basin No. 2	Shale 3	U, NO3(N), F, As
MW115A	South of Pond 2	Shale 3	U, NO3(N), F, As
MW122A[3]	Northwest of Pond 2	Shale 3	U, NO3(N), F, As
MW123A[3]	Southwest of Pond 2	Shale 3	U, NO3(N), F, As
MW124A[3]	South of Pond 5	Shale 3	U, NO3(N), F, As
MW127A[3]	Southwest of Fluoride Holding Basin No. 2	Shale 3	U, NO3(N), F, As
MW059A	Southwest of Pond 2	Shale 4	U, NO3(N), F, As
MW062A	South of Fluoride Holding Basin No. 1	Shale 4, 2	U, NO3(N), F, As
MW097A	West of Pond 2 at Property Boundary	Shale 4	U, NO3(N), F, As
MW099A	Northwest Corner of Industrial Area in Woods	Shale 4	U, NO3(N), F, As
MW107	800 Feet West of Pond 5	Shale 4	U, NO3(N), F, As
MW108	800 Feet Southwest of Pond 5	Shale 4	U, NO3(N), F, As
MW111A	Northeast Portion of Agland	Shale 4	U, NO3(N), F, As
MW112A	Southwest Portion of Facility on Agland Field	Shale 4	U, NO3(N), F, As
MW125A[3]	South of Pond 3 East	Shale 4	U, NO3(N), F, As
MW126A[3]	Southwest of Pond 5	Shale 4	U, NO3(N), F, As
MW129A[3]	Southwest of Pond 2 Near Facility West Boundary	Shale 4	U, NO3(N), F, As
MW059B	Southwest of Pond 2	Shale 5	U, NO3(N), F, As
MW090B	Northwest of Pond 5 Near Reservoir Weir	Shale 5	U, NO3(N), F, As
STA04	Southwest of Pond 2 Near Port Road Bridge	Shale 5	U, NO3(N), F, As
MW098B	West of Pond 2 at Property Boundary (old 004 Path)	Shale 5	U, NO3(N), F, As
MW100B	West of Fluoride Sludge Holding Basin 2 in 005 Drainage	Shale 5	U, NO3(N), F, As

Table 4
Groundwater Monitoring Plan
Sampling and Analysis Schedule

Monitor ID	Location	Groundwater Unit Monitored	Parameters Analyzed
MW105B	West of Pond 5	Shale 5	U, NO3(N), F, As
MW128B[3]	SW portion of the Agland	Shale 5	U, NO3(N), F, As
Corrective Action Monitoring (Quarterly Sampling Frequency)			
2224A	005 Collection Trench	Shale 3	U, NO_3(N), F, As
2224B	005 Monitor Trench	Shale 3	U, N03(N), F, As
2247	95A Collection Trench	Shale 4	U, N03(N), F, As
MW095A	Southwest of Pond 2 Near Facility West Boundary	Shale 4	U, N03(N), F, As
2248	10 Collection Trench	Terrace/Shale 1	U, N03(N), F, As
MW031	South of Main Process Building	Terrace/Shale 1	U, N03(N), F, As
Seep and Drainage Monitoring (Quarterly Sampling Frequency)			
2241	005 Drainage - 25 feet East of COE Property Boundary Fence	Shale 5	U, N03(N), As
2242	005 Drainage - Pool Near MW100B	Shale 4	U, N03(N), As
2243	007 Drainage at Drainage from North Holding Basin	Shale 4	U, N03(N), As
2244	004 Drainage - 20 feet East of COE Property Boundary Fence	Shale 4	U, N03(N), As
2245	Seep North of Port Road Bridge and East of 001 Drainage	Shale 4	U, N03(N), F, As
2246	001 Drainage N of Port Road Bridge	Shale 4	U, N03(N), As
Surface Water Monitoring (Annual Sampling Frequency)			
2201	Illinois River - 1600 feet Upstream of 001 Confluence		U, NO_3(N), As, Ra-226
2202	Illinois River - 600 feet Downstream of 001 Confluence		U, NO_3(N), As, Ra-226
2203	Arkansas River - Upstream Towards Highway 64 Bridge		U, NO_3(N), As, Ra-226
2204	Arkansas River - Downstream Near I-40 Bridge		U, NO_3(N), As, Ra-226

Note 1: Analyze for antimony, arsenic, barium, beryllium, cadmium, chromium, fluoride, lead, molybdenum, nickel, nitrate(as N), radium-226, selenium, thallium, thorium-230 and uranium
Note 2: Well will be abandoned and plugged as necessary to allow reclamation activities
Note 3: Well installed upon approval of GWMP

Table 5
Monitoring Well Plugging and Abandonment Schedule

Location	Plugging Schedule[1]	Location	Plugging Schedule[1]
2301A	After Approval of GW Monitoring Plan	MW018	After Approval of GW Monitoring Plan
2301B	After Approval of GW Monitoring Plan	MW018A	Maintain until Reclamation
2302A	After Approval of GW Monitoring Plan	MW019	Maintain until Reclamation
2302B	After Approval of GW Monitoring Plan	MW019A	After Approval of GW Monitoring Plan
2303A	After Approval of GW Monitoring Plan	MW020	After Approval of GW Monitoring Plan
2322A	After Approval of GW Monitoring Plan	MW020A	After Approval of GW Monitoring Plan
2340A	After Approval of GW Monitoring Plan	MW021	After Approval of GW Monitoring Plan
2341	After Approval of GW Monitoring Plan	MW021A	After Approval of GW Monitoring Plan
2342	After Approval of GW Monitoring Plan	MW022	After Approval of GW Monitoring Plan
2343	After Approval of GW Monitoring Plan	MW022A	After Approval of GW Monitoring Plan
2344	After Approval of GW Monitoring Plan	MW023	After Approval of GW Monitoring Plan
2345	After Approval of GW Monitoring Plan	MW024	After Approval of GW Monitoring Plan
2347	After Approval of GW Monitoring Plan	MW024A	After Approval of GW Monitoring Plan
2348	After Approval of GW Monitoring Plan	MW025	Maintain until Reclamation
2349	After Approval of GW Monitoring Plan	MW025A	After Approval of GW Monitoring Plan
2350	After Approval of GW Monitoring Plan	MW026	After Approval of GW Monitoring Plan
2351	After Approval of GW Monitoring Plan	MW026A	After Approval of GW Monitoring Plan
2352	After Approval of GW Monitoring Plan	MW027	After Approval of GW Monitoring Plan
2353	After Approval of GW Monitoring Plan	MW027A	After Approval of GW Monitoring Plan
2354	After Approval of GW Monitoring Plan	MW028	After Approval of GW Monitoring Plan
2355	After Approval of GW Monitoring Plan	MW028A	After Approval of GW Monitoring Plan
2356	After Approval of GW Monitoring Plan	MW029	After Approval of GW Monitoring Plan
FTP-2B	After Approval of GW Monitoring Plan	MW030	After Approval of GW Monitoring Plan
MW001	After Approval of GW Monitoring Plan	MW030A	After Approval of GW Monitoring Plan
MW002	After Approval of GW Monitoring Plan	MW031A	After Approval of GW Monitoring Plan
MW002A	After Approval of GW Monitoring Plan	MW032	After Approval of GW Monitoring Plan
MW003	After Approval of GW Monitoring Plan	MW032A	After Approval of GW Monitoring Plan
MW003A	After Approval of GW Monitoring Plan	MW035	Maintain until Reclamation
MW004	After Approval of GW Monitoring Plan	MW035A	After Approval of GW Monitoring Plan
MW004A	After Approval of GW Monitoring Plan	MW036	Maintain until Reclamation
MW005	After Approval of GW Monitoring Plan	MW036A	After Approval of GW Monitoring Plan
MW005A	After Approval of GW Monitoring Plan	MW037	After Approval of GW Monitoring Plan
MW006	After Approval of GW Monitoring Plan	MW037A	After Approval of GW Monitoring Plan
MW006A	After Approval of GW Monitoring Plan	MW038	After Approval of GW Monitoring Plan
MW008	Maintain until Reclamation	MW038A	After Approval of GW Monitoring Plan
MW008A	After Approval of GW Monitoring Plan	MW039	After Approval of GW Monitoring Plan
MW009	After Approval of GW Monitoring Plan	MW039A	After Approval of GW Monitoring Plan
MW009A	After Approval of GW Monitoring Plan	MW040A	After Approval of GW Monitoring Plan
MW010	Maintain until Reclamation	MW041	After Approval of GW Monitoring Plan
MW010A	After Approval of GW Monitoring Plan	MW041A	After Approval of GW Monitoring Plan
MW011	After Approval of GW Monitoring Plan	MW043	After Approval of GW Monitoring Plan
MW011A	After Approval of GW Monitoring Plan	MW045A	After Approval of GW Monitoring Plan
MW012	After Approval of GW Monitoring Plan	MW046	After Approval of GW Monitoring Plan
MW012A	After Approval of GW Monitoring Plan	MW046A	After Approval of GW Monitoring Plan
MW012B	After Approval of GW Monitoring Plan	MW047	After Approval of GW Monitoring Plan
MW013	After Approval of GW Monitoring Plan	MW048A	After Approval of GW Monitoring Plan
MW013A	After Approval of GW Monitoring Plan	MW049A	After Approval of GW Monitoring Plan
MW014	Maintain until Reclamation	MW050	After Approval of GW Monitoring Plan
MW014A	Maintain until Reclamation	MW050A	Maintain until Reclamation
MW015	After Approval of GW Monitoring Plan	MW050B	After Approval of GW Monitoring Plan
MW016	After Approval of GW Monitoring Plan	MW051	After Approval of GW Monitoring Plan
MW016A	After Approval of GW Monitoring Plan	MW051A	After Approval of GW Monitoring Plan
MW017	After Approval of GW Monitoring Plan	MW052	After Approval of GW Monitoring Plan
MW017A	After Approval of GW Monitoring Plan	MW053	Maintain until Reclamation

Table 5
Monitoring Well Plugging and Abandonment Schedule

Location	Plugging Schedule[1]	Location	Plugging Schedule[1]
MW054	Maintain until Reclamation	MW053A	After Approval of GW Monitoring Plan
MW055	After Approval of GW Monitoring Plan	MW078A	After Approval of GW Monitoring Plan
MW057	After Approval of GW Monitoring Plan	MW079	Maintain until Reclamation
MW057A	After Approval of GW Monitoring Plan	MW079A	After Approval of GW Monitoring Plan
MW058	After Approval of GW Monitoring Plan	MW080	Maintain until Reclamation
MW058A	After Approval of GW Monitoring Plan	MW080A	After Approval of GW Monitoring Plan
MW060A	After Approval of GW Monitoring Plan	MW082	After Approval of GW Monitoring Plan
MW061A	After Approval of GW Monitoring Plan	MW082A	After Approval of GW Monitoring Plan
MW062B	After Approval of GW Monitoring Plan	MW083	After Approval of GW Monitoring Plan
MW063	After Approval of GW Monitoring Plan	MW083A	After Approval of GW Monitoring Plan
MW063A	After Approval of GW Monitoring Plan	MW084	After Approval of GW Monitoring Plan
MW064	After Approval of GW Monitoring Plan	MW084A	Maintain until Reclamation
MW064A	After Approval of GW Monitoring Plan	MW085	After Approval of GW Monitoring Plan
MW065	After Approval of GW Monitoring Plan	MW085A	After Approval of GW Monitoring Plan
MW065A	After Approval of GW Monitoring Plan	MW086	Maintain until Reclamation
MW066	After Approval of GW Monitoring Plan	MW086A	Maintain until Reclamation
MW066A	After Approval of GW Monitoring Plan	MW087A	After Approval of GW Monitoring Plan
MW067	After Approval of GW Monitoring Plan	MW088A	After Approval of GW Monitoring Plan
MW067A	After Approval of GW Monitoring Plan	MW091A	After Approval of GW Monitoring Plan
MW068	After Approval of GW Monitoring Plan	MW092A	After Approval of GW Monitoring Plan
MW068A	After Approval of GW Monitoring Plan	MW093A	After Approval of GW Monitoring Plan
MW069	After Approval of GW Monitoring Plan	MW094A	After Approval of GW Monitoring Plan
MW069A	After Approval of GW Monitoring Plan	MW097	After Approval of GW Monitoring Plan
MW070A	After Approval of GW Monitoring Plan	MW101A	After Approval of GW Monitoring Plan
MW071A	After Approval of GW Monitoring Plan	MW102	After Approval of GW Monitoring Plan
MW072	After Approval of GW Monitoring Plan	MW102A	After Approval of GW Monitoring Plan
MW072A	After Approval of GW Monitoring Plan	MW103	After Approval of GW Monitoring Plan
MW072B	After Approval of GW Monitoring Plan	MW103A	After Approval of GW Monitoring Plan
MW073A	After Approval of GW Monitoring Plan	MW104B	After Approval of GW Monitoring Plan
MW074	After Approval of GW Monitoring Plan	MW106	After Approval of GW Monitoring Plan
MW075	Maintain until Reclamation	MW109A	After Approval of GW Monitoring Plan
MW075A	After Approval of GW Monitoring Plan	MW113A	After Approval of GW Monitoring Plan
MW076	After Approval of GW Monitoring Plan	MW114A	After Approval of GW Monitoring Plan
MW076A	After Approval of GW Monitoring Plan	MW116A	After Approval of GW Monitoring Plan
MW077	Maintain until Reclamation	MW117	After Approval of GW Monitoring Plan
MW077A	After Approval of GW Monitoring Plan	MW118	After Approval of GW Monitoring Plan
MW078	After Approval of GW Monitoring Plan	MW119A	After Approval of GW Monitoring Plan
		MW120	After Approval of GW Monitoring Plan

[1] Maintain until Reclamation - These wells will be monitored until reclamation activities require abandoning/plugging

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D-01

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FIGURE NO. 18 "MONITORING WELL LOCATIONS WELLS COMPLETED IN SHALE 2"

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FIGURE NO. 18

D-02

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FIGURE NO. 20 "MONITORING WELL LOCATIONS WELLS COMPLETED IN SHALE 4"

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D-04

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D-05

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FIGURE NO. 22 "CORRECTIVE ACTION, SEEP, DRAINAGE AND SURFACE WATER MONITORING LOCATIONS"

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FIGURE NO. 22

D-06

Enclosure 3

Investigation of Uranium in Groundwater
Northwest Area of Sequoyah Facility

Investigation of Uranium in Groundwater
Northwest Area of Sequoyah Facility

Introduction

Groundwater monitoring in the Terrace and Shallow Bedrock Groundwater Systems in the northwest area of the Facility indicated uranium impacts to both of these systems. Wells located near Solid Waste Burial Area No. 2 and north of Fluoride Holding Basin No. 2 have uranium concentrations greater than the MCL of 30 µg/l. Uranium levels detected in monitoring wells northwest of this area indicate that a plume may be moving in this direction.

Experience with groundwater sampling in the northwest area of the Facility has indicated that there is not much water in the upper layers of terrace, shale and sandstone. Installation of a recovery trench in this area may not be an effective means of recovering groundwater that is present in deeper layers.

SFC decided that an additional investigation should be conducted to determine the hydrogeological conditions and the potential source of uranium contamination. Measures to be taken to remediate the impacts also need to be evaluated. SFC decided that the most effective means for obtaining the needed information would be the excavation of two trenches – north and west of Fluoride Holding Basin No. 2. The trenches should be placed parallel to flow and slope of the ground surface. SFC anticipated encountering the geologic strata above and including Shale 4. Hydrogeological conditions in the area were evaluated to determine where the investigation trenches should be placed. This report describes the findings of the investigation. The area where the investigation was conducted is shown in Figure 1.

Groundwater Contamination

Uranium analyses for groundwater samples collected from monitoring wells located in the northwest area of the Facility were evaluated. Figures 2 and 3 include color-coded symbols to indicate the range of uranium concentrations at monitoring wells located in the Terrace and Shallow Bedrock Systems, respectively. A review of monitoring data indicates the following:

Terrace System-

- The uranium concentrations at MW068 have varied over the past 10 years with concentrations from 10 and 30 µg/l.
- Uranium concentrations at MW087 showed a significant increase in 2000.
- Uranium concentrations at MW078 showed a significant increase in 1999.
- MW035 had very high uranium concentrations ranging up to about 6500 µg/l in 1994 and about 1800 µg/l in 1997. Concentrations have been much lower in recent years.
- Uranium analyses for initial samples collected in 1991 from MW075, MW038 and MW054 were slightly elevated (13 to 34 µg/l) but decreased within a year or so.
- Uranium concentrations at Monitoring Well 2302A showed a significant increase at the end of 2003. Uranium concentrations were below 10 µg/l prior to 2003.

Shallow Bedrock System-

- Uranium concentrations at MW088A have shown an increasing trend.
- Uranium concentrations at MW050A have shown a decreasing trend, with a maximum of about 800 µg/l in 1993 and a concentration of 300 µg/l in 2003.
- Uranium concentrations at MW067A have shown an increasing trend, increasing from about 40 µg/l in 1997 to about 350 µg/l in 2003.
- Uranium concentrations at MW087A have typically ranged from about 20 to 100 µg/l with results since 2000 being near 50 µg/l.

- Uranium concentrations at MW068A showed a maximum of about 17 µg/l in 1999 and decreased to about 2 µg/l in 2003.
- Uranium concentrations at MW099A ran about 20 µg/l during 1999 through 2001 but have decreased to about 4 µg/l in 2002 and 2003.

Several cross sections through this area have been prepared to show geology and well completion information. The site conceptual model was used to generate the location of the geological units. Figure 4 shows the location of the cross sections. Figures 5 and 6 show cross sections A-A' and B-B', respectively. Geological units from the site conceptual model are included as well as lithological information for each well obtained at the time of well installation. Well completion (screen / sand pack intervals) is shown for each well to indicate which groundwater unit or units are being sampled. Typical uranium concentrations observed at each well are also included.

Investigation Trenches

The groundwater contamination northwest of the restricted area fence line appears to be below a sandstone unit (Unit 2 Sandstone) that would be impossible to penetrate by conventional trenching methods. SFC decided to excavate the north trench in a south to north direction in an effort to expose the various shale and sandstone units as the excavation extended to the north. Groundwater seeping from the exposed units was sampled. A similar approach was planned for the west trench, proceeding from the east to west with the excavation.

Excavation of the north trench started on September 14, 2004 and was completed on September 15, 2004. The location of the trench is shown on Figures 2 and 3. A cross section of the trench with a 2X vertical exaggeration is shown in Figure 7. Excavation of the trench started at the south end and proceeded northward. A layer of weathered sandstone was encountered near the ground surface and was easily penetrated. Table 1 includes a summary of the field notes and elevations for each geological unit encountered.

Water was observed only at the far north end of the north trench. Weathered and black fissile shale was encountered at the north end of the trench. Groundwater appeared to be seeping in at the interface between the weathered and black fissile shale. The bottom of the trench was approximately 18 feet deep at this location. Twenty-four hours after completion of the trench, approximately 6 feet of water had collected in the bottom of the trench. The area that the water had collected in was about 3 feet wide by 12 feet long. Some minor slumping had occurred overnight. Samples of the water were collected, preserved and sent to Outreach Laboratory for analysis. Sample analyses are included in Table 2. Uranium, nitrate and arsenic analyses were all less than the MCL values of 30 µg/l, 10 mg/l and 0.05 mg/l, respectively. The initial samples were collected from the trench shortly after excavation was completed and had significant solids present. These samples were collected shortly after completion of the excavation because it appeared that the trench might cave in. The elevated arsenic analysis for the first sample collected is likely due to the high solids content.

Excavation of the west trench started on September 27, 2004 and was completed on September 28, 2004. The location of the trench is shown on Figures 2 and 3. A cross section of the trench with a 2X vertical exaggeration is shown in Figure 8. Excavation of the trench started at the east end and proceeded west. A hard layer of silty sandstone was encountered at a depth of about 6 feet at the east end of the trench. However, the excavation equipment was able to break through this rock layer, with difficulty. Hard sandstone was encountered at a depth of 11.5 feet. This hard sandstone layer could not be penetrated with excavation equipment. Weathered shale and clay were present between the silty sandstone and hard sandstone. This information is shown on the cross section included as Figure 8.

Water was observed only at the far west end of the west trench. Weathered shale and black fissile shale was encountered at the west end of the trench. Several hours after the excavation a pool of water had collected in the bottom of the trench. Twenty-four hours after the excavation had been completed about 0.5 feet of water had collected in an area 2.5 feet wide by 5 feet long. A sample of the water was collected, preserved and sent to Outreach Laboratory for analysis. Sample analyses are included in Table 2. A high nitrate concentration was observed in the sample collected from the west end of the west trench. The uranium and arsenic analyses were less than the MCL values of 30 µg/l and 0.05 mg/l. The arsenic analysis was greater than the MCL of 10 mg/l.

Both investigation trenches were backfilled shortly after groundwater samples and physical measurements were taken. Pictures taken during the excavation of the trenches are included in Appendix A. A description of the location where each picture was taken is included as a caption.

Observations and conclusions

Observations made during completion of the excavation of the north and west investigation trenches are as follows:

- No free water was encountered in geological strata situated above Unit 4 Shale in either trench.
- A hard competent sandstone (Unit 2 Sandstone) exists at depth in both trenches.

Conclusions reached after completion of the excavation of the north and west investigation trenches are as follows:

- The lack of free water in geological strata above Unit 4 Shale indicates that, while impacted soils are expected to exist at Fluoride Holding Basin No. 2, Solid Waste Burial Area No. 2, Burial Area No. 1, Emergency Basin and North Ditch, the extent of horizontal transport of potential contamination is less than previously predicted.
- In light of new data downward movement of contamination is expected to Unit 4 Shale primarily during high precipitation events.
- Horizontal transport will be in the Unit 4 Shale which ultimately discharges to the 007 Drainage.

Evaluation of Potential Sources of Groundwater Contamination

The following have been identified as potential sources of uranium in groundwater in the northwest area:

- Soil contamination in the fenced area north of Fluoride Holding Basin No. 2.
- Soil contamination in the Bone Yard / Waste Burial Areas.
- Buried waste in Solid Waste Burial Area No. 2 and Waste Burial Area No. 1.
- Sediments and sludges contained in the Emergency Basin / North Ditch.
- Sediments and sludge contained in Fluoride Holding Basin No. 2.
- Soil contamination over northwestern portion of Facility.

A drum crusher was utilized for compacting empty 55-gallon yellowcake drums in the area directly north of Fluoride Holding Basin No. 2. Approximately 40,000 empty yellowcake drums were also stored, prior to crushing, in the area north of the basin. This activity resulted in many small areas of surface soil contamination where uranium apparently spilled from drums. SFC conducted a gamma walkover of this area on October 6, 2004 to characterize the extent of surface soil contamination. After the gamma walkover was completed areas with elevated gamma readings were targeted for soil sampling. Hand auger samples from 0 – 0.5 feet deep were collected and analyzed for uranium from several of the targeted locations. Results of the gamma walkover and soil analyses are shown on Figure 9. In addition to total uranium analysis a 7-day leach test was

conducted on the sample collected at HA671 (approximately the same location as HA677). The results of the total uranium and leachate analyses are 4070 µg/g and 3760 µg/l, respectively. This indicates that the uranium is leachable and is a potential source for contamination of groundwater in this area.

An incident occurred during February 1984 where approximately 15,000 gallons of surface water from the excavated portion of the burial area (Bone Yard / Waste Burial Areas) was released to the northwest. An estimate was made that between eight and ten pounds of uranium were released during this event. Equipment stored in this area has also contributed to contamination of surface soils. Although the equipment stored in this area has been moved and a soil cover placed over the area to reduce contamination in storm water runoff, the potential for contamination of groundwater through infiltration and leaching still exists.

Based on plant records, Solid Waste Burial Area No. 2 (North) contains approximately 8,100 cubic feet of low-level wastes containing about 0.04 Ci (130 pounds) of natural uranium. Solid Waste Burial Area No. 1 (South) contains approximately 43,000 cubic feet of low level waste containing about 0.64 Ci (2080 pounds) of natural uranium. The soil covering the burial areas is impacted near the surface by uranium from the materials that were formerly stored on the ground in these areas. Soil in the areas surrounding the burial areas are also likely impacted, though not necessarily from the buried wastes.

The Emergency Basin contains approximately 14,500 cubic feet of sediment containing about 0.54 Ci (1760 pounds) of natural uranium. Soils surrounding the unit are impacted generally at depths less than 5 feet. In 1986, rinse water from a recovery effort associated with a UF6 release was collected in this area. A sample of this liquid was collected and the analysis indicated a uranium concentration of 34,000 µg/l.

The North Ditch contains approximately 20,750 cubic feet of sediment containing about 1.42 Ci (4630 pounds) of natural uranium. In 1979, SFC concluded that a drain tile from the new tank farm was the source of uranium in the North Ditch. The drain tile suspected of containing uranium was removed. Samples taken in June 1979 from the North Ditch, prior to tile removal and clay backfill, indicated uranium levels of 99,000 µg/l, while samples taken November 1, 1979, after tile removal and 2.4 inches of rainfall, indicated uranium levels reduced to 28,000 µg/l. In February 1982, a pipeline ruptured and resulted in the release of 3,000 gallons of raffinate into the North Ditch. The breach in the containment ditch, which allowed the spill to enter the North Ditch, was repaired. During 1992, a leak of dilute hydrofluoric acid from the HF Off-gas Scrubber system occurred, draining approximately 300 gallons of fluid to the surrounding area. The fluids and wash water drained to the North Ditch. Sample analysis of the fluid determined the uranium concentration to be 90,000 µg/l.

The Emergency Basin and North Ditch have been connected with a pipeline. Recent uranium analyses of samples collected over the past several years from the Emergency Basin and North Ditch range from about 50 to 1800 µg/l. The Emergency Basin and North Ditch are unlined and provide a potential source of groundwater contamination. However, due to the location of these basins it appears more likely that groundwater movement would be toward the 005 Drainage.

Fluoride Holding Basin No. 2 was built 1985 to store calcium fluoride sludge from the lime neutralization process with an estimated capacity of 201,000 cubic feet. The basin was originally hypalon-lined and temporarily used upon completion for storing treated raffinate. The treated raffinate was transferred to the Clarifiers, the liner was removed and the basin used for storage of calcium fluoride sludge. SFC is not aware of any releases or remedial actions for this basin. Sulfuric acid, used for pH control of the waste stream, leaked from a storage tank located at the southeast corner of the basin during the mid 1980's. This tank was emptied and moved to the yellowcake storage pad during 1995.

Uranium concentrations in soil in the northwest portion of the Facility have been evaluated and samples with uranium concentrations greater than 1000 µg/g plotted on Figure 10. Below each location identification is the uranium concentration. Most of the soil samples with uranium analyses greater than 1000 µg/g are located near the ground surface and decrease in concentration with depth.

Remediation Alternatives

SFC has evaluated various remediation alternatives for the northwest portion of the Facility and considered the following options:

- Recovery Trenches
- Recovery Wells (Horizontal and Vertical)
- Recovery Pit
- Source Removal
- Source cap

A few of these alternatives could be eliminated based on recently collected data. The first option considered was the installation of a deep recovery trench to intercept the flow of groundwater and pump this groundwater to a surface impoundment for treatment to remove the uranium. This method is being successfully used at other locations at the Facility. However, the uranium impacted groundwater in the northwest area appears to exist at depths below a hard sandstone unit that can not be excavated with normal construction equipment. SFC does not believe that interception trenches would be effective.

Horizontal wells were also considered. Placement of the horizontal wells would require heavy drilling equipment to navigate the steep drainages at the facility to place a horizontal well into Shale 4. Based on cost and difficulty, this alternative was discarded.

A shallow recovery trench or pit has been used successfully in the past to recover shallow contaminated surface/groundwater in this area. The groundwater model was used to evaluate this alternative.

Source removal has been considered and would prevent continued uranium contamination of the groundwater. The investigation has determined that there are many potential sources that may contribute to the groundwater contamination in the northwest area of the Facility, some of which cannot be removed until the Reclamation Plan is approved. No particular sources were identified that are currently significant contributors. Thus, removal of these sources should not proceed unti the reclamation plan for the Facility is approved.

The remaining viable alternatives were evaluated using the calibrated groundwater model. The following assumptions and observations were made during the remedial alternative modeling:

- The current conditions (calibrated steady-state) model was used to evaluate the effectiveness of the remedial alternatives. The shallow bedrock system remains saturated in this model, whereas much of the shallow system is dry in the predictive model.
- Saturated hydrostratigraphic units in the shallow system estimated in 2000 when the model was constructed is not evident in recent trenching.
- The long term predictive model indicates that much of the groundwater in the shallow system in the northwest area is eliminated due to reductions in recharge water; i.e. capping of the cell, removal of the emergency basing, the north ditch and the fire water system.

The remedial alternative considered for further evaluation using the calibrated groundwater model include:

- Shallow French drain to recover the uranium before it reached Shale 4
- Shallow vertical well installed the source area
- Deep vertical wells installed in Shale 4
- Installation of a shallow recovery pit (drain) in the source area
- Capping the source area with and asphalt pad

The installation of a shallow French drain was evaluated using the groundwater model. The objective of the alternative was to recover the uranium before it reached Shale 4. Modeling results indicate that, although the upper layers were locally desaturated near the drain, the alternative was generally ineffective very far from the drain

Shallow vertical wells installed in the source area were evaluated with the model. Up to six shallow wells were simulated to evaluate this alternative. The modeling results indicates that, similar to the French drain alternative, the shallow aquifer system was desaturated in the immediate vicinity of the wells, the alternative was generally ineffective in reducing the uranium that reached Shale 4.

The installation of deep vertical wells installed in Shale 4 was evaluated as an alternative. The modeling results indicated that one well was not sufficient to recover the uranium in Shale 4. The addition of a second well provided sufficient capture to recover the uranium in shale 4 and to prevent further migration of the shallow groundwater plume. The final modeling results indicate that the wells should be installed and screened only in Shale 4 at locations indicated in Figure 11. Pumping rates up to 2 gallons per minute may be achieved. If, after well construction, greater pumping rates can be achieved without pumping the well dry, the rate should be increased up to 5 gallons per minute. This alternative is considered effective.

Installation of a shallow recovery pit (drain) in the source area was evaluated as a possible alternative. Historically, a recovery pit had been operated in the Northwest Area with some success. The pit was installed in a local depression in the hard sandstone bedrock. Groundwater was allowed to collect in the pit ands was pumped periodically. The results of the modeling indicate that this alternative was marginally effective containing the shallow contamination, but did not prevent deep contaminant migration. The modeled location of the pit is illustrated in Figure 11.

Capping the source area with an impermeable asphalt pad was considered and evaluated using the model. While not entirely successful at eliminating downward migration of the shallow plume, the modeling results indicate that significant migration reduction was achieved. The approximate location of the cap is shown in Figure 11.

Table 1
Field Notes - North Trench

North Investigation Trench - NW Area Investigation (Excavation on September 14 and 15, 2004)

Distance N End, ft	Easting	Northing	Ground	Trench Bottom	Field Observations (depths in feet from ground surface)
0	2836096	197118			
5	2836094	197123	534.77	527.20	0-0.5:Topsoil / 0.5-1:Sandstone / 1-3:Clay & Gravel Mix / 3-7.5:Shale
25	2836087	197142	533.61	525.57	0-1:Top Soil, Gravel / 1-3.5:Clay, some Shale, Gravel / 3.5-8:Shale, some Clay, Gravel
45	2836080	197161	532.36	525.28	
50	2836078	197166			0-3:Gravel and Clay / 3-7:Weathered Shale
75	2836069	197189	530.22	525.01	0-2.5:Top Soil, Gravel, Clay / 2.5-5.5:Clay and Shale
100	2836060	197212	528.65	524.70	0-2.5:Top Soil, Gravel, Clay / 2.5-4:Clay and Shale
125	2836052	197236	526.61	524.28	0-3:Top Soil, Gravel, Clay
150	2836043	197260	525.02	523.68	0-1:Top Soil, Gravel, Clay
169	2836036	197277	523.48	523.20	
172	2836035	197281		521.88	
175	2836034	197283	522.57	521.61	0-1:Broken Sandstone and Soil
178	2836033	197286		521.43	
182	2836032	197290		520.26	
188	2836030	197295		518.32	
195	2836027	197302		513.93	
200	2836026	197307	517.19	512.24	0-0.5:Broken Sandstone, Soil / 0.5-2:Silty Soil, Clay / 2-5:Weathered Shale, Clay
225	2836016	197330	511.47	507.60	0-4: Gravel, Clay, Weathered Shale
240	2836011	197345	507.74	503.51	0-4: Gravel, Clay, Weathered Shale, Sandstone Unit Ends
250	2836088	197354	505.95	487.95	0-5: Gravel, Clay, Some Weathered Shale / 5-12:Weathered Shale / 12-18:Black Shale

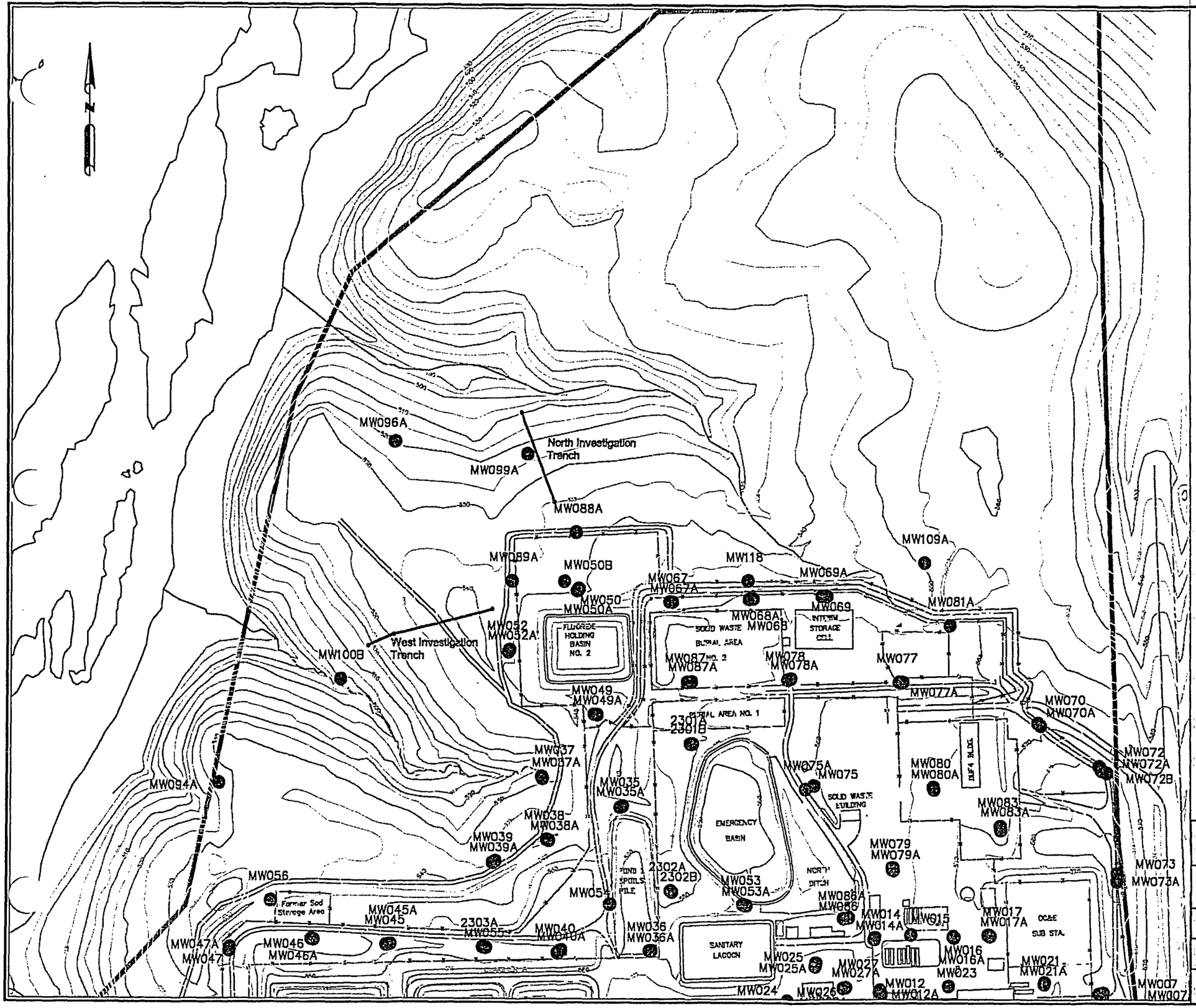
Notes:
1 - Trench bottom is hard sandstone surface that could not be penetrated with the trackhoe.
2 - Water is seeping into the north end of the trench near the interface of the weathered shale and black shale.
3 - Collected samples of water that collected at the north end of the trench at 0900 and 0945 (9/15/04) for uranium, nitrate and arsenic analysis.
4 - 24 hours after excavation 6 feet of water had collected in the trench bottom. Area where water had collected was about 3 feet by 12 feet.
5 - An additional water sample was collected at 0910 on September 16, 2004 for uranium, nitrate and arsenic analysis.

Table 2
NW Investigation Area
Water Sample Results

Location	Date	Time	Uranium µg/l	Nitrate mg/l	Arsenic mg/l
North End of North Trench	09/15/2004	900	< 1	1.2	0.029
North End of North Trench	09/15/2004	945	< 1	1.2	0.005
North End of North Trench	09/16/2004	910	< 1	1.1	< 0.004
West End of West Trench	09/29/2004	1225	< 1	114	< 0.004

Note:

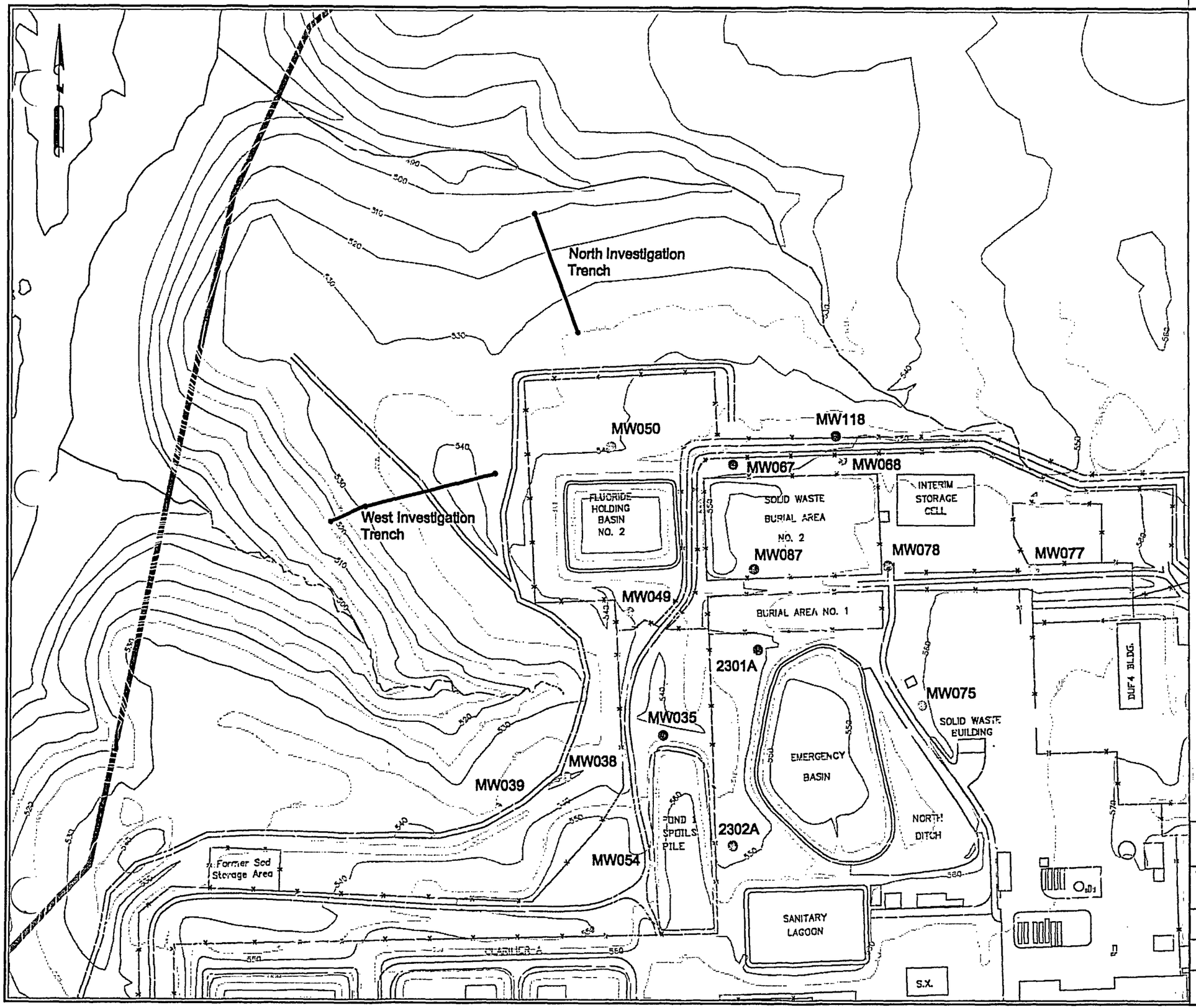
- The North Trench was completed at about 0845 on 09/15/2004. Water samples were collected shortly after completion because it appeared that the trench might cave in. The initial samples had significant solids present. The sample collected from the North trench on 09/16/2004 at 0910 was clear.



SEQUOYAH FUELS CORPORATION

Northwest Area Uranium Impact Investigation

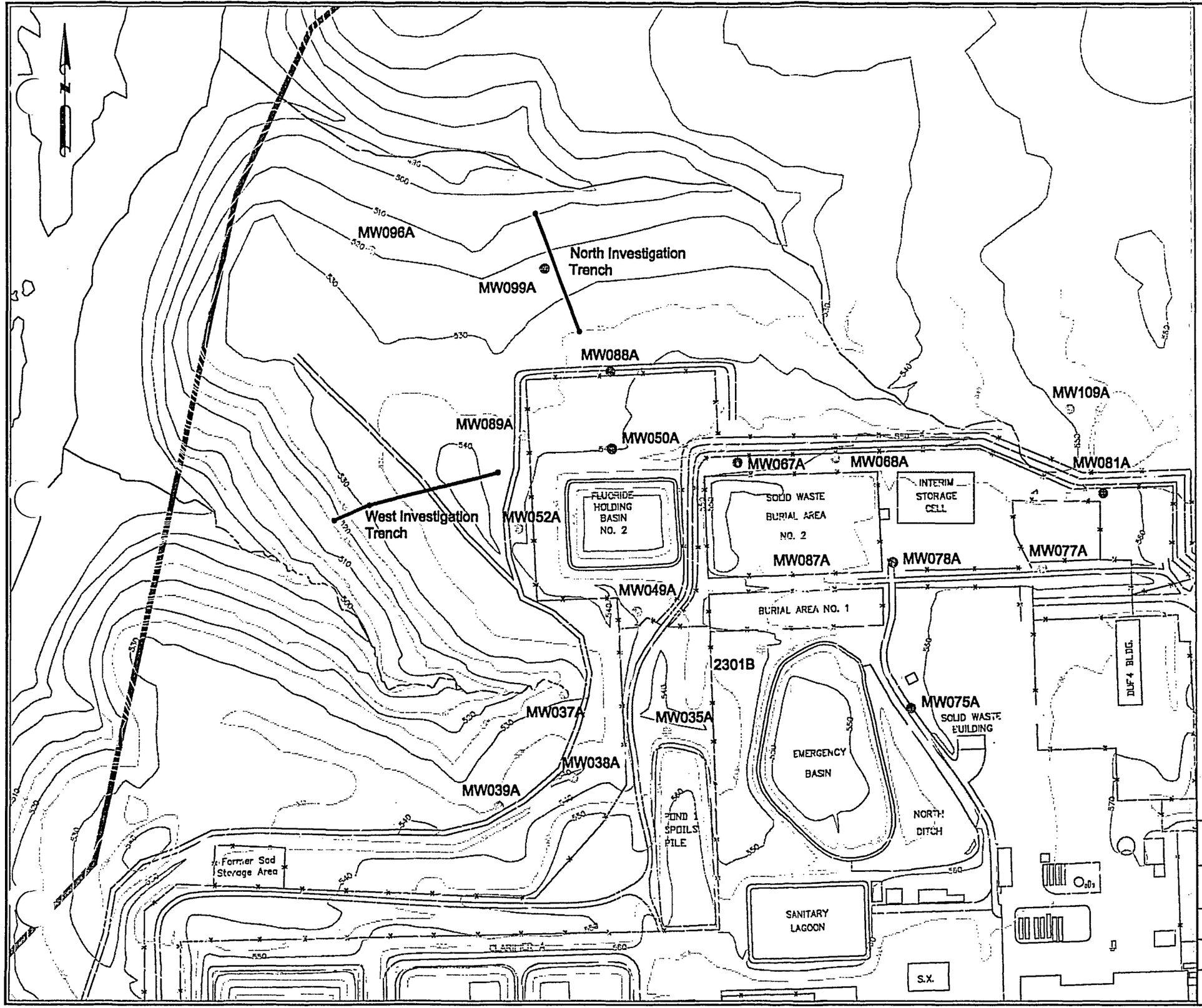
Title: Investigation Trench Locations	
PREPARED BY: SCM	Filename: Figure1.dwg
Reviewed by: SCM	Figure No. 1
Date: 28 Dec 2004	



SEQUOYAH FUELS CORPORATION

Northwest Area Uranium Impact Investigation

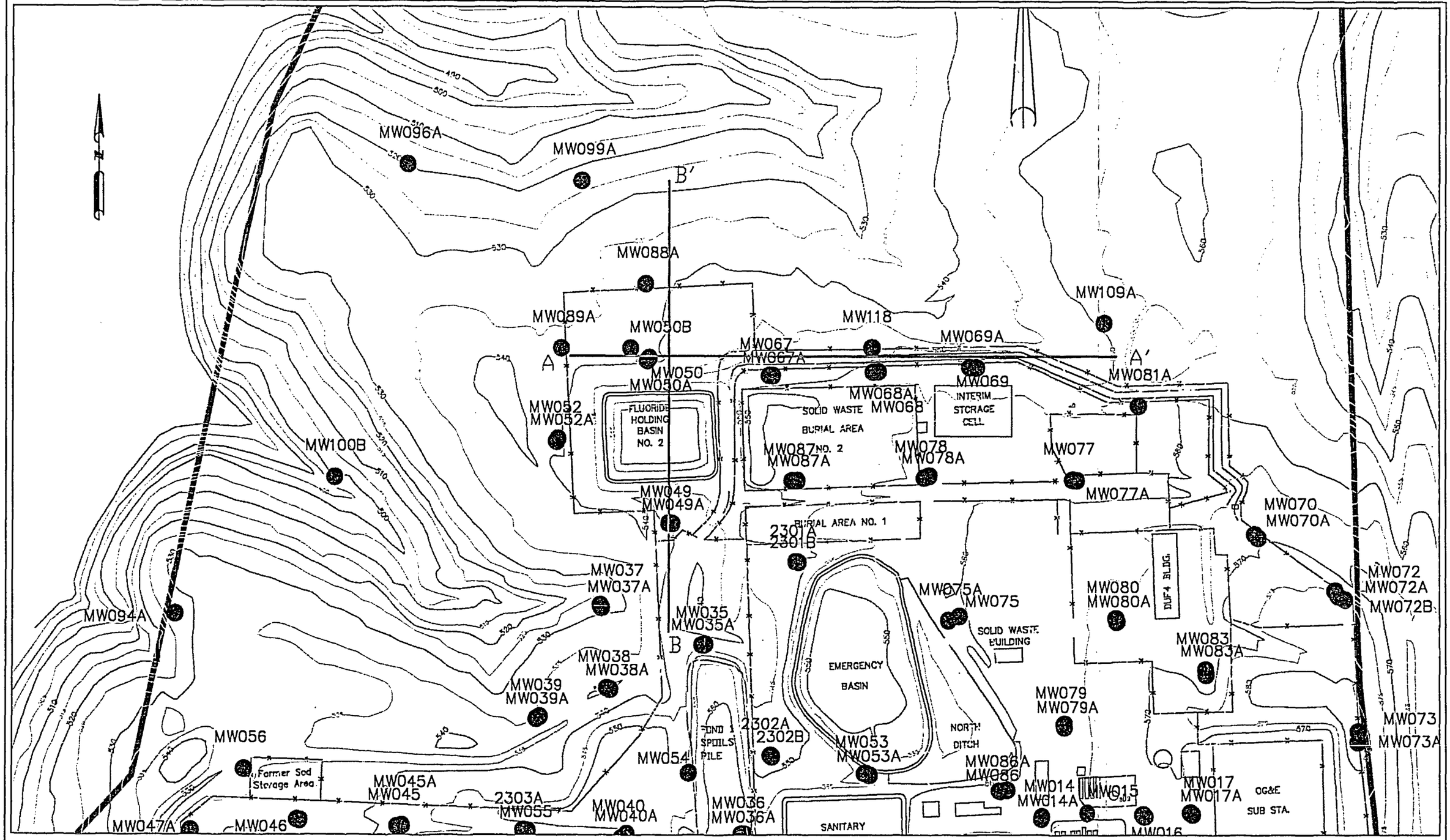
Title: Terrace Groundwater Uranium Concentrations	
PREPARED BY: SCM	Filename: Figure2.dwg
Reviewed by: SCM	Figure No. 2
Date: 28 Dec 2004	



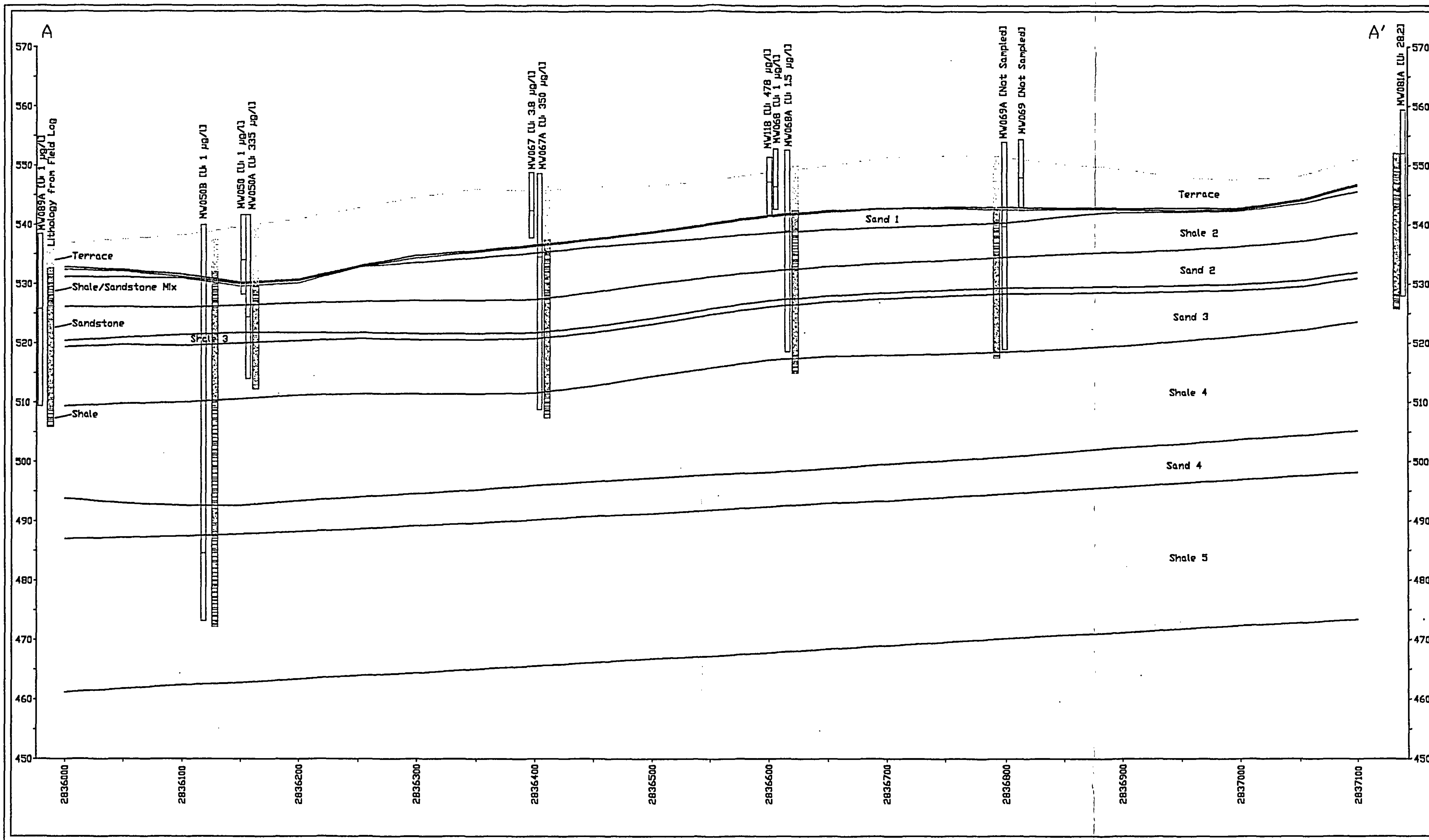
SEQUOYAH FUELS CORPORATION

Northwest Area Uranium Impact Investigation

Title: Shallow Bedrock Groundwater Uranium Concentrations	
PREPARED BY: SCM	Filename: Figure3.dwg
Reviewed by: SCM	Figure No. 3
Date: 28 Dec 2004	



SEQUOYAH FUELS CORPORATION Northwest Area Uranium Impact Investigation	
Title: Cross Section Locations	
PREPARED BY: SCM	Filename: Figure4.dwg
Reviewed by: SCM	Figure No. 4
Date: 28 Dec 2004	



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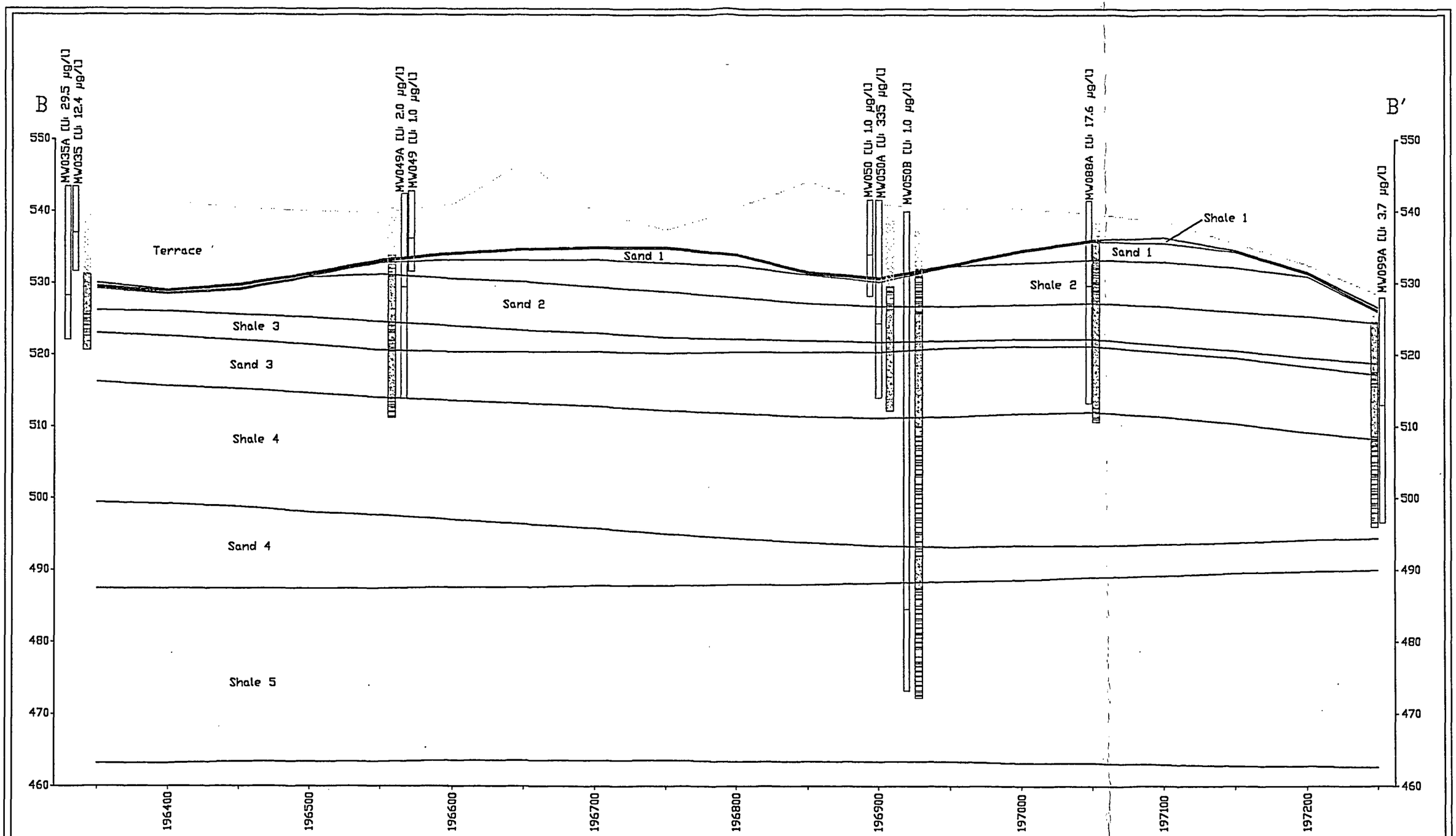
Northwest Area Uranium Impact Investigation

Title: Section A - A'	
PREPARED BY: SCM	Filename: Figure5.dwg
Reviewed by: SCM	Figure No. 5
Date: 28 Dec 2004	



SEQUOYAH FUELS CORPORATION	
Northwest Area Uranium Impact Investigation	
Title: Section B - B'	
PREPARED BY: SCM	Filename: Figure6.dwg
Reviewed by: SCM	Figure No. 6
Date: 28 Dec 2004	

Looking West at Cross Section of North Trench
2X Vertical Exaggeration

N

Ground Surface

Excavated Material

Sandstone 2

Shale 3

Sandstone 3

Shale 4

First Water Encountered

Sandstone 4

540
530
520
510
500
490
480
470
460

197100
197150
197200
197250
197300
197350
197400

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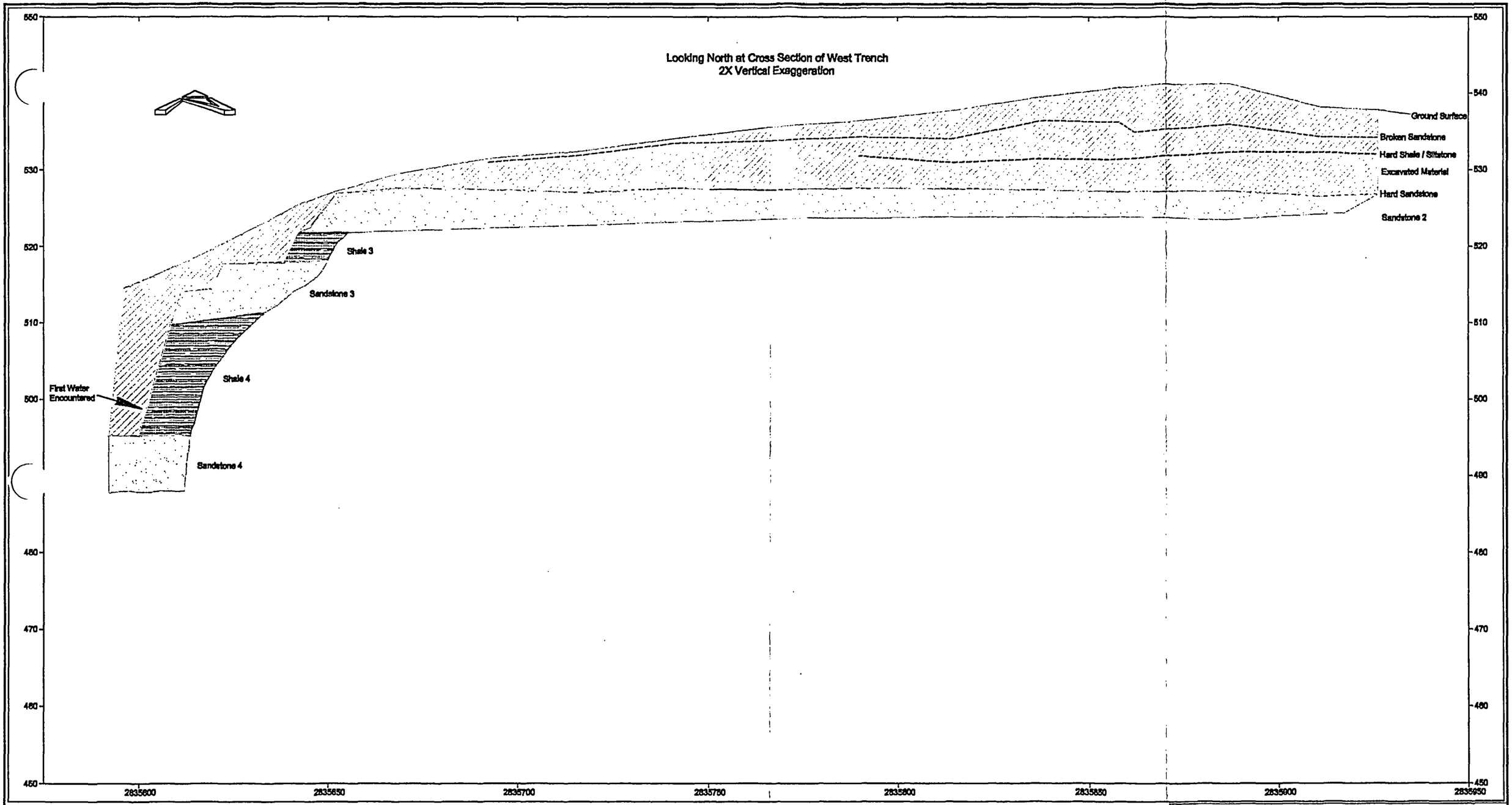
Northwest Area Uranium Impact Investigation

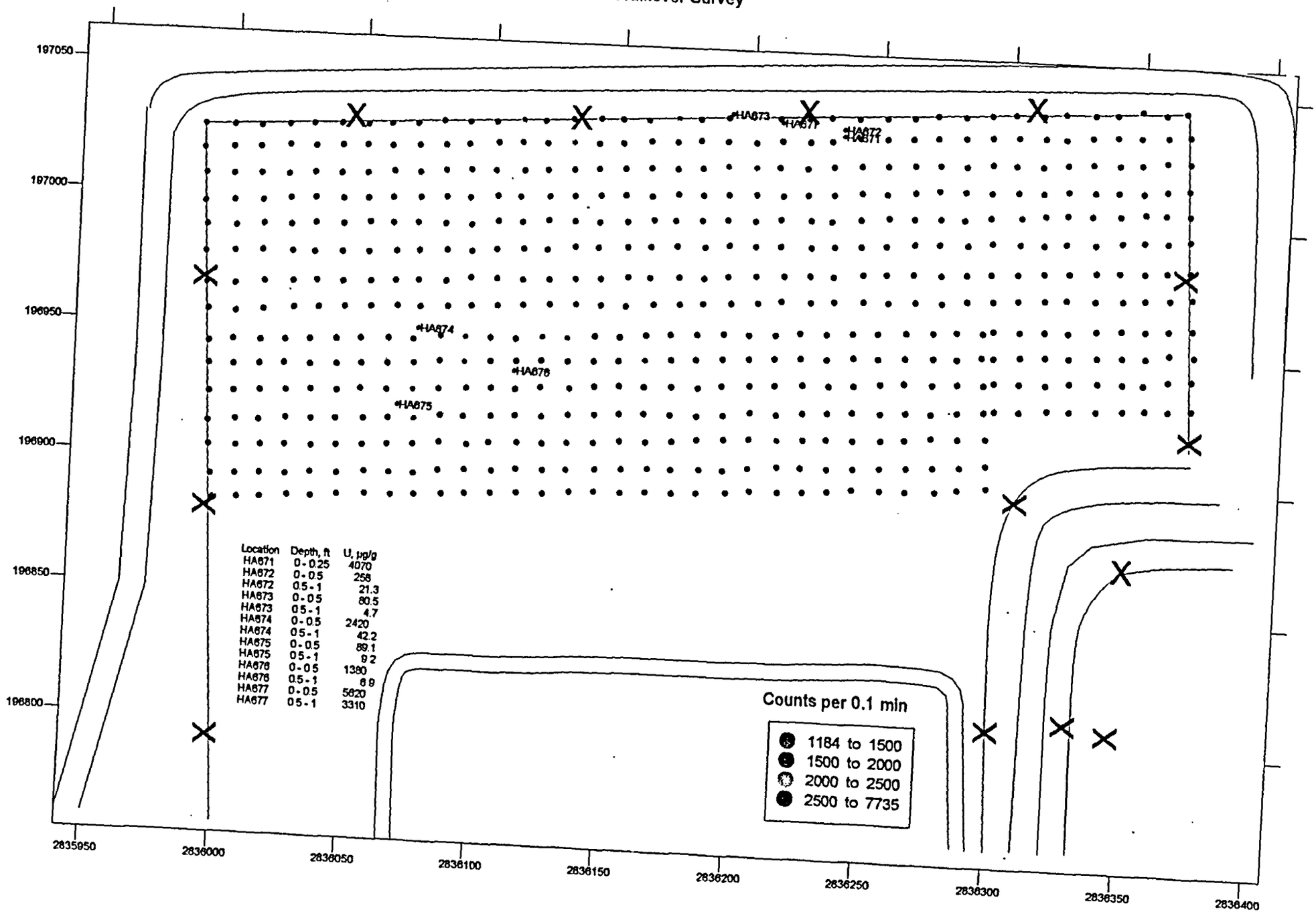
Title: North Trench Cross Section	
PREPARED BY: SCM	Filename: Figure7.dwg
Reviewed by: SCM	Figure No. 7
Date: 09 Dec 2004	

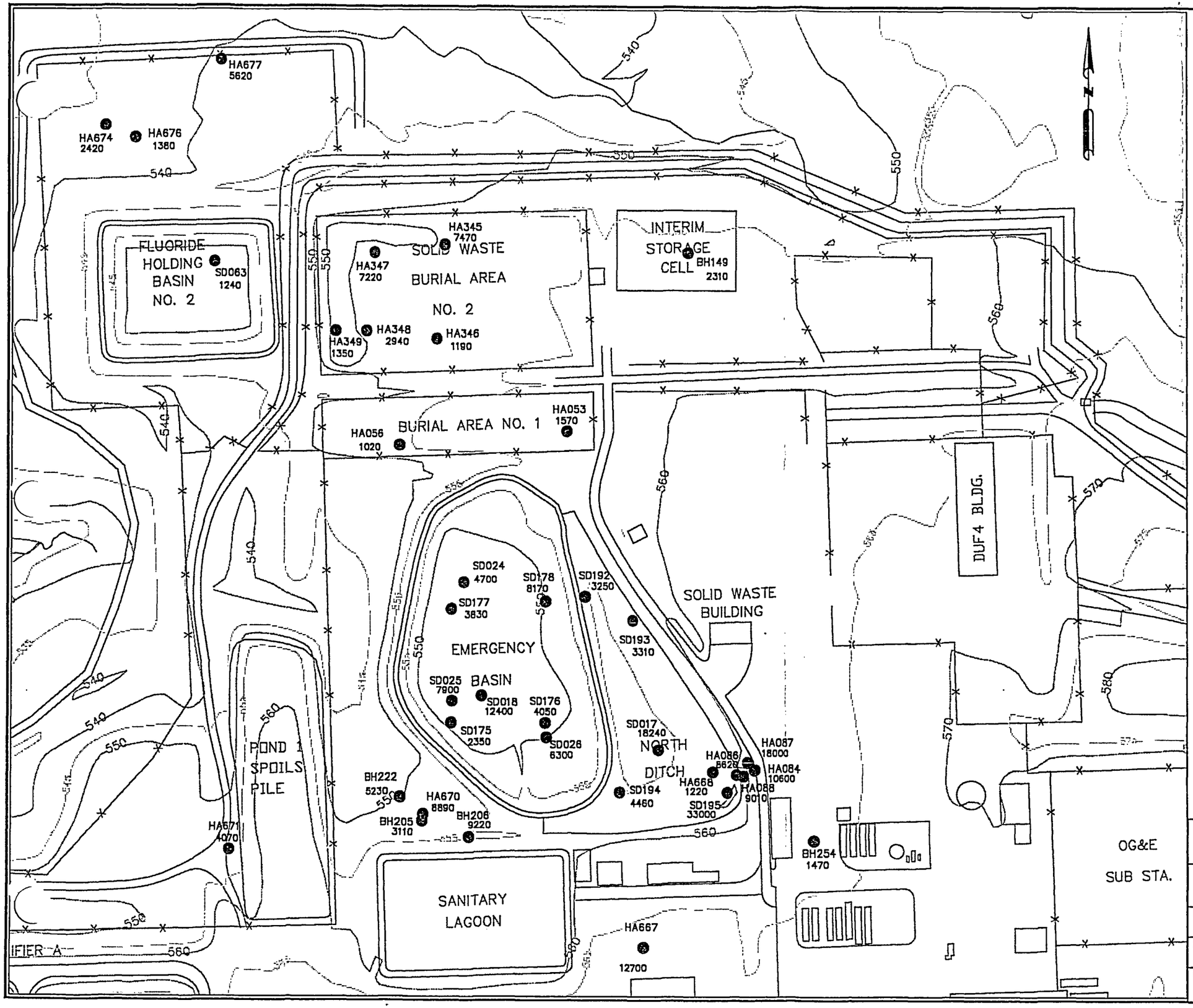
Looking North at Cross Section of West Trench
2X Vertical Exaggeration



SEQUOYAH FUELS CORPORATION Northwest Area Uranium Impact Investigation	
Title: West Trench Cross Section	
PREPARED BY: SCM	Filename: Figure8.dwg
Reviewed by: SCM	Figure No. 8
Date: 09 Dec 2004	

Figure 9
Gamma Walkover Survey



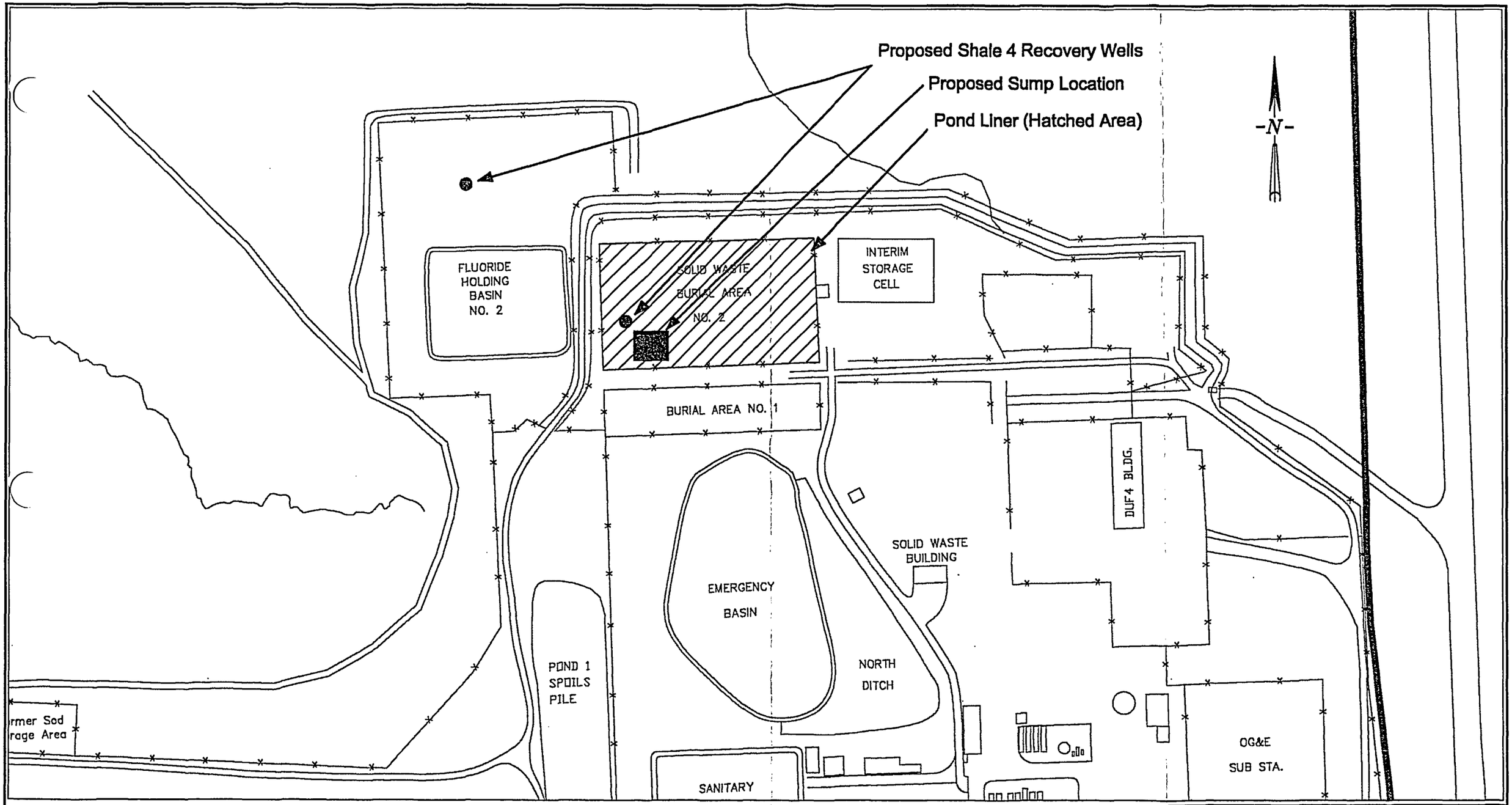


Note: Sample locations with uranium concentrations greater than 1000 µg/g. Uranium concentrations in µg/g shown below each sample location identification.

SEQUOYAH FUELS CORPORATION

Northwest Area Uranium Impact Investigation

Title: Soil, Sediment and Source Samples Uranium Concentrations	
PREPARED BY: SCM	Filename: Figure10.dwg
Reviewed by: SCM	Figure No. 10
Date: 28 Dec 2004	



SEQUOYAH FUELS CORPORATION Northwest Area Uranium Impact Investigation	
Title: Proposed Shale 4 Recovery Wells, Sump and Pond Liner Cap Locations	
PREPARED BY: SCM	Filename: Figure11.dwg
Reviewed by: SCM	Figure No. 11
Date: 29 Dec 2004	

Appendix A

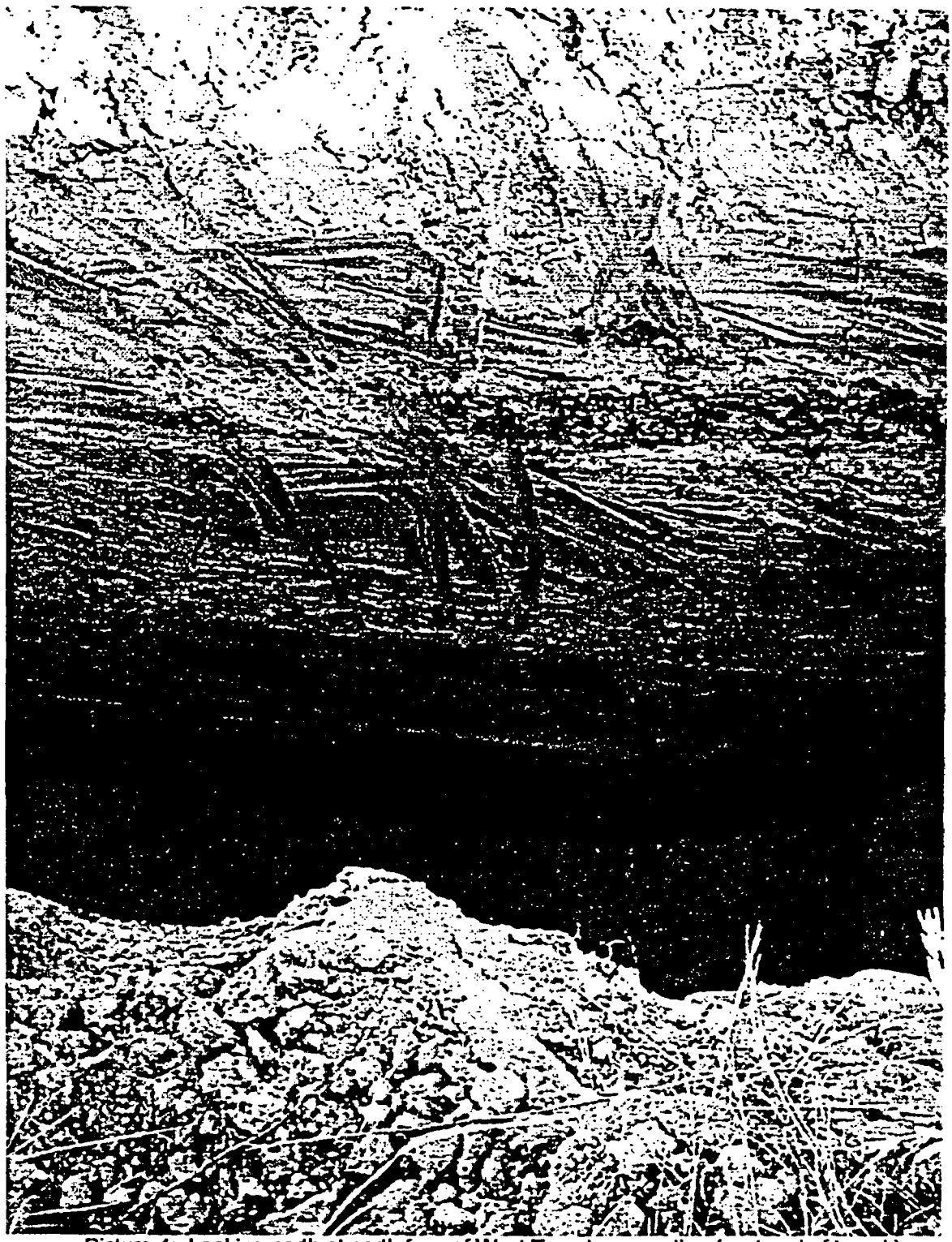
Pictures Taken During Excavation of North and West Investigation Trenches

Northwest Area Uranium Impact Investigation

Picture 1: Looking south from the north end of the North Trench.

Picture 2: Water collected at the north end of the North Trench.

Picture 3: Looking west during excavation of the West Trench – dry soil condition.



Picture 4: Looking north at north face of West Trench excavation (east end of trench).

Picture 5: Looking east from west end of West Trench.