DOE/AL/62350-182
REV. 0

United States Department of Energy

LONG-TERM SURVEILLANCE PLAN FOR THE TUBA CITY, ARIZONA DISPOSAL SITE

October 1996

UMTRA

Uranium Mill Tailings Remedial Action Project

9611010195 961024
PDR WASTE PDR

INTENDED FOR PUBLIC RELEASE

This report has been reproduced from the best available copy. Available in paper copy and microfiche

Number of pages in this report: 65

DOE and DOE contractors can obtain copies of this report from:

Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831
(615) 576-8401

This report is publicly available from:

National Technical Information Service
Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

DOE/AL/62350-182
REV. 0

LONG-TERM SURVEILLANCE PLAN FOR THE TUBA CITY, ARIZONA, DISPOSAL SITE

October 1996

This document supersedes UMTRA-DOE/AL-350218.0000.

Prepared for
U.S. Department of Energy
Environmental Restoration Division
UMTRA Project Team
Albuquerque, New Mexico

Prepared by
Jacobs Engineering Group Inc.
Albuquerque, New Mexico

TABLE OF CONTENTS

Section		Page
1.0	INTRODUCTION	1-1
1.1	Background	1-1
1.2	Licensing process	1-1
1.3	Long-term surveillance plan	1-3
2.0	FINAL SITE CONDITIONS	2-1
2.1	Site history	2-1
2.2	Final site conditions	2-1
2.2.1	Description and location of the disposal site area	2-1
2.2.2	Disposal site access and security	2-2
2.2.3	Disposal cell design	2-2
2.2.4	Ground water protection strategy	2-4
3.0	SITE DRAWINGS AND PHOTOGRAPHS	3-1
3.1	Disposal site vicinity map	3-1
3.2	Disposal site topographic map	3-1
3.3	Disposal site map	3-1
3.4	Disposal site as-built drawings	3-2
3.5	Site baseline photographs	3-2
3.6	Site aerial photographs	3-2
4.0	PERMANENT SITE SURVEILLANCE FEATURES	4-1
4.1	Survey boundary monuments	4-1
4.2	Boundary monument	4-1
4.3	Site markers	4-2
4.4	Entrance and perimeter signs	4-2
4.5	Settlement plates	4-2
4.6	Additional site surveillance requirements	4-2
5.0	GROUND WATER MONITORING	5-1
5.1	Ground water characterization	5-1
5.1.1	Hydrogeologic setting	5-2
5.1.2	Ground water quality	5-5
5.1.3	Extent of contamination	5-11
5.2	Ground water monitoring program	5-15
5.2.1	Long-term ground water monitoring	5-15
5.2.2	Evaluative ground water monitoring	5-16
5.3	Corrective action	5-20
5.4	Data validation and quality assurance	5-21
5.5	Reporting	5-21
6.0	SITE INSPECTIONS	6-1
6.1	Inspection frequency	6-1
6.2	Inspection team	6-1
6.3	Preparation for inspections	6-1

TABLE OF CONTENTS (Concluded)

Section **Page**

6.4 Site inspection procedures 6-2
6.4.1 Off-site areas 6-3
6.4.2 On-site areas 6-3
6.4.3 Modifying processes 6-4
6.4.4 Vegetation 6-5
6.5 Site inspection map 6-5
6.6 Site inspection photographs 6-6
6.7 Site inspection checklist 6-7
6.8 Site inspection report 6-7

7.0 FOLLOW-UP INSPECTIONS 7-1

8.0 CUSTODIAL MAINTENANCE AND REPAIR 8-1

9.0 CORRECTIVE ACTION 9-1

10.0 RECORD KEEPING AND REPORTING REQUIREMENTS 10-1

11.0 EMERGENCY NOTIFICATION AND REPORTING 11-1

12.0 QUALITY ASSURANCE 12-1

13.0 LIST OF CONTRIBUTORS 13-1

14.0 REFERENCES 14-1

ATTACHMENT 1 LEGAL DESCRIPTION
ATTACHMENT 2 AGENCY NOTIFICATION AGREEMENTS

LIST OF FIGURES

Figure **Page**

1.1 Tuba city site location map, Tuba City, Arizona 1-2

2.1 Disposal cell cross section, Tuba City, Arizona, site 2-3

5.1 Estimated water table elevation contour map of shallow Navajo Sandstone aquifer, Tuba City processing site/disposal site 5-3
5.2 Estimated potentiometric surface of the deep Navajo Sandstone aquifer, Tuba City processing site/disposal site 5-4
5.3 Ground water monitor well, extraction well, and deep test well locations, Tuba City, Arizona, site 5-6
5.4 Cross sections locations, Tuba City, Arizona, site 5-12
5.5 Hydrogeologic cross section A-A', Tuba City, Arizona, site 5-13
5.6 Hydrogeologic cross section B-B', Tuba City, Arizona, site 5-14
5.7 Ground water monitor well network, Tuba City, Arizona, site 5-18

LIST OF TABLES

Table **Page**

5.1 Statistical summary of background ground water quality, Tuba City, Arizona, site 5-7
5.2 Baseline statistical summary of ground water quality of monitor wells screened in the contaminant plume, Tuba City, Arizona, site 5-9

LIST OF ACRONYMS

Acronym	Definition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
LTSP	long-term surveillance plan
NRC	U.S. Nuclear Regulatory Commission
POC	point of compliance
QA	quality assurance
QC	quality control
RAP	remedial action plan
RRM	residual radioactive material
TDS	total dissolved solids
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
U.S. 160	U.S. Highway 160
USGS	U.S. Geological Survey

CHANGE HISTORY

Document version	Date	Pages/comments
Rev. 0, Ver. 1	2/10/9	Initial version of final.
Rev. 0, Ver. 2	2/12/96	Addressed NRC comments on ground water monitoring; transferred document from HTI to In-house.
Rev. 0, Ver. 3	2/19/96	Author and client comments incorporated into edited document. Single-spaced in preparation for signoff.
Rev. 0, Ver. 4	9/23/96	Addressed NRC comments on ground water monitoring, POC monitoring for Sub Part A compliance.
Rev. 0, Ver. 5	10/24/96	Address additional NRC comments.

1.0 INTRODUCTION

This long-term surveillance plan (LTSP) for the Uranium Mill Tailings Remedial Action (UMTRA) Project disposal site at Tuba City, Arizona, describes the site surveillance activities. The U.S. Department of Energy (DOE) will carry out these activities to ensure the disposal cell continues to function as designed. This final LTSP was prepared as a requirement for acceptance under the U.S. Nuclear Regulatory Commission (NRC) general license for custody and long-term care of residual radioactive materials (RRM) (10 CFR §40.27).

1.1 BACKGROUND

Title I of the *Uranium Mill Tailings Radiation Control Act* (UMTRCA) of 1978 (42 USC §7901 *et seq.*) authorized the DOE to perform remedial actions at the inactive uranium processing site near Tuba City, Arizona, to reduce the potential effect on public health from the unstabilized RRM in and around the uranium mill tailings. The Tuba City site is in Coconino County, Arizona, about 6 miles (mi) (10 kilometers [km]) east of Tuba City, Arizona, in Sections 17 and 20, Township 32 North, Range 12 East, Gila and Salt River Meridian (Figure 1.1).

The Tuba City processing site originally consisted of an original tailings pile, relocated tailings from adjacent subpiles, windblown and waterborne deposits, and other contaminated materials including demolished mill buildings. The primary activities of the remedial action were the stabilization in place of the tailings pile and associated contaminated materials, the construction of an infiltration/radon barrier cap over the contaminated materials, and the addition of a riprap cover as an erosion protection measure. Remedial action began in 1988 and was completed in 1990. A total of 1,400,000 cubic yards (yd^3) (1,100,000 cubic meters [m^3]) of contaminated materials were placed in the 50-acre (ac) (20-hectares [ha]) disposal cell. The entire disposal site covers 145 ac (59 ha) and is fenced to restrict access. The NRC, Navajo Nation, and Hopi Tribe conditionally concurred with the DOE remedial action plan (RAP) (DOE, 1989). The surface remedial action was conducted to comply with requirements of the U.S. Environmental Protection Agency (EPA) standards in 40 CFR Part 192.

1.2 LICENSING PROCESS

The NRC has developed regulations for issuance of a general license for long-term care of DOE UMTRA Project (Title I) disposal sites, including the Tuba City disposal site (10 CFR §40.27). The general license will become effective when the NRC concurs in the DOE's certification that the remedial action is complete and accepts the Tuba City disposal site LTSP. Because the Tuba City processing site tailings were stabilized in place and there is existing ground water contamination, the NRC licensing process will proceed in two phases. When the NRC concurs with DOE certification that ground water restoration has been completed in accordance with 40 CFR Part 192, the LTSP will be

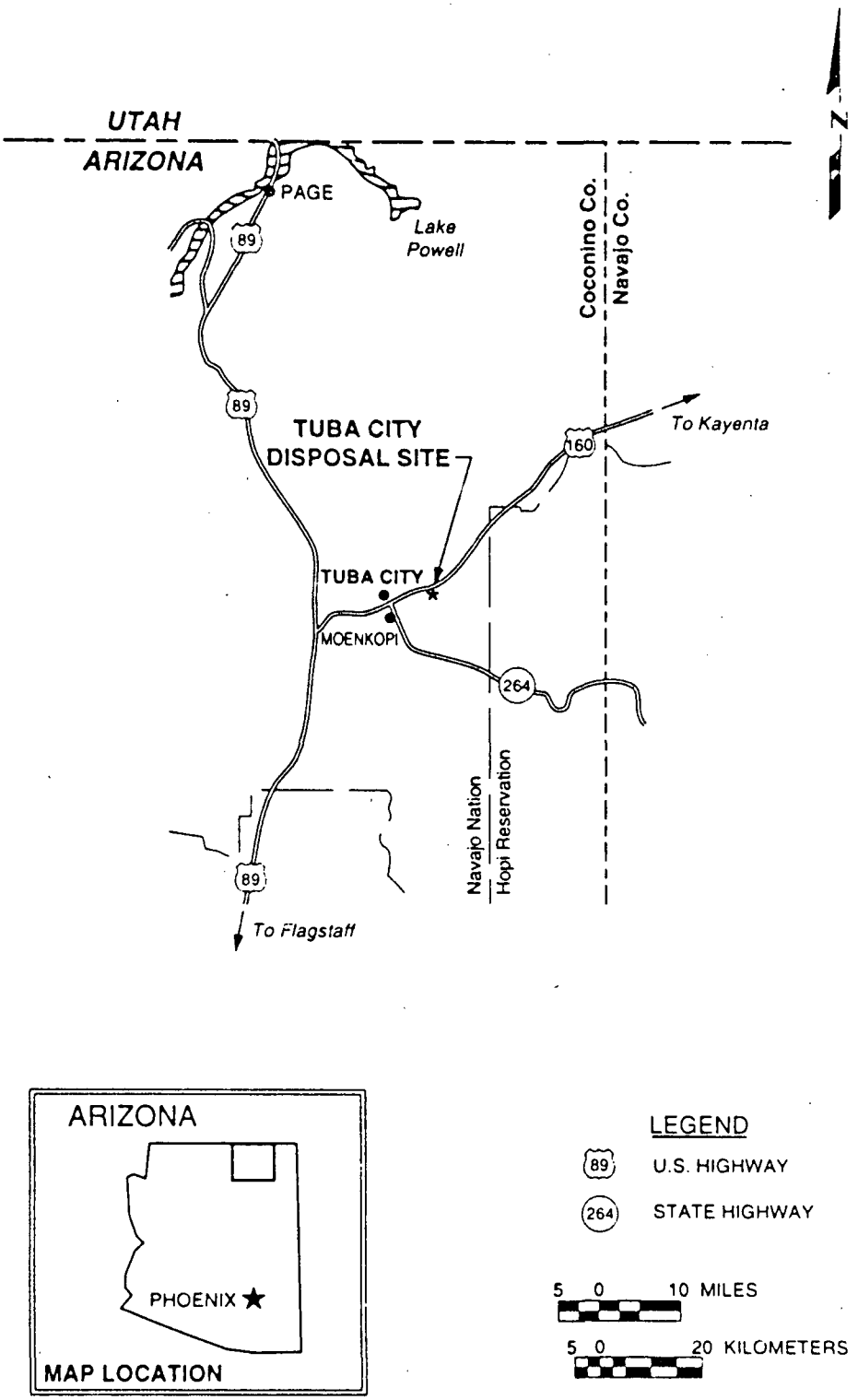


FIGURE 1.1
TUBA CITY SITE LOCATION MAP
TUBA CITY, ARIZONA

amended, as appropriate, and the licensing process for the Tuba City disposal site will be completed.

Ownership of the Tuba City site will remain with the Navajo Nation. However, the DOE will provide evidence of permanent access to the disposal site for long-term care activities. The access agreement for the Tuba City disposal site will be included in Attachment 1 with a legal description of the site boundaries.

1.3 LONG-TERM SURVEILLANCE PLAN

This LTSP describes the long-term surveillance program to be implemented at the Tuba City site. This program will ensure that the disposal site continues to perform as designed. The LTSP is based on the DOE's guidance document for implementing the UMTRA Project long-term surveillance program (DOE, 1992a).

2.0 FINAL SITE CONDITIONS

2.1 SITE HISTORY

On 1 February 1956, the U.S. Atomic Energy Commission opened a uranium ore-buying station at the Tuba City mill site, and began buying ore pending completion of mill construction on the site by the Rare Metals Corporation of America. The mill began operation in June 1956, with a nominal capacity of 260 tons (240 metric tons) of ore per day. This soon increased to 300 tons (270 metric tons) per day, and the mill operated at this rate until it temporarily ceased operations in May 1962. From 1956 to 1962, the mill processed ore using sulfuric acid leaching, sand-slime separation, and resin-in-pulp ion exchange recovery. In April 1963, the Rare Metals Corporation was acquired by the El Paso Natural Gas Company. The mill process then was modified to accommodate a change to the Orphan Lode uranium mine, Grand Canyon, Arizona, as the principal ore supply. The mill conversion required installation of additional ore-grinding equipment, a flotation circuit to remove sulfides, pressure leach vessels, filters for liquids-solids separation, precipitation tanks, and solution carbonation equipment. Operations resumed at a design capacity of 200 tons (180 metric tons) per day, which was maintained until the mill closed permanently in late 1966. During the 10 years of milling (1956 to 1966), about 800,000 tons (725,000 metric tons) of ore were processed. The uranium tailings at the Tuba City site were placed as slurry in three contiguous piles (DOE, 1989).

Remedial action at the Tuba City site was completed in April 1990. Contaminated materials totaling 1,400,000 yd^3 (1,100,000 m^3) were stabilized in place in a 50-ac (20-ha) disposal cell on the 145-ac (59-ha) disposal site (MK-F, 1995).

2.2 FINAL SITE CONDITIONS

2.2.1 Description and location of the disposal site area

The Tuba City site lies at an elevation of approximately 5100 feet (ft) (1550 meter [m]) above the National Geodetic Vertical Datum of 1929 on alluvial and eolian deposits in the Southern Kaibito Plateau. The site area is on a gently sloping terrace approximately 6000 ft (1825 m) northwest of the Moenkopi Wash, an intermittent stream that drains west-southwest into the Little Colorado River. Surface drainage from the site is to the southeast toward Moenkopi Wash. The terrain north and west of the site is gently rolling. To the east and south, the terrain is more dissected due to erosion along the flank of Moenkopi Wash. South of the site, two broad alluvial terraces cut into the Navajo Sandstone. These terraces are modified by arroyos and capped by active and arrested windblown sand deposits (dunes). Although mostly covered by dune deposits, the Navajo Sandstone appears to be close to the surface throughout the area (DOE, 1989).

The disposal site vicinity is semiarid and desert-like. Vegetation is sparse, and land use is limited to grazing. No archaeological or historic sites are known to exist at the Tuba City site (DOE, 1986a).

Figure 1.1 is a map of the Tuba City area. The disposal site also can be located using the following directions:

- Proceed northeast from Tuba City, Arizona, on U.S. Highway 160 (U.S. 160) for 5 mi (8 km).
- Note the prominent mound of tailings covered with black rock on the right.
- The turnoff road on the right is unmarked but easily recognized by the gate in the highway fence just north of the disposal cell.
- Turn right (south) off U.S. 160.
- Unlock the gate in the highway fence just off U.S. 160.
- Proceed south on the graded, unpaved road for approximately 600 ft (180 m) to the gate in the site security fence.

2.2.2 Disposal site access and security

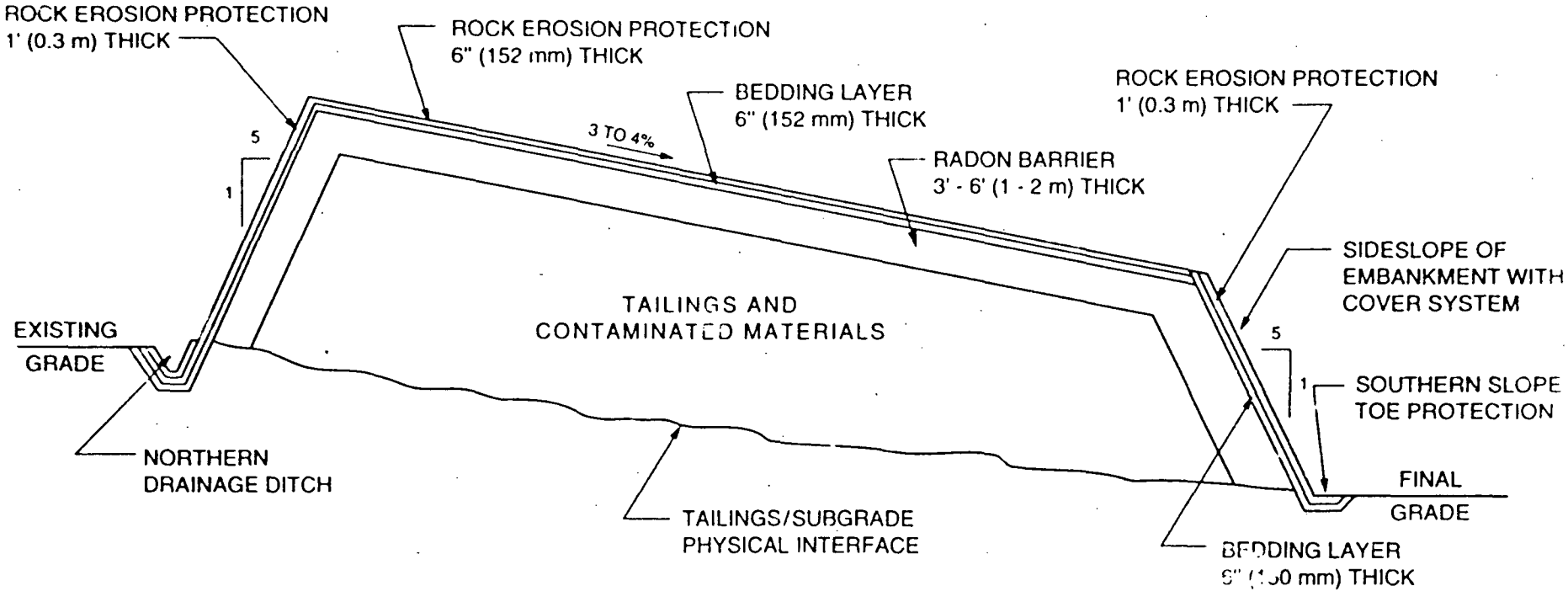
Tribal authorities will be notified in a timely manner prior to any site visits. Keys to locks on the U.S. 160 fence and the disposal site security fence are held by the DOE, the Hopi Tribe, and the Navajo Nation.

The Tuba City disposal site is visible from U.S. 160. However, two locked gates separate the highway from the site. An entrance sign and 30 perimeter signs around the site fence inform the public of the site's function and ownership (Section 4.0).

2.2.3 Disposal cell design

Relocated tailings from the adjacent subpiles and windblown and other contaminated materials were placed in the original tailings pile and compacted for stability. The above-grade disposal cell is roughly triangular, with a maximum side length of 1940 ft (590 m) and a minimum side length of 1580 ft (480 m). The average height of the disposal cell is about 30 ft (10 m) above ground level (DOE, 1989). A drainage ditch on the north and west sides of the disposal cell directs runoff water away from the site. Figure 2.1 and Plate 1 show plan and cross-sectional views.

A 3.5-ft (1-m) thick infiltration/radon barrier (Figure 2.1) constructed of compacted clay is designed to protect the ground water by minimizing infiltration into the disposal cell and reducing the radon emanations from the



NOTE: COVER THICKNESSES IN EMBANKMENT COVER SYSTEM ARE NOT TO SCALE (CONCEPTUAL ONLY).

FIGURE 2.1
DISPOSAL CELL CROSS SECTION
TUBA CITY, ARIZONA, SITE

disposal cell to less than 20 picocuries per square meter per second (pCi/m^{2}s). A field test of the cover indicates the borrow material would ensure the compacted infiltration/radon barrier would have a saturated hydraulic conductivity of 1.0E-8 centimeters (cm) per second (DOE, 1988).

The erosion protection layer is designed to protect the disposal cell from runoff, flooding, and gully development. A 6-inch (15-millimeter [mm])-thick layer of riprap on the topslopes is underlain by a 6-inch (15-mm)-thick sand filter to promote drainage. A 1-ft (0.3-m)-thick layer of riprap was placed on the sideslopes and apron (toe) of the disposal cell (Figure 2.1). The erosion protection barrier ties into the rock-armored drainage channels on the north, east, and west sides of the disposal cell. The drainage ditch diverts surface runoff around and away from the disposal cell (Figure 2.1).

2.2.4 Ground water protection strategy

The ground water protection strategy at the Tuba City disposal site is to limit water migration through the materials in the disposal cell and thus limit contaminant migration out of the cell. Because the contaminated materials at the Tuba City site were stabilized in place, the disposal cell overlies a contaminant plume, that resulted from the surface uranium processing activities at the site before remedial action. Based on the hydraulic properties of the cover design and a field test of the cover (DOE, 1988), the NRC has concluded that water infiltration through the cover and the stabilized tailings will be minimized to the extent practicable. This in turn minimizes the potential for future ground water contamination (NRC, 1989).

3.0 SITE DRAWINGS AND PHOTOGRAPHS

At the completion of remedial action, DOE documented disposal site as-built conditions with as-built drawings, baseline photographs, and aerial photographs for comparisons over time (MK-F, 1995).

The DOE also prepared a disposal site topographic map that will become part of the Tuba City permanent site file. The site inspection map will be updated, as necessary, after each site inspection. The DOE will archive all site drawings, maps, and photographs. DOE may modify these maps, drawings, and photographs as necessary, and will be responsible for maintaining all these maps, drawings, and photographs in the Tuba City permanent site file.

3.1 DISPOSAL SITE VICINITY MAP

The Tuba City disposal site vicinity map encompasses an area with a radius of approximately 1.5 mi (2.4 km) from the center of the disposal site. A larger radius is not necessary because the disposal site is in a remote area with uniform land use and the nearest town is 6 mi (10 km) to the east. The disposal site vicinity map will be placed in the site atlas, which is maintained in the Tuba City permanent site file.

The vicinity map shows the disposal site boundary, the disposal cell, land ownership around the disposal site (Indian lands), latitude and longitude, section, township, range, principal meridian, off-site ground water monitoring wells, drainage systems, and roads.

The vicinity map will be updated, as necessary, after each site inspection. If changes to the map are required, a new map will be prepared which will include the revision number and the year of revision.

3.2 DISPOSAL SITE TOPOGRAPHIC MAP

The Tuba City disposal site topographic map, prepared immediately after the completion of remedial action from a final topographic survey of the disposal site area, is included in the Tuba City completion report (MK-F, 1995). The topographic map also will be added to the site atlas, which will be placed in the permanent site file. The map was created with a scale of 1 inch equals 200 ft (1:2400), a contour interval of 2 ft (0.6 m), and coverage of the disposal site and an area of 0.25 mi (0.40 km) around the site perimeter.

3.3 DISPOSAL SITE MAP

The Tuba City disposal site map (Plate 1) was compiled using the final topographic map of the disposal site.

When the disposal site map is updated, the revised map will include the year of revision and the revision number. This map will serve as the base map for site inspections (Section 6.7). A new inspection map will be prepared after each inspection. Each new map will indicate the year and type of inspection.

3.4 DISPOSAL SITE AS-BUILT DRAWINGS

A set of as-built drawings illustrates the final disposal cell construction and final disposal site conditions. They may be used to document changes in physical site conditions and to the disposal cell over time, or to develop corrective action plans, if required.

3.5 SITE BASELINE PHOTOGRAPHS

A photographic record of the final site conditions at the Tuba City disposal site will be included in the permanent site file. This record consists of a series of aerial and ground photographs that provide a baseline visual record of final site construction activities and final site conditions to complement the as-built drawings. In addition, the final completion report for the disposal site contains a complete set of photographs that documents each phase of construction (MK-F, 1995). The postconstruction photographs can be used as an orientation tool prior to site inspections and provide a baseline record of surveillance features.

3.6 SITE AERIAL PHOTOGRAPHS

The aerial photographs taken throughout remedial action activities between 1988 and 1990 are presented in the Tuba City completion report (MK-F, 1995). These photographs provide a permanent record of site conditions that can be used to monitor changes (e.g., erosion patterns, vegetation changes, and land use) over time and to provide orientation prior to site inspections. The need for new aerial photographs will be evaluated at 5-year intervals, beginning with the year the license becomes effective. The specifications for aerial photographs are provided in Attachment 3 of the guidance document for implementing the UMTRA Project long-term surveillance program (DOE, 1992a).

4.0 PERMANENT SITE SURVEILLANCE FEATURES

Survey and boundary monuments, site markers, entrance and perimeter signs, and settlement plates are the permanent surveillance features at the Tuba City disposal site. One boundary monument and three survey monuments define the four corners of the legal boundaries of the fenced, irregularly shaped perimeter of the disposal site. Perimeter warning signs are placed at intervals around the disposal site so that one or more signs are visible in daylight from any direction. One perimeter sign and one site marker are placed at the official entrance on the northern side of the disposal site. The other site marker is near the center of the crest of the disposal cell. The four settlement plates are located along the edges of the crest of the disposal cell (Plate 1).

The construction and emplacement of the site surveillance features described below meet the specifications in DOE's guidance document for implementing the UMTRA Project long-term surveillance program (DOE, 1992a).

4.1 SURVEY BOUNDARY MONUMENTS

Three survey/boundary monuments, Berntsen RT-1 metal markers, are set into the top of a truncated cone of reinforced (precast) concrete that is set in concrete. The bottoms of the holes for the survey/boundary monuments are at least 18 inches (460 mm) below frost line (total depth 38 inches [970 mm]). In each hole, the four metal bars that reinforce the concrete also could be used to locate the monuments with detectors, if they were buried over time.

The three survey/boundary monuments are located inside the security fence at the southwest, northwest, and northeast corners of the site. The monuments establish permanent horizontal control based on the project grid system and define three of the four corners of the disposal site (Plate 1). They are referenced to the U.S. Geological Survey (USGS) triangulation station (station name: Tuba City) on Dynamite Hill, about 5 mi (8 km) west of the disposal site (MK-F, 1989).

Because blowing sand and tumbleweed accumulate along the fence lines, several survey and boundary monuments were difficult to locate during the 1991 annual prelicensing site inspection (DOE, 1992b). Measurements have been made to assist in locating the monuments in the future.

4.2 BOUNDARY MONUMENT

A Berntsen federal aluminum survey monument, Model A-1, is used for the fourth boundary monument (Plate 1). Ceramic magnets are epoxied into the cap and base of the monument, and are oriented vertically for maximum detection if the monument becomes covered. The boundary monument is set with the base 38 inches (970 mm) below ground and the top 10 inches (250 mm) above ground to facilitate location. The boundary monument is inside the fence at the southeast corner of the site.

Because blowing sand and tumbleweed accumulate along the fence line, the boundary monument was difficult to locate during the 1991 annual site inspection (DOE, 1992b). Measurements were made to assist in locating the monument in the future.

4.3 SITE MARKERS

The two unpolished granite site markers with an incised message are located on the site. Site marker SMK-1, near the entrance on the northern boundary of the site, is set in a bed of reinforced concrete that extends 3 ft (1 m) below ground surface. Site marker SMK-2, at the crest of the disposal cell, is set in a bed of reinforced concrete that extends to the top of the infiltration/radon barrier.

The markers identify the Tuba City disposal site, the general location of the disposal cell (tailings), the date of closure (30 March 1989), the tonnage of tailings (2,250,000 tons [2,190,000 metric tons]), and the curies of radioactivity (940 curies of Ra-226). In addition, the international radiation symbol is also inscribed in each marker.

4.4 ENTRANCE AND PERIMETER SIGNS

There is an entrance sign at the site gate. In addition to the entrance sign, 30 perimeter signs are sufficiently close to each other that one or more are visible to anyone approaching the fence from any direction. All signs are mounted on steel posts and are set 1 to 2 ft (0.3 to 0.6 m) inside the security fence. The perimeter signs display the international symbol indicating the presence of radioactive materials. The signs also show the cell contains uranium mill tailings and that trespassing is forbidden. The entrance sign has the same information as the perimeter signs plus the site name and the name and telephone numbers of site contacts. The tops of the signs are 70 inches (1800 mm) above ground surface. The sign posts are embedded in concrete to a depth of 38 inches (970 mm) below ground surface.

4.5 SETTLEMENT PLATES

Long-term settlement of the disposal cell can be monitored using the four settlement plates installed after the cell was completed. All four settlement plates were placed on the topslope of the disposal cell along the crest (Plate 1).

4.6 ADDITIONAL SITE SURVEILLANCE REQUIREMENTS

If the survey/boundary monuments continue to be difficult to locate because of shifting sands and tumbleweed accumulation, reference posts will be installed to assist the site inspection teams. One 5-ft (1.5-m)-long, 4-inch (100-mm)-diameter reference post will be installed in concrete at each location to assist in locating the monuments. The holes for the reference posts will be a minimum of 10 inches (250 mm) in diameter, and the bottoms of the holes will be at least 18 inches (460 mm) below frost line (total depth will be 38 inches [970 mm]).

5.0 GROUND WATER MONITORING

The Tuba City disposal cell is designed to provide long-term protection against future ground water contamination downgradient from the site and to comply with the final EPA ground water protection standards in Subpart A of 40 CFR Part 192 (1995). The residual radioactive materials (RRM) from the Tuba City site were stabilized in place with remedial action completed in 1990. Consequently, ground water contamination related to uranium processing activities prior to surface remedial action is still present beneath and downgradient from the site. Transient drainage (a component of disposal cell design), and periodic infiltration of surface runoff from the cell cover via the south and southwest aprons may impact ground water beneath and downgradient from the disposal site. Planned contaminant containment activities to be initiated at the downgradient edge of the disposal cell late in 1996 will also impact ground water quality in the uppermost aquifer. All of these conditions limit the effectiveness of normal point of compliance (POC) monitoring of ground water in the uppermost aquifer as a reliable indicator of disposal cell performance.

The DOE plans to perform evaluative monitoring of ground water in the uppermost aquifer to evaluate trends in ground water quality, monitor the downgradient extent of contamination in ground water, analyze the impacts of transient drainage and surface runoff, and assess the effects of ground water restoration measures associated with containing the contamination related to uranium processing activities. The evaluative monitoring well network will consist of three monitor wells adjacent to the south apron on the downgradient edge of the disposal cell, one upgradient background monitor well, two baseline monitor wells within the area of contamination, and one monitor well downgradient from the edge of the contamination. Additional monitor wells may be installed by the DOE as required to effectively monitor ground water conditions at the site. The evaluative monitoring described in the LTSP will be carried out in conjunction with UMTRA Ground Water Project activities, and will be protective of human health and the environment.

Application for Subpart A licensing of the Tuba City disposal cell will be submitted with the condition that the need for ground water monitoring at a POC for Subpart A compliance be assessed and implemented after completion of Subpart B activities. The long-term monitoring program at the Tuba City site is outlined in this LTSP, which will function as the concurrence document for the Subpart A licensing process.

5.1 GROUND WATER CHARACTERIZATION

Ground water in the vicinity of the Tuba City site was characterized to establish baseline conditions for ground water quality prior to disposal cell closure. Statistical methods were applied to evaluate ground water quality and resultant trends over time. This document summarizes ground water conditions; details are available in other Tuba City site documents, including Appendix D of the RAP (DOE, 1989), and the water sampling and analysis plan (DOE, 1996).

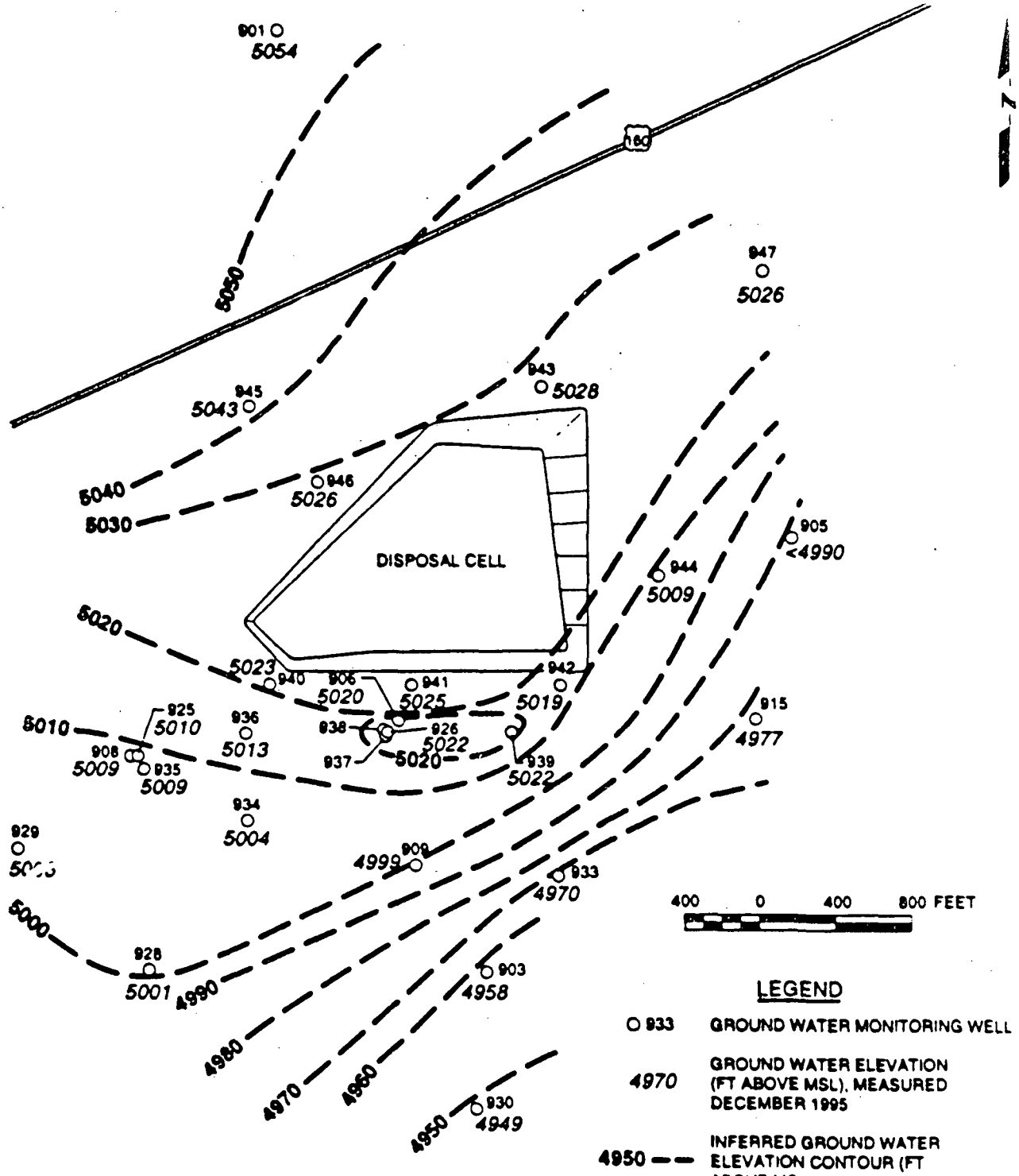
5.1.1 Hydrogeologic setting

Near-surface geologic formations at the Tuba City site are part of the Glen Canyon Group, which is composed of (in descending order from land surface) the Navajo Sandstone, the Kayenta Formation, and the Moenave Formation. The Navajo Sandstone is a fine- to medium-grained sandstone unit locally cemented with carbonate and displaying large-scale crossbeds. The Navajo Sandstone is approximately 430 ft (130 m) thick in the site vicinity. It intertongues with the underlying Kayenta Formation in a zone as much as 300 ft (90 m) thick. The Kayenta Formation consists of interbedded fine-grained sandstone and mudstone. The bedding is lenticular and cross-bedding is common in the sandy units. The Moenave Formation consists of very fine- to fine-grained sandstone and thin siltstone strata (DOE, 1989).

The Navajo Sandstone is the major aquifer in the Tuba City site vicinity and with the underlying Kayenta Formation, makes up what is referred to as the "N-aquifer" of the region (Cooley et al., 1969). There is no continuous hydraulic barrier to ground water flow between the Navajo Sandstone and Kayenta Formation (DOE, 1989). The lower boundary of the N-aquifer occurs at the contact between the Kayenta and Moenave Formations. Although overlain by the Carmel Formation and a silty member of the Entrada Sandstone, which created confined aquifer conditions in many areas, the N-aquifer is unconfined in the Tuba City area (Harshbarger et al., 1957). The major recharge area for the N-aquifer is in the vicinity of Shonto, about 40 mi (64 km) north of Tuba City (Eychaner, 1983). Ground water flow diverges from the recharge area, flowing northeast toward Laguna Creek and south toward Tuba City and Moenkopi Wash. Local infiltration, including Greasewood Lake (dry), undoubtedly provides some recharge in the site area.

The depth to the water table in the Navajo Sandstone ranges from about 20 to 150 ft (6 to 45 m) below land surface in the site vicinity. Figures 5.1 and 5.2 show the shallow ground water table surface and deeper potentiometric surface determined for wells completed in the Navajo Sandstone at the site. The ground water table gradient is to the southeast toward Moenkopi Wash. Springs occurring on both sides of Moenkopi Wash indicate the N-aquifer discharges to the wash (USGS, 1969). Hydraulic conductivity in the Navajo Sandstone (based on slug tests performed in eight monitor wells) ranged from 50 to 900 ft (15 to 270 m) per year, with a geometric mean of 160 ft (50 m) per year. The average linear ground water velocity ranged from 10 to 200 ft (3 to 60 m) per year with a geometric mean of 30 ft (10 m) per year, assuming a hydraulic gradient of 0.04, and an effective porosity of 0.2 (Freeze and Cherry, 1979; DOE, 1989).

Ground water levels have been relatively consistent over time, generally fluctuating less than two feet per year. An exception was a water level increase of about four feet in monitor well 906 just south of the disposal cell in 1993. The cause of this increase may very likely be related to focused infiltration of precipitation runoff from the disposal cell during 1992 and 1993. The years 1992 and 1993 were very wet in the Tuba City area with average annual precipitation of 11.6 and 10.8 inches, respectively, versus normal precipitation of approximately 5.0 inches. The water level in this monitor well has subsequently shown a declining trend. Monitor well 906 is the only site monitor well that appears to be affected by disposal cell runoff.

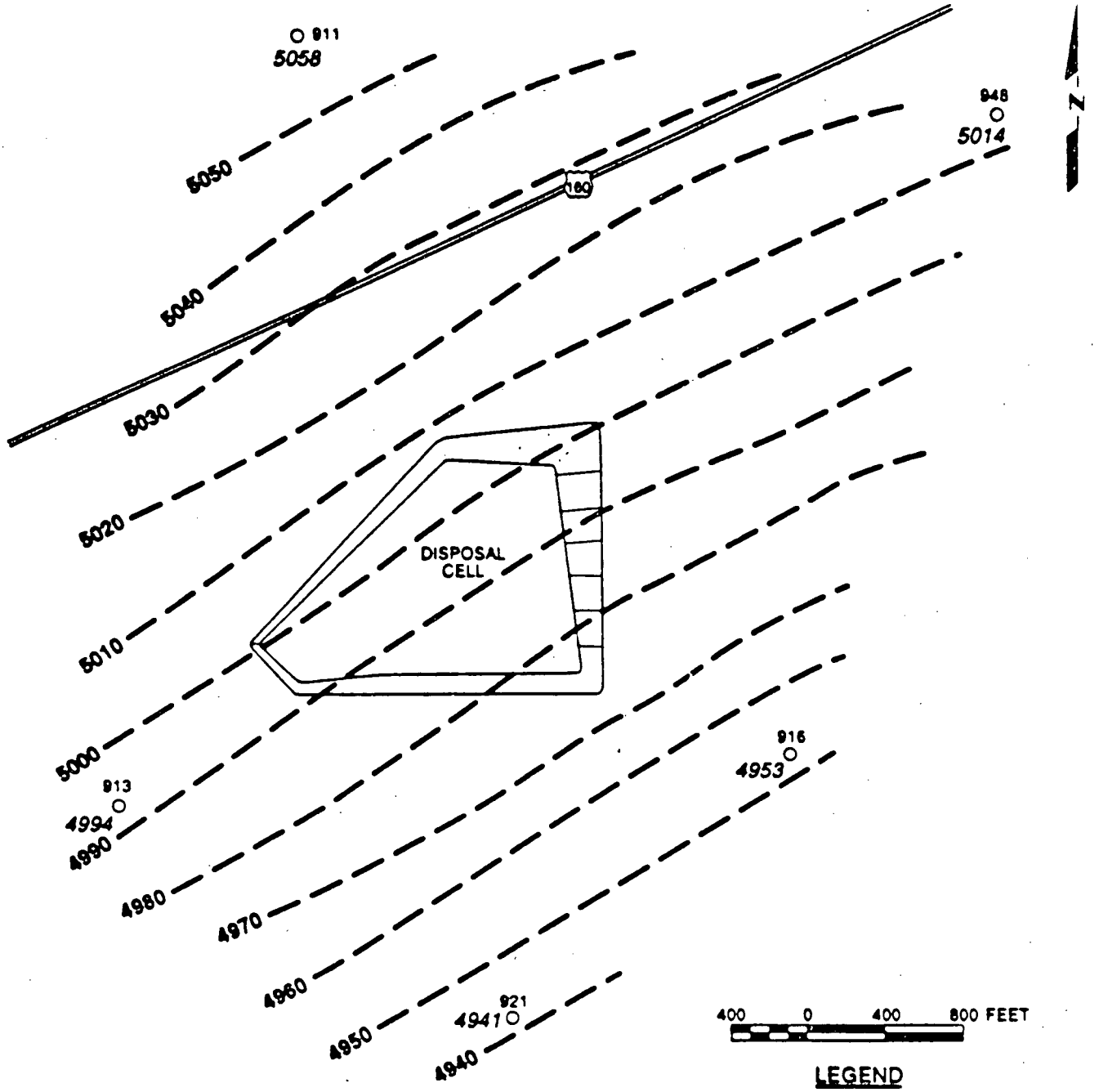


NOTES: 1. POSTED ELEVATIONS ARE ESTIMATED VALUES. FINAL VERTICAL GEODETIC SURVEYS HAVE NOT BEEN DETERMINED FOR SOME LOCATIONS.

2. CONTOUR INTERVAL = 10 FT.

FIGURE 5.1
ESTIMATED WATER TABLE ELEVATION CONTOUR MAP OF SHALLOW NAVAJO SANDSTONE AQUIFER TUBA CITY PROCESSING SITE/DISPOSAL SITE

MAC: BITE/TUB/LTSP/WTRTBLSHALLOW TUB



LEGEND

○ 916	GROUND WATER MONITORING WELL
4953	GROUND WATER ELEVATION (FT ABOVE MSL), MEASURED DECEMBER 1995
4950 — —	INFERRED GROUND WATER ELEVATION CONTOUR (FT ABOVE MSL)
160	U.S. HIGHWAY

NOTES: 1. POSTED ELEVATIONS ARE ESTIMATED VALUES. FINAL VERTICAL GEODETIC SURVEYS HAVE NOT BEEN DETERMINED FOR SOME LOCATIONS.

2. CONTOUR INTERVAL = 10 FT.

FIGURE 5.2
ESTIMATED POTENTIOMETRIC SURFACE OF DEEP NAVAJO SANDSTONE AQUIFER TUBA CITY PROCESSING SITE/DISPOSAL SITE

5.1.2 Ground water quality

Ground water quality at the Tuba City site has been determined by collecting and analyzing ground water samples from a network of DOE monitor wells (Figure 5.3). The current network of wells at the site consists of 38 monitor wells, including three disposal cell wells (940, 941, and 942); four extraction wells (925, 926, 936, and 939), and one deep test well (948). Additionally, the former Rare Metals Corporation of America water supply wells (968, 970, 971, and 972) are located north of U.S. 160. Seventeen monitor wells, the four extraction wells, the water supply well, and the disposal cell wells were installed in late 1995 and were sampled for the first time in December 1995.

Background ground water quality

Background ground water quality is defined as the quality of ground water that would exist if uranium processing activities had not occurred. Background ground water quality in the N-aquifer has been established using data collected from monitor wells 901, 910, and 917. Monitor wells 901 and 910 are upgradient from the disposal site and monitor well 917 is crossgradient from the disposal cell.

Background ground water quality has been characterized from ground water samples collected between 1988 and 1991. Background ground water quality in the N-aquifer is characterized as calcium bicarbonate or sodium bicarbonate water with low total dissolved solids (TDS) (450 milligrams per liter [mg/L] or less) and slightly basic pH. Table 5.1 presents a statistical summary of background ground water quality.

Baseline ground water quality

Baseline ground water quality was established for the Tuba City site as a way to evaluate disposal cell performance because surface remedial action at the Tuba City site involved stabilization in place (RRM was not removed from its original location). Determination of baseline conditions is required because activities associated with uranium milling operations have degraded ground water quality beneath and downgradient from the disposal cell to the extent that hazardous constituent concentrations are greater than background. In some locations, these concentrations exceed the maximum concentration limits (MCL) specified in 40 CFR §192.02(a)(1995). Consequently, background ground water quality and MCLs are not appropriate for determining the concentration limits needed to evaluate disposal cell performance.

Baseline ground water quality conditions for the Tuba City site were defined statistically and are summarized in Table 5.2. Water quality data for 1988 to 1991 from monitor wells 906, 908, 909, and 912 were used to define baseline conditions. In general, most inorganic constituents (with and without MCLs) at these locations were present at concentrations comparable to background. However, nine constituents (cadmium, lead, molybdenum, nitrate, selenium, tin, uranium, zinc, and net gross alpha) were determined to have concentrations that statistically exceed background.

Figure 5.3
Ground Water Monitor Well, Extraction Well, and Deep Test Well Locations Tuba City, Arizona, Site

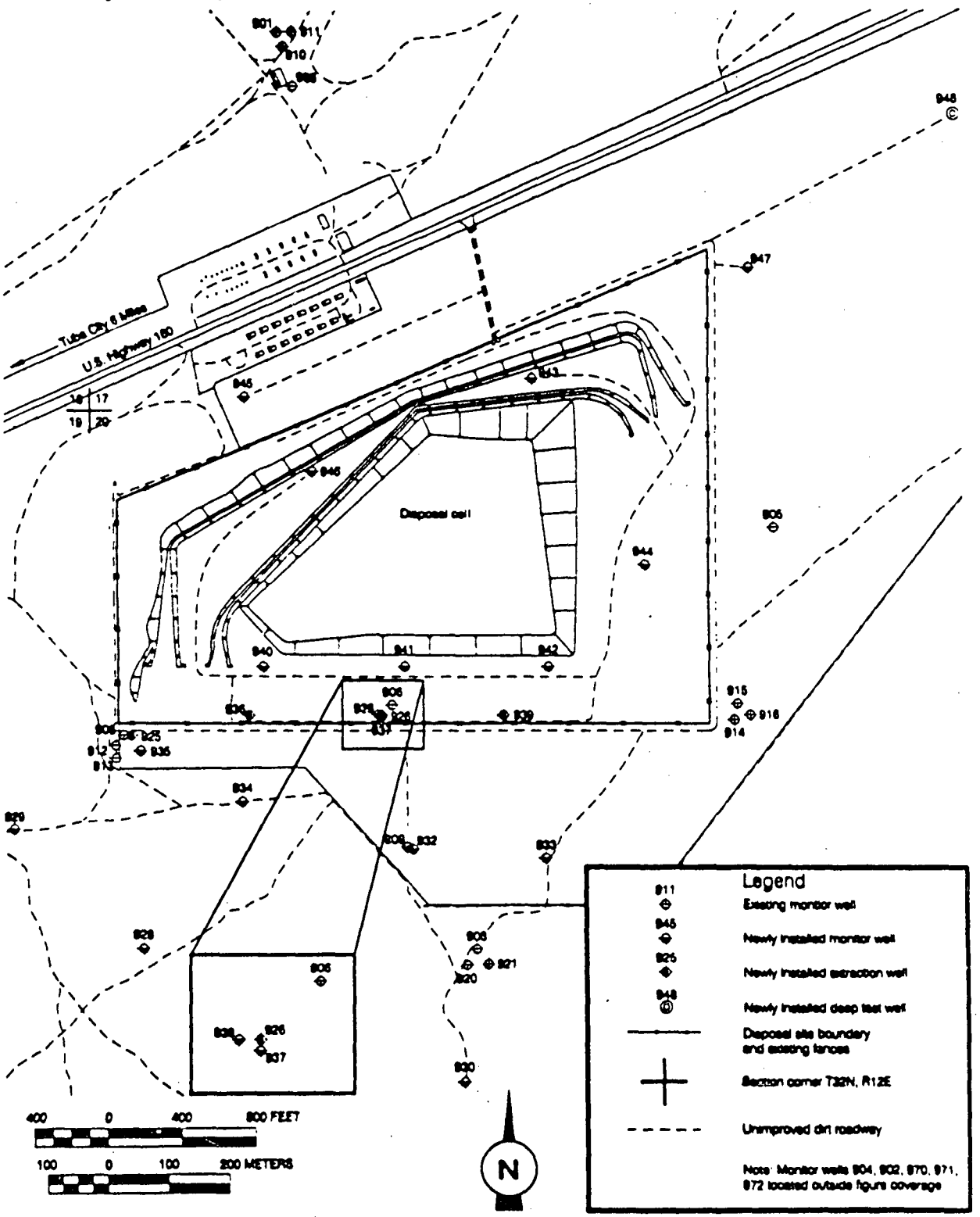


Table 5.1 Statistical summary of background ground water quality, Tuba City, Arizona, site

Constituent	MCL (mg/L)	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
EPA inorganics with MCLs							
Arsenic	0.05	18	0.001 - 0.01	0	BD	BD	BD
Barium	1.0	18	0.0013-0.1	72	0.063	0.092	0.10
Cadmium	0.01	18	0.001	0	BD	BD	BD
Chromium	0.05	24	0.0032-0.01	4	BD	BD	0.0039[b]
Lead	0.05	24	0.0017-0.01	8	BD	BD	0.0035[b]
Mercury	0.002	12	0.0002	0	BD	BD	BD
Molybdenum	0.10	24	0.0048-0.01	0	BD	BD	BD
Net gross alpha (pCi/L)	15	24	NA	NA	0.0	1.42	5.56
Nitrate	44	24	0.1-1.0	100	10.9	15.0	21.7
Ra-226 & Ra-228 (pCi/L)	5	24	NA	NA	0.0	0.6	3.6
Selenium	0.01	24	0.0016-0.005	0	BD	BD	BD
Silver	0.05	12	0.01	0	BD	BD	BD
Uranium	0.044	24	0.0003-0.003	75	0.0006	0.0014	0.012

Table 5.1 Statistical summary of background ground water quality, Tuba City, Arizona, site (Concluded)

Constituent	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
Inorganic constituents without MCLs						
Antimony	9	0.003	11	BD	BD	0.007
Beryllium	12	0.005-0.010	0	BD	BD	BD
Cobalt	12	0.03-0.05	0	BD	BD	BD
Copper	12	0.01-0.02	0	BD	BD	BD
Cyanide	12	0.01	0	BD	BD	BD
Nickel	18	0.0061-0.04	0	BD	BD	BD
Sulfide	12	0.1	33	BD	BD	1.2
Thallium	12	0.01-0.1	0	BD	BD	BD
Tin	18	0.005	0	BD	BD	BD
Vanadium	24	0.0051-0.01	92	0.0076	0.012	0.03
Zinc	24	0.0026-0.005	63	0.017	BD	0.056

[a]Detection limits vary for parameters because of differences in sample analysis procedures over time (1988 to 1991).
[b]Maximum value reported above detection limit.

Notes: 1. Data from upgradient wells TUB-01-0901, -0910, and -0917, collected from 1988 to 1991.
2. Measurements are in milligrams per liter except as noted.

BD – below detection.
NA – not applicable for combined radiological parameters.
pCi/L – picocuries per liter.

Table 5.2 Baseline statistical summary of ground water quality of monitor wells screened in the contaminant plume, Tuba City, Arizona, site

Constituent	MCL (mg/L)	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
EPA inorganics with MCLs							
Arsenic	0.05	32	0.01-0.05	13	BD	BD	0.017[b]
Barium	1.0	28	0.0013-0.1	36	BD	BD	0.08[b]
Cadmium	0.01	32	0.001	19	BD	BD	0.004
Chromium	0.05	40	0.0032-0.01	13	BD	BD	0.18
Lead	0.05	40	0.0017-0.011	15	BD	BD	0.02
Mercury	0.002	20	0.0002	0	BD	BD	BD
Molybdenum	0.10		0.0048-0.01				
906		10		70	BD	0.025	0.12
908		10		20	BD	BD	0.12
909		10		20	BD	BD	0.04
912		10		20	BD	BD	0.02
Net gross alpha (pCi/L)	15	40	NA	NA	0.0	14	147
Nitrate	44		0.10-1.0				
906		10		100	770	992	1200
908		10		100	620	860	1100
909		10		100	710	890	1070
912		10		100	189	288	383
Ra-226 & Ra-228 (pCi/L)	5	40	NA	NA	0.0	0.9	11
Selenium	0.01		0.0016-0.03				
906		10		40	BD	BD	0.018[b]
908		10		100	0.005	0.022	0.039
909		10		50	BD	0.007	0.013[b]
912		10		40	BD	BD	0.009[b]
Silver	0.05	20	0.01	0	BD	BD	BD
Uranium	0.044		0.0003-0.003				
906		10		100	0.502	0.615	0.990
908		10		100	0.082	0.113	0.167
909		10		100	0.043	0.055	0.085
912		10		100	0.022	0.030	0.046

Table 5.2 Baseline statistical summary of ground water quality of monitor wells screened in the contaminant plume, Tuba City, Arizona, site (Concluded)

Constituent	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
Inorganic constituents without MCLs						
Antimony	12	0.003-0.006	0	BD	BD	BD
Beryllium	20	0.005-0.01	0	BD	BD	BD
Cobalt	20	0.03-0.05	0	BD	BD	BD
Copper	20	0.01-0.02	10	BD	BD	0.01[b]
Cyanide	20	0.01	5	BD	BD	0.02
Nickel	28	0.0061-0.04	18	BD	BD	0.45
Sulfide	20	0.1	20	BD	BD	8.5
Thallium	20	0.01-0.10	15	BD	BD	0.10
Tin	28	0.005-0.05	25	BD	BD	0.057
Vanadium	40	0.0051-0.01	65	0.007	0.01	0.10
Zinc	40	0.0026-0.01	68	BD	0.011	0.617

[a]Detection limits vary for parameters because of differences in sample analysis procedures over time (1988 to 1991).
[b]Maximum value reported above detection.

Notes: 1. Data are from monitor wells TUB-01-0906, -0908, -0909, and -0912, collected from 1988 to 1991.
2. Measurements are in milligrams per liter except as noted.

BD – below detection.
NA – not applicable for combined radiological parameters.
pCi/L – picocuries per liter.

5.1.3 Extent of contamination

Residual radioactive materials at the Tuba City site were stabilized in place. Ground water in the uppermost aquifer was contaminated by uranium processing activities which occurred from 1956 until 1966, and from residual drainage until completion of surface remedial activities in 1990. Site-related contaminants in ground water have been detected at least 1500 feet downgradient from the processing site and include molybdenum, nitrate, selenium, strontium, sulfate, and uranium. Concentrations of these constituents have remained relatively constant over time, except for an increase in concentrations of uranium, nitrate, and sulfate noted during 1993 in monitor well 906, coincident with the rise in ground water level. After peaking in 1993, concentrations have generally declined through the last ground water sampling round in mid-1995.

The sources of contaminants in ground water and reasons for recent variations in concentrations are not well established, but could be related to the following conditions:

- Concentrations of existing constituents in ground water (those present prior to disposal cell closure) may increase temporarily as recharge is eliminated from the cell footprint as a result of the thick low-permeability cover.
- The contribution of contaminants in transient drainage is a possibility, but probably does not represent a significant and long-term source. The slimes were composed of very fat clays and are not significantly covered by other materials, and thus were not subjected to loading to the point where massive amounts of water were ejected. Transient drainage would possibly have been released relatively quickly, and may not even have been detected by the existing ground water monitoring program. Much of it may have remained in the vadose zone.
- The possible contribution of contaminants caused by infiltration of runoff from the disposal cell cover (approximately 40 acres) collecting in the south and southwest aprons and percolating through remnants of the holding ponds (with a possible source of contaminants in the vadose zone) may be substantial in years of elevated precipitation (1992/1993), particularly in the vicinity of monitor well 906, which is installed in close proximity to the apron and holding ponds.

Contaminated ground water in the uppermost aquifer near the source area (represented by monitor well 906) is characterized by nitrate concentrations at 1310 mg/L, sulfate at 3640 mg/L, and TDS at 7100 mg/L. Ground water quality at the fringe of the contaminated area (represented by monitor well 903, approximately 1400 ft (427 m) south of well 906) is characterized by nitrate concentrations at 43 mg/L, sulfate at 37 mg/L, and TDS at 268 mg/L (DOE, 1996).

Figure 5.4 gives the locations of cross sections showing the vertical distribution of nitrate, sulfate, TDS, and uranium (Figures 5.5 and 5.6). Contaminant migration appears to be contained vertically, with constituents concentrated in the upper 50 ft (15 m) of the aquifer. The monitor well cluster 908, 912, and 913 appears to provide evidence of contaminant stratification, with nitrate concentrations ranging from

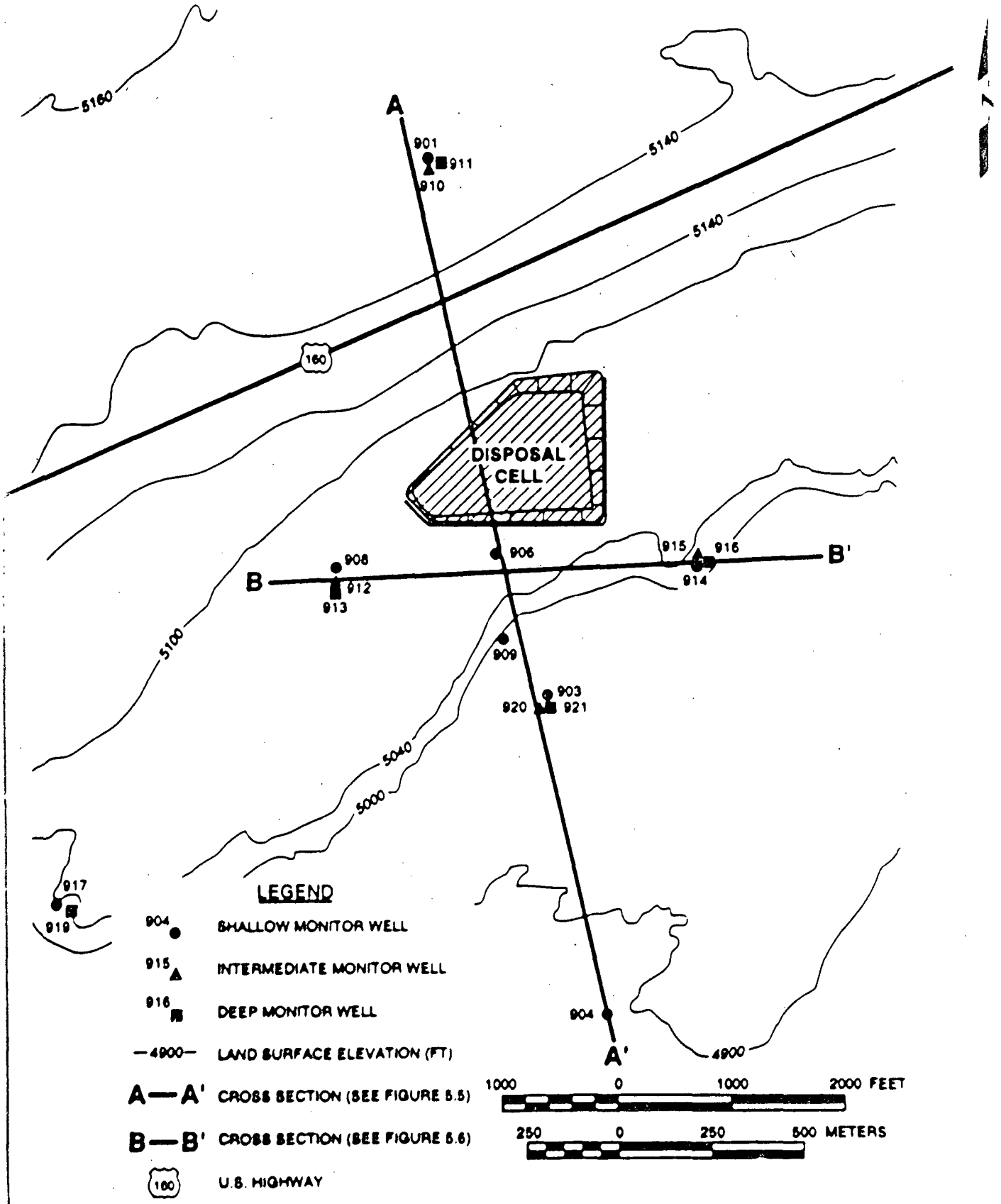


FIGURE 5.4
CROSS SECTION LOCATIONS
TUBA CITY, ARIZONA, SITE

SITE TUBA CITY SECTION LOCS

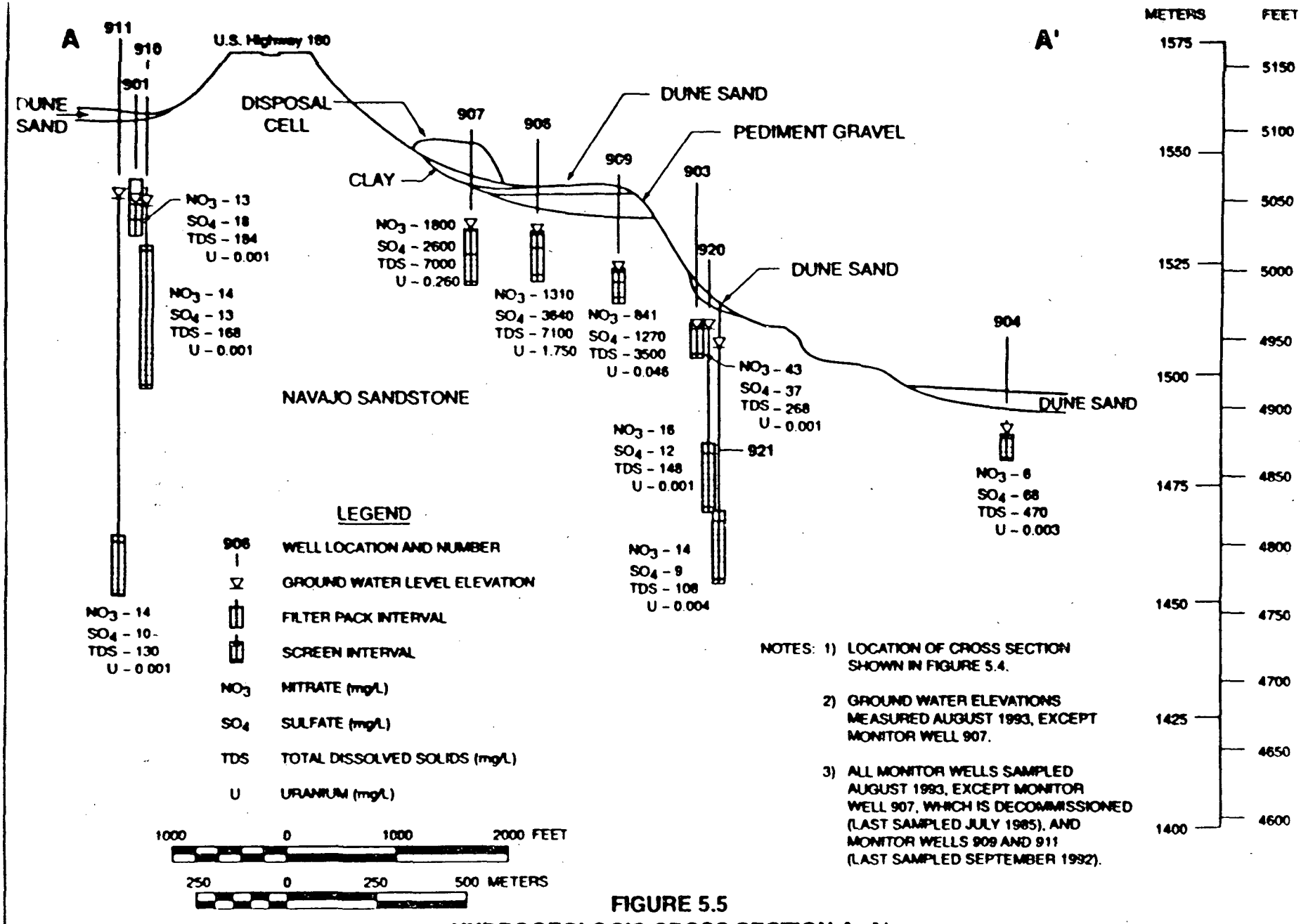


FIGURE 5.5
HYDROGEOLOGIC CROSS SECTION A–A'
TUBA CITY, ARIZONA, SITE

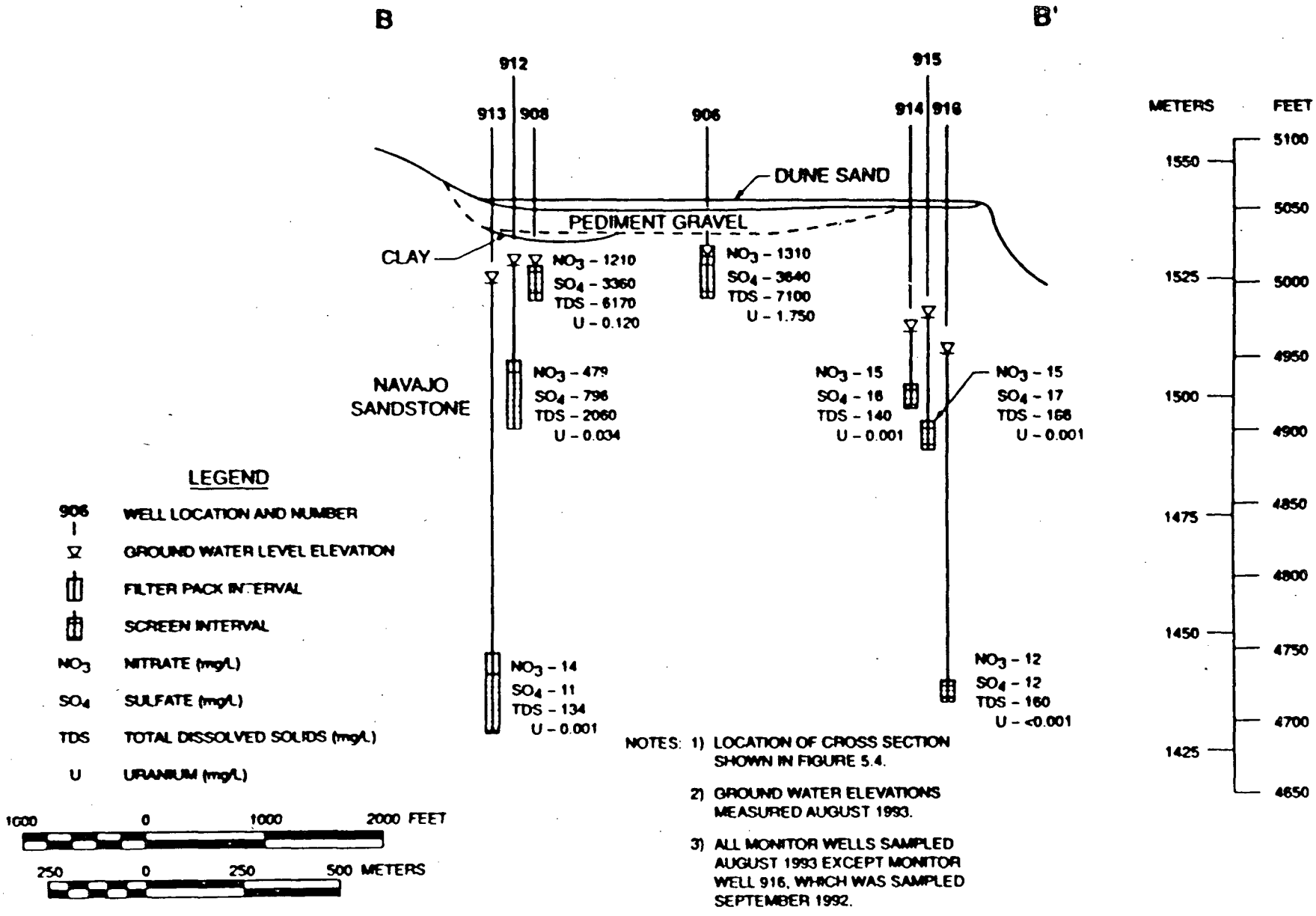


FIGURE 5.6
HYDROGEOLOGIC CROSS SECTION B–B'
TUBA CITY, ARIZONA, SITE

1200 mg/L in the shallowest well (908) to virtually background in the deepest well (913). The stratification of contaminants within

ground water is not unexpected because the source was located on the surface, the Navajo Sandstone is naturally stratified, and there is no active, local, natural recharge mechanism to drive constituents deep into the aquifer. In addition, the difference in water levels in well clusters suggests the vertical ground water migration is impeded by subsurface barriers.

Preliminary screening for organic constituents in ground water was performed in December 1995. Results of this sampling indicated that no organic constituents of concern are present in ground water in the vicinity of the Tuba City disposal site.

Additional information on the extent of groundwater contamination at the site is provided in the water sampling and analysis plan (DOE, 1996).

5.2 GROUND WATER MONITORING PROGRAM

Performance assessment measures and/or criteria will be determined in an effort to assess disposal cell performance during ground water restoration activities. Visual inspection to evaluate the integrity of the disposal cell will be performed annually as specified in sections 6.1 and 6.4.2. Evaluative monitoring (as outlined in section 5.2.2), in conjunction with monitoring during ground water restoration activities, will be performed to provide an overall assessment of ground water conditions in the uppermost aquifer at the Tuba City site during the period of Subpart B activities. This will ensure that any potential deviations from the anticipated performance of the disposal cell, with regards ground water conditions, will be noted and evaluated during the process of ground water remediation.

Ground water monitoring at a POC for demonstration of disposal cell performance is not effective because of pre-existing site-related contamination in ground water, transient drainage, infiltration of surface runoff, and manipulation of the ground water system as a result of contaminant containment activities. However, all of these inter-related factors need to be evaluated and understood to the extent possible in order to design, implement, and monitor a ground water restoration system. The ground water monitoring programs for Subparts A and B will provide an ongoing evaluation of trends in ground water conditions during the ground water restoration phase of the project. This monitoring will serve a dual purpose by assessing the progress of the ground water remediation efforts, as well as possibly giving an indication of disposal cell performance (although the anticipated impact from the disposal cell should be minimal and essentially indistinguishable from the existing quality of ground water).

5.2.1 Long-term ground water monitoring

Pursuant to 40 CFR §192.03 (1995), the DOE will implement a ground water monitoring program to be carried out over a period of time commencing upon completion of remedial actions taken to comply with the standards in 40 CFR §192.02 (1995), and of a duration which is adequate to demonstrate that future performance of the system of disposal can be reasonably expected to be in

accordance with the design requirements of 40 CFR §192.02(c) (1995).According to 40 CFR §192.20(a)(4) (1995), performance of the disposal system and prevention of contamination of ground water may also be assessed by indirect methods as well as by direct monitoring of ground water.

Long-term monitoring of ground water in the uppermost aquifer at POC wells to demonstrate disposal cell performance is not technically feasible at the Tuba City site due to: 1) pre-existing site-related contamination in ground water, 2) possible transient drainage resulting from disposal cell construction, and 3) infiltration of surface water via the south and southwest cell aprons and possible leaching of vadose zone contaminants downgradient from the disposal cell. Also, changes in the ground water/aquifer system resulting from planned contaminated ground water containment activities, will have an impact on ground water quality conditions in the uppermost aquifer.

Compliance with Subpart A of 40 CFR Part 192 (1995) at the Tuba City site will consist of a two step process. Initially, application for Subpart A licensing will be submitted with the condition that the need for ground water monitoring at a POC to demonstrate disposal cell performance be assessed and implemented after completion of Subpart B (ground water restoration) activities. Upon completion of ground water restoration activities at the Tuba City site, ground water conditions will be evaluated and the need for ground water monitoring at a POC to fulfill the requirements of Subpart A will be determined. If it appears that ground water monitoring will provide an effective means of evaluating disposal cell performance, a monitoring program will be designed and implemented, with the concurrence of the NRC. At such time, the LTSP would be revised to incorporate the details of the overall monitoring plan for both Subparts A and B and to meet the requirements of 10 CFR § 40.27(b)(2). If a ground water monitoring program is not proposed after restoration activities are complete, the LTSP would still be revised to reflect the appropriate long-term surveillance and maintenance activities.

5.2.2 Evaluative ground water monitoring

The DOE plans to perform evaluative monitoring of ground water in the uppermost aquifer to: 1) evaluate trends in ground water quality, 2) monitor the downgradient extent of contamination in ground water, 3) analyze the impacts of transient drainage and surface runoff, and 4) assess the effects of ground water restoration measures associated with containing the contamination related to uranium processing activities.

Trends in ground water quality will be evaluated by comparing the analytical results from the monitor wells at the downgradient edge of the disposal cell and the baseline monitor wells within the area of contamination with baseline concentrations for constituents of concern that have been established in Section 5.1.2. Significant variations in concentrations of constituents of concern will be noted, and may trigger additional investigations, pending coordination with ongoing Subpart B activities, and consultation with the NRC.

The downgradient extent of contamination will be evaluated by assessing analytical results from the monitor well that is out of the area of site-related contamination. If it

appears that the contamination is migrating further downgradient, investigative measures will be implemented to ensure that human health and the environment in areas downgradient from the contamination are protected.

Analyses of the potential contribution of transient drainage from the disposal cell and infiltration of surface runoff from the cover to the overall contamination of ground water beneath and downgradient from the disposal cell are being performed and will continue during the ground water restoration phase of the project. The conceptual site model of the Tuba City site will be updated based on these analyses and the Site Observational Work Plan (SOWP) (DOE, 1995) will be revised to reflect the results of these activities. The final SOWP revision will recommend the restoration strategy to be implemented under the ground water remedial action for the site. A remedial action plan that documents the compliance strategy, characterization data, analyses, and the proposed implementation plan will then be prepared for review.

Ground water restoration to contain the contamination related to uranium processing activities will be initiated at the downgradient edge of the disposal cell late in 1996. This will consist of pumping ground water from a series of extraction wells for a period in excess of six months. This activity will significantly impact ground water flow and quality characteristics in the area, and will preclude any meaningful disposal cell performance monitoring during this period. Ground water conditions will be monitored to assess the effectiveness of the ground water remediation activities.

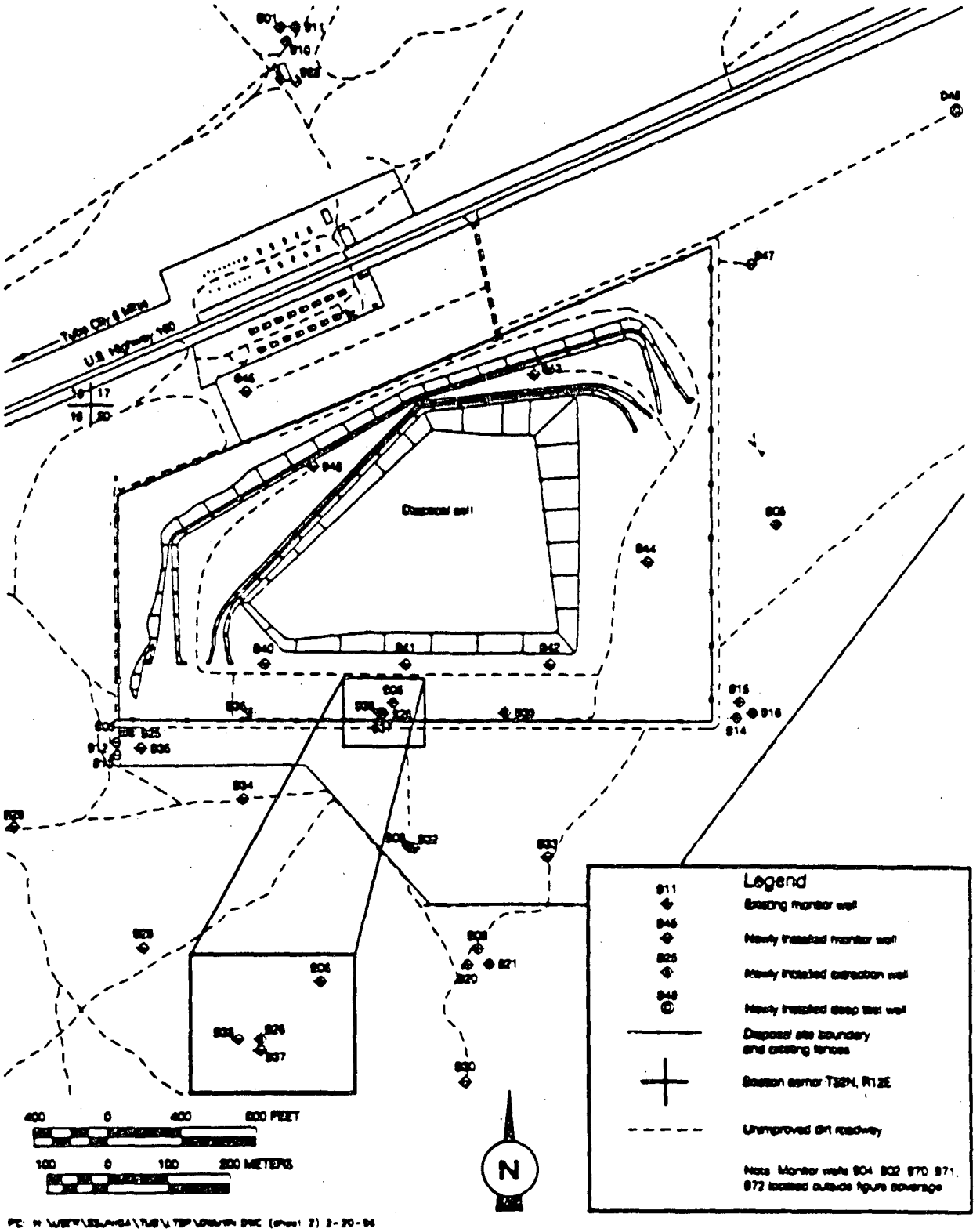
Ground water monitoring network

The evaluative monitoring well network will consist of seven existing monitor wells (Table 5-3 and Figure 5.7). Three monitor wells (940, 941, and 942) are adjacent to the south apron on the downgradient edge of the disposal cell. One upgradient monitor well (945) will be sampled to assess background conditions. Two baseline monitor wells (906 and 908) are within the area of site-related contamination. One monitor well (903) is downgradient from the edge of the contamination. If increased contaminant levels are noted in monitor well 903, monitor well 930 further downgradient will be sampled.

Table 5-3 Monitoring well network

Monitor Well	Ground Elevation	Screen Depth (Top)	Screen Length	Comment
TUB01-0903	4980.4	28.0	20.0	Downgradient
TUB01-0906	5060.4	44.0	20.0	Baseline
TUB01-0908	5055.9	52.0	15.0	Baseline
TUB01-0940	5062.2	45.0	20.0	Disposal cell
TUB01-0941	5062.3	45.0	20.0	Disposal cell
TUB01-0942	5062.5	54.0	20.0	Disposal cell
TUB01-0945	5137.3	110.0	20.0	Background

Figure 5.7
Ground Water Monitor Well Network
Tuba City, Arizona Site



Additional monitor wells may be installed by the DOE as required to effectively monitor ground water conditions at the site. These monitor wells may be used as POC wells for Subpart A monitoring if deemed necessary after completion of Subpart B activities. The evaluative monitoring described in the LTSP will be carried out in conjunction with UMTRA Ground Water Project activities, and will be protective of human health and the environment.

There are currently no domestic or drinking water wells in the contaminated ground water (DOE, 1994). Because no one is drinking the affected water and there is no surface expression of contaminated ground water, there are currently no health or environmental risks associated with the contaminated ground water. Currently the maximum extent of site-related contamination in ground water is approximately 1500 feet downgradient from the disposal cell. The nearest two points of ground water withdrawal are a low-yield domestic well approximately 1.5 miles east-northeast of the site, and a spring approximately 1.2 miles east-southeast of the site near Moenkopi Wash (used for livestock watering). Because of their locations (distance and cross-gradient from the contamination) these sources of ground water will probably not be affected by any existing contamination that may migrate from beneath the site or be mobilized in the future.

Monitoring of surface springs that are associated with Moenkopi Wash (the only springs within a two-mile radius) is not currently part of the evaluative monitoring program at the Tuba City site because site-related contamination in ground water is not near this portion of the wash. The only spring currently used in the area is approximately 1.2 miles east-southeast of the site along Moenkopi Wash. If significant migration of site-related contamination in ground water is observed in the direction of Moenkopi Wash and the springs, then a program to monitor potentially affected springs will be implemented.

Analyte selection

The parameter list for the evaluative monitoring contains the following hazardous constituents: nitrate, molybdenum, selenium, and uranium. These constituents exceeded MCLs prior to cell closure at least once in one or more monitor wells impacted by uranium processing. Additionally, these constituents are considered sensitive indicators of disposal cell performance due to their presence in the tailings material, relatively high mobility in ground water, and low concentration in background ground water quality. Conversely, cadmium, lead, tin, and zinc, while also present in wells impacted by uranium processing activities prior to cell closure, are not considered reliable indicators of cell performance because they are relatively immobile in the subsurface. Consequently, cadmium, lead, tin, and zinc are not included in the proposed list of hazardous constituents included in the evaluative monitoring. Although higher than background prior to cell closure, net gross alpha is not considered a reliable indicator of performance due to the potential influence of radionuclides other than uranium-238 decay products (Faure, 1977).

Provisional upper baseline limits are proposed for evaluative monitoring for each hazardous constituent: nitrate, 1379 mg/L; molybdenum, 0.14 mg/L; selenium, 0.05 mg/L; and uranium, 1.171 mg/L. These limits were derived based on preclosure (1988 to 1991) data obtained from well 906 with the exception of

selenium, which was found primarily in monitor well 908. The resulting limits are concentrations that, with 95 percent confidence, would be exceeded less than 5 percent of the time during long-term monitoring if ground water conditions in the vicinity of the monitor well did not change. The limits are called "upper tolerance limits" in the literature and were calculated following EPA guidance (EPA, 1989).

Additional analytes may be added to support an assessment of ground water restoration efforts. Standard field parameters and water levels also will be measured during sampling.

The upper baseline limits proposed here are provisional because baseline conditions were established for locations other than the disposal cell monitor wells. Monitoring wells 906 and 908 with the POC network will allow a comparison of constituent concentrations at disposal cell and baseline locations to determine transient excursions from baseline conditions, potential chemical gradients between baseline and disposal cell locations, and stabilization of postclosure disposal cell hydrology.

Sampling frequency

At a minimum the evaluative monitoring well network will be sampled semiannually for the next two years, after which sampling frequency will be reevaluated.

5.3 CORRECTIVE ACTION

The EPA standards (40 CFR §192.04 [1995]) require implementation of a corrective action program within 18 months if the ground water concentration limits established for the disposal site under 40 CFR §192.02(c)(1995) are or may be exceeded. The corrective action program will restore the performance of the disposal system to the original concentration limits established under 40 CFR §192.02(c)(3), to the extent reasonably achievable.

NRC regulations (10 CFR §40.27(b)[1995]) require annual site inspections (at a minimum) to confirm the integrity of the disposal site and to determine if maintenance and/or monitoring are required. The condition of the disposal cell cover is of concern with respect to potential impacts to ground water. For example, should subsidence or cracking be detected, prompt maintenance would be necessary to avoid potential seepage through the cover by runoff or snowmelt. The proposed inspection frequency and reporting requirements (to the NRC) are specified criterion 12, Appendix A. The requirement for instituting maintenance and emergency measures is specified in 10 CFR §40.27(b)(5).

Observations at the Tuba City site indicate increased concentrations of potentially hazardous constituents in ground water downgradient from the disposal cell. These increases are attributed to possible transient drainage related to disposal cell construction, or to infiltration of surface run-off from the cell cover and possible leaching of constituents from the unsaturated zone. Concentrations of hazardous constituents in ground water that exceed the approved concentration limits may indicate only that these phenomena are taking place. They would not represent failure of the disposal system and would not require the DOE to initiate a corrective

action program, in accordance with 40 CFR §192.04(1995). Regulation 40 CFR §192.20(a)(4)(1995) states, "Temporary excursions from applicable limits of ground water concentrations that are attributable to a disposal operation itself shall not constitute a basis for considering corrective action under 40 CFR §192.04(1995) during the disposal period . . . ." Although this section of the regulations explicitly refers to excursions prior to cell closure, the effects of cell compaction (e.g., transient drainage) may not appear until after closure. Therefore, transient drainage from a completed disposal cell is not an indicator of disposal cell failure, if it is related only to excess water draining from the compacting tailings.

However, if migrating ground water contamination presents an imminent threat to downgradient water users, corrective action to protect human health and the environment may be required, regardless of the source of contamination. If corrective action is necessary, the DOE will submit a corrective action plan for NRC review and concurrence (a copy of the plan will be transmitted to the affected tribal government). The plan will include a ground water monitoring plan to demonstrate the effectiveness of the corrective action, which the DOE will implement after consultation with the NRC.

5.4 DATA VALIDATION AND QUALITY ASSURANCE

The UMTRA Project TAC has established standard operating procedures for monitor well installation and development, water and soil sampling, sample preservation and transport, field procedures, chain of custody samples for laboratory analysis, acquisition protocols, and validating and managing analytical data. All aspects of ground water monitoring are conducted in accordance with these procedures, which are updated regularly to reflect changes in industry standards, best management practices, and DOE and EPA guidance. The quality assurance (QA) procedures described below are consistent with the Resource Conservation and Recovery Act ground water technical enforcement guidance document (EPA, 1986) and the long-term surveillance program QA program plan (DOE, 1992c).

5.5 REPORTING

The DOE maintains and updates specific records and reports required to document long-term surveillance program activities at the Tuba City UMTRA Project site. The DOE will submit an annual report to the NRC documenting the results of the LTSP, as required by 10 CFR §40.27. DOE will keep all relevant and required records at an appropriate location. These documents will be available for review by the NRC, tribal representatives, and the public.

6.0 SITE INSPECTIONS

The DOE will conduct inspections of the Tuba City disposal site to identify any changes to the disposal cell and site over time and to identify potential problems before extensive maintenance, repairs, or corrective action is needed. Fundamental to the inspection will be the detection and documentation of progressive change caused by slow natural processes. Findings from these inspections will be compared to baseline conditions to provide a basis for future inspections. There are two types of site inspections: routine annual inspections and follow-up inspections. Each site inspection must be documented in a report that identifies the findings of the inspection.

6.1 INSPECTION FREQUENCY

The Tuba City site will be inspected annually for the first 5 years after licensing. At the end of the 5-year period, the DOE will evaluate the need to continue annual inspections, basing its recommendation on an evaluation of the annual reports filed for maintenance or unscheduled events. If it is determined that less frequent inspections are required, the DOE will modify the LTSP and submit it to the NRC for approval. The Hopi Tribe and Navajo Nation also will receive copies for review. Subsequent inspections will be considered the scheduled site inspection.

Site inspections at the Tuba City disposal site preferably should take place in the summer (the growing season) to determine if volunteer growth plant is affecting the integrity of the cover and if maintenance of the disposal cell cover is necessary.

6.2 INSPECTION TEAM

The inspection team will consist of a chief inspector and one or more assistants. The chief inspector will be a geotechnical engineer, a civil engineer, or an engineering geologist knowledgeable in processes that could adversely affect the site (e.g., geomorphic agents of change). When they are needed for follow-up inspections, the team will include additional technical experts appropriate to the problems under investigation. Because the Tuba City disposal site has a rock cover and volunteer plant growth is likely, a plant specialist may be required to evaluate the extent of volunteer plant growth on the cover. Additionally, because of the potential for windblown sand accumulation on the cover, a geologist will be required to document the changes and the potential long-term effects.

6.3 PREPARATION FOR INSPECTIONS

Before each inspection, inspectors will complete the following tasks:

- Review the final LTSP, the permanent site file, the previous site inspection reports and site inspection maps, and all maintenance or corrective action reports.

- Prepare the site inspection checklist based on previous inspections or repairs; incorporate any needed modifications.

- Verify and update the names and telephone numbers of all parties with whom access or notification agreements have been executed.

- Verify the DOE 24-hour telephone number and appropriate agency telephone numbers and contacts; arrange to modify the entrance sign, as needed.

- Schedule the site inspection.

- Assemble the equipment needed for the inspection.

- Adjust the Brunton compass's magnetic declination for the Tuba City ar

- Notify the NRC and tribal representatives for their possible attendance at the inspection.

6.4 SITE INSPECTION PROCEDURES

The site inspection will cover the disposal site area, the disposal cell, and the immediate off-site areas. All site inspection activities and observations should be recorded and described using the as-builts, initial site inspection checklist, site inspection map, a field notebook, and photographs. Observations and photographic stations should be recorded on the field maps. After the inspection is complete, these maps are to be drafted and kept in the permanent site file.

The initial site inspection checklist is a guideline for the inspectors. After each inspection, the checklist will be revised to include new information or to delete items that are no longer pertinent. Revisions to the checklist will be documented in the inspection report.

A photographic record of the site inspection must be maintained. Site conditions should be documented by ground photographs to record developing trends and to enable the DOE to evaluate the need for and extent of future activities. If possible, any site feature or condition that requires the inspectors to make a written comment, explanation, or description will be photographed. A site inspection photo log will be used for recording the photographs. All features will be photographed as specified in Section 6.6. The inspectors may determine the number of photographs, the view angles, and the lenses needed to ensure that sufficient photographs are taken for agency review.

6.4.1 Off-site areas

The area within a maximum of 0.25 mi (0.40 km) of the disposal site boundary will be surveyed for evidence of land-use changes that indicate increased human activity (i.e., greater probability of intrusion onto the site). New roads or paths, changes in vegetation, and relevant geomorphic features such as gullies or aeolian formations, any of which could initiate site-threatening erosion, also will be observed.

6.4.2 On-site areas

The integrity of the disposal cell will be evaluated from a series of transects walked around the disposal cell perimeter; along the base, crest, and sideslopes of the disposal cell; and in and around the cell apron. Sufficient transects must be walked so as to thoroughly cover and inspect the disposal site area. Diagonal transects of the crest will be made, and the edge of the crest will be walked. Additional transects at approximately 50-yd (46-m) intervals will be walked along the sideslopes. Transects along the entire length of each diversion channel will be made to determine whether the channels have been functioning and can be expected to continue to function as designed.

At a minimum, the site perimeter and site area transects will be monitored for damage to or disturbance of the following features:

- Site perimeter roads.
- Fences, gates, and locks.
- Permanent site surveillance features.
- Ground water monitor wells.
- Site area vegetation or volunteer plant growth.
- Sedimentation or erosion.

The complete length of transects along the engineered component (diversion channels and disposal cell slopes) will be walked and examined for evidence of the following:

- Structural instability resulting from differential settlement, subsidence, cracking, sliding, or creep.
- Erosion as evidenced by developing rills or gullies.
- Sedimentation or debris.
- Rapid rock cover deterioration caused by weathering or erosion.
- Removal of rock or other disposal cell material.
- Seepage.

- Intrusion (inadvertent or deliberate) by humans or animals.
- Animal burrowing.
- Vandalism.
- Trails showing human or animal activity.
- Volunteer plant growth.

6.4.3 Modifying processes

Changes caused by natural processes are most likely on the lower topslopes and lower portions of the sideslopes of the disposal cell and in the diversion channels. Careful examination of the toe of the slope of the disposal cell will be a key part of the inspection. At the Tuba City disposal site, processes of concern include settling, subsidence, slumping, plant and animal intrusion, erosion (gullying), and aeolian sedimentation. The inspection report will detail any observed modifying features, including a description of the problem, relevant measurements and photographs, and an assessment of possible impacts. The description of the modifying process will include information such as the following:

- Extent of area affected.
- Number and size of features (e.g., spacing, length, depth, and width of gullies).
- Related erosional features.
- Patterns of occurrence.
- Species present (if plants or animals are found at the site).
- Location and density of volunteer plant growth.

Inadvertent or casual intrusion by humans or animals is not of great concern, but evidence of cover removal, extensive vandalism to signs and monuments, or the presence of well-established trails will be described in detail. Continued vandalism may require more active measures to control access to the site.

If new conditions requiring monitoring or immediate action are discovered during the inspection, the inspection report should describe the problem and the recommended follow-up action (if required).

6.4.4 Vegetation

Planned vegetation

Graded areas around the disposal cell and around and between the diversion channels were reseeded with grass and other drought-tolerant plants in the fall of 1990. While the southwestern United States received higher-than-normal rainfall in 1991, the success of the reseeding program was difficult to evaluate in the first year. Some areas, where only scattered seeds appear to have germinated, were rather bare. Except for tumbleweeds growing at widely scattered locations, vegetation appeared to be healthiest near the east fence line on both sides of the fence. However, it was not clear whether plants in that area were seeded or naturally sown (DOE, 1992b). This planned vegetation must be inspected during each annual inspection until the plant cover is determined to be sufficient and stable.

Volunteer plant growth

Monitoring weeds is important, primarily to prevent root penetration into the infiltration/radon barrier, which could provide a possible conduit for the escape of radon. During the 1991 prelicensing inspection, only one plant (a Russian thistle) was found on the disposal cell. Although more plants may have been present, they were too few and too small to be of concern during the inspection (DOE, 1992b).

If the inspection team reports that numerous plants are growing on the cell, a follow-up inspection by a plant specialist will be required. The plant specialist will determine whether the plant growth threatens the integrity of the disposal cell (e.g., roots growing into the infiltration/radon barrier or into the tailings). If it is determined that plants are threatening cell integrity, a vegetation control program should be instituted. When vegetation control measures are completed, a plant specialist will inspect the disposal cell to determine their effectiveness.

6.5 SITE INSPECTION MAP

A new site inspection map will be prepared after each scheduled inspection using the disposal site map as a base (Plate 1). This map must include the following:

- Inspection traverses.
- Photographic locations.
- Locations and descriptions of any new, anomalous, or unexpected features.
- Features identified during previous inspections for observation or monitoring.
- Inspection date.

6.6 SITE INSPECTION PHOTOGRAPHS

Photographs will be taken during site inspections to document conditions at the disposal cell and the disposal site. These photographs will provide a continuous record for monitoring changing conditions over time and can be compared with baseline photographs to monitor site integrity.

If possible, a photograph should include a reference point such as a survey monument, boundary monument, site marker, or monitor well. Large-scale features such as drainage ditches or disposal cell slopes will include a north arrow and scale for reference.

For specific areas where a photograph is used to monitor change over time, the distance from the feature and the azimuth should be recorded and all subsequent photographs should be taken from the same orientation to provide an accurate picture of changing conditions. The magnetic compass declination should be corrected for true north.

Each photograph will be recorded on a photo log. An appropriate description of the feature photographed, including azimuth (if required), will be entered into the log. All site inspection photographs, as well as all corresponding photo log forms, will be maintained in the permanent site file.

<u>Features to be photographed</u>

The following disposal site features should be documented with photographs during every inspection at the Tuba City disposal site:

- Permanent site surveillance features (Section 4.0).
- Fences, gates, access roads, perimeter roads, and paths.
- Drainage ditch and drainage channels.
- Ground water monitor wells.
- The disposal cell (top, sides, apron, and surrounding area). Panoramic sequences of photographs from selected vantage points may be used for this purpose.
- Off-site features the inspector deems significant and includes in the text of the inspection report that may affect the site in the future.
- Volunteer vegetation on the disposal cell.
- Vegetation that may affect the integrity of the site.

- Aeolian sedimentation or erosion.
- Evidence of erosion the inspector deems significant and includes in the text (e.g., gullies, rills).
- Erosion protection material (riprap).

Any new or potential problem areas identified during a site inspection will be well documented with photographs. Photographs must also be taken to record developing trends and to allow inspectors to make reasonable decisions concerning additional inspections, custodial maintenance or repairs, or corrective action.

6.7 SITE INSPECTION CHECKLIST

A checklist will be used during site inspections to document the key features inspected. When the field inspection is concluded, the site inspection checklist must be completed and the certification statement must be signed. Overlays for the as-built drawings or revised drawings will be developed, noting any potential problems or other site conditions requiring attention. The revised drawings should be labeled with the date and type of site inspection. The completed photo logs should be attached to the inspection checklist.

6.8 SITE INSPECTION REPORT

A report will be completed after each site inspection to document the scope and findings of the inspection. The report must document anomalous, new, or unexpected conditions or situations so as to record developing trends and to enable the responsible agency to make reasonable decisions concerning follow-up inspections, custodial maintenance, repair, and corrective action. Photographs may be considered documentation.

The site inspection report must include the following information at a minimum:

- Date and location of inspection.
- Narrative of site inspection, results, conclusions, and recommendations.
- Site inspection checklist and any relevant supporting documentation.
- Site inspection map and other drawings, maps, or figures, as required.
- Inspection photographs and photo log sheet.
- Recommendations for follow-up inspections, repair, or custodial maintenance.

- Custodial maintenance or repair report and certification.
- Description and quantification of a problem requiring corrective action.
- Status of ongoing or incomplete custodial maintenance or corrective action.
- Conclusions and recommendations.
- Names, qualifications, and signatures of inspectors.

7.0 FOLLOW-UP INSPECTIONS

Follow-up inspections may be triggered by reports or information indicating that site integrity has been or may be compromised.

Follow-up inspections investigate and quantify specific problems found during a previous site inspection or ground water sampling event. These inspections determine whether processes currently active on or near the site threaten site security or stability, and they evaluate the need for custodial maintenance, repair, or corrective action. Follow-up inspections should be made by technical specialists in an appropriate discipline (e.g., soils scientist or geomorphologist) to evaluate erosion processes.

The follow-up inspection begins with an initial site visit to determine the need for definitive tests or studies. Additional visits may be scheduled if more data are needed to draw conclusions and recommend corrective action.

Follow-up inspections also are scheduled by the DOE when it receives outside information that indicates site integrity has been or may be threatened. Events that could trigger follow-up inspections include severe vandalism, intrusion by humans or livestock, severe rainstorms or floods, and unusual natural events such as tornados and earthquakes.

An assessment of each unusual event must be submitted to the NRC within 60 days of the initial report that damage or disruption has occurred at the disposal site. At a minimum, this report must include the following:

- A description of the problem.
- A preliminary assessment of the maintenance, repair, or corrective action required.
- Conclusions and recommendations.
- Assessment data, including field and inspection data, and photographs.
- Names and qualifications of the field inspectors.

A copy of the report and supporting documentation will be maintained in the permanent site file. The annual report to the NRC will include the results of these follow-up inspections.

8.0 CUSTODIAL MAINTENANCE AND REPAIR

While no routine custodial maintenance is scheduled for the Tuba City disposal site, maintenance will be performed as needed. Unscheduled maintenance or repairs may be required based on the recommendations in site inspection reports.

Unscheduled custodial maintenance required at this site may include the following:

- Repairing fences.
- Repairing the gate.
- Replacing perimeter warning signs.
- Reestablishing survey control and boundary monuments.
- Removing tumbleweeds, volunteer plant growth, or other debris from the diversion channels and around fences.
- Moving sand to uncover fences or fill gaps under fences.
- Repairing damage caused by burrowing animals.
- Reseeding areas on the disposal cell perimeter where initial seeding failed.

To authorize these kinds of repairs, the DOE will prepare a purchase order or statement of work that will include contractor qualifications.

If problems are identified that affect the integrity of the disposal cell or compliance with 40 CFR Part 192, the DOE will treat the required activity as a corrective action requiring NRC approval (Section 9.0).

The annual site inspection report to the NRC must include the following information on unscheduled maintenance or repair:

- Summary of work required.
- Work order, purchase order, or statement of work.
- Contractor qualifications, if applicable.
- Contractor documentation of work completion.
- DOE certification of completion of work.

After the work is complete, the contractor must submit verification of the completed work and/or a written report if the action is considered significant. The DOE will inspect the site, as necessary, and review the report before certifying that all work is completed in accordance with all required specifications. Copies of all records, documentation, and

certifications will be included in the Tuba City permanent site file. Copies of all relevant documentation will also be transmitted to the Hopi Tribe and Navajo Nation.

9.0 CORRECTIVE ACTION

Site inspections and custodial maintenance are designed to identify and correct problems at the developmental stage, eliminating the need for corrective action. However, extreme natural events, vandalism, or unanticipated events may threaten the stability of the disposal cell. The impacts of such events could require corrective action, which could include temporary emergency measures. In most cases, DOE would need to assess the problem to determine a final corrective action that would minimize the problem and prevent its recurrence. The initial step in assessing the problems and identifying the appropriate corrective action could include one or more follow-up inspections. This inspection/preliminary assessment would include, but not be limited to, the following:

- Identifying the nature and extent of the problem.
- Reevaluating the engineering design parameters.
- Establishing a data collection and/or evaluative monitoring program to quantify the magnitude of the problem.

The following conditions at the disposal cell could require corrective action:

- Surface rupture.
- Subsidence, sliding, or slope instability.
- Development of rills or gullies.
- Deterioration of the erosion protection rock.
- Seepage originating from the disposal cell.
- Gully development on or adjacent to the disposal site that could affect disposal cell integrity.
- Rapid headward cutting of an off-site gully or arroyo that threatens the stability of the disposal cell.
- Damage to the disposal cell cover from extreme seismic or other natural catastrophic events.
- Vandalism (e.g., removal of cover materials).
- Verification of an excursion during the ground water monitoring program.

When unusual damage or disruption is discovered, the DOE will notify the NRC and submit an inspection/preliminary assessment report for NRC review within 60 days after the

problem is identified. The preliminary assessment report will evaluate the problem and recommend the next step (e.g., immediate action or continued evaluation). After the NRC reviews the report and recommendations, the DOE will develop a corrective action plan for NRC approval. When the NRC approves the corrective action, the DOE will implement the plan.

NRC regulations do not stipulate a time frame for implementing corrective action. However, the EPA ground water regulations require that a corrective action program begin within 18 months of an exceedance at a disposal cell is confirmed (40 CFR §192.04). Assessing the extent of the problem and developing a corrective action plan will not be considered initiation of the corrective action program. The UMTRA LTSP guidance document contains details on corrective action (DOE, 1992a).

The DOE will prepare progress reports while a problem is under evaluation or corrective action is being implemented. The NRC will receive a copy of each report so it will be informed of all potential problems and solutions. The DOE also will provide all reports to the Hopi Tribe and the Navajo Nation.

After the corrective action is complete, the DOE will certify that all work is in accordance with EPA standards and will submit this certification to the NRC. A copy of the certification statement will become part of the permanent site files, as well as all reports, data, and documentation generated during the corrective action.

10.0 RECORD KEEPING AND REPORTING REQUIREMENTS

The DOE will maintain a permanent site file containing all the information needed to prepare for and conduct surveillance activities at the Tuba City site. Complete, accurate reports of site surveillance activities will be maintained in accordance with archival procedures set forth in 41 CFR Part 101 and 36 CFR Parts 1220-1238 (Subchapter B, Records Management).

The Tuba City permanent site file will include all original deeds, custody agreements, other property documents, plans and reports documenting site remedial action, and long-term surveillance program documentation. These records will be handled in accordance with DOE Order 1324.5B, *Records Management Program*, to ensure their proper handling, maintenance, and disposition. The DOE will update the Tuba City permanent site file, as necessary, after site inspections are complete.

The DOE will provide an annual report to the NRC documenting the results of the annual site inspections and any other activities conducted in conjunction with the long-term surveillance program. Copies of the annual report will be added to the Tuba City permanent site file. Criterion 12 to Appendix A of 10 CFR Part 40 stipulates that the annual report must be submitted no more than 90 days after the date of the last UMTRA Project site inspection for that calendar year. The DOE also will submit reports to the NRC documenting follow-up inspections and any corrective action plans and reports. All preliminary inspection reports of unusual damage or disruption must be submitted to the NRC within 60 days of the discovery. The DOE also will report the results of the ground water monitoring program annually to the NRC.

The DOE will provide reports of site inspections, ground water monitoring, and other long-term surveillance program activities to the Navajo Nation and the Hopi Tribe, in accordance with cooperative agreements between the DOE and the tribes.

11.0 EMERGENCY NOTIFICATION AND REPORTING

While the Tuba City disposal cell was designed to comply with 40 CFR Part 192 with minimum maintenance and oversight for a period of 1000 years, or at least 200 years, unforeseen events could affect the disposal cell's ability to remain in compliance with these standards. Therefore, the DOE has requested notification from tribal, state, and federal agencies of discoveries or reports of purposeful intrusion or damage at the disposal site as well as the occurrence of earthquakes, tornados, or floods in the disposal site area.

The DOE is negotiating notification agreements with the Navajo Division of Public Safety (Tuba City, Arizona), the Hopi Bureau of Indian Affairs Police (Moenkopi Village, Arizona), the Arizona Department of Public Safety (Flagstaff, Arizona), the USGS National Earthquake Information Center (Denver, Colorado), and the Arizona State Office of the National Weather Service (Flagstaff, Arizona). Copies of the agreements are presented in Attachment 2. The designated emergency telephone number is the DOE's 24-hour telephone line (970) 248-6070. This number is posted on the Tuba City disposal site entrance sign so the public can notify the DOE if problems are discovered.

Contact lists and telephone numbers for all agencies with whom the DOE has entered into agreements will be updated annually, in conjunction with the site inspection, and included in the disposal site inspection report.

To further solidify the agreements with these agencies, the DOE will update these agencies periodically about issues concerning for the Tuba City disposal site.

The DOE has requested that the Navajo Division of Public Safety, the Hopi Bureau of Indian Affairs police, and the Arizona Department of Public Safety notify the DOE of unusual occurrences in the disposal site area that may affect surface or subsurface stability.

The DOE subscribes to the USGS Early Warning Service for notification of an earthquake of sufficient magnitude to threaten a disposal site. This service provides data on the magnitude of the event and the location of the epicenter.

The DOE has requested that the USGS National Earthquake Information Center notify the DOE of seismic events that meet any of the following descriptions:

- An earthquake centered within a 9-mi (14-km) radius of the site.
- Any earthquake of magnitude 4.0 or greater centered between a 9-mi (14 km) and 19-mi (30-km) radius of the site.
- Any earthquake of magnitude 6.2 or greater centered between a 19-mi (30-km) and a 40-mi (64-km) radius of the site.

The DOE has requested that the Arizona State Office of the National Weather Service in Flagstaff, Arizona, notify the DOE within 8 hours of issuing a flash flood or tornado warning in Coconino County, Arizona.

12.0 QUALITY ASSURANCE

The DOE has developed QA procedures specific to the UMTRA long-term surveillance program. The long-term surveillance program QA program plan (DOE, 1992c), which complies with DOE Order 5700.6C, specifies the following requirements:

- Program planning.
- Program activities, including inspections, site maintenance, corrective action, and emergency responses.
- Ground water monitoring or other monitoring, if required.
- Personnel qualifications and training.
- Program surveillance and audits.
- Analytical QA.
- Analytical data validation.

All site inspections, ground water and other monitoring data, records, photographs, maps, and other information related to the LTSP for the Tuba City disposal site are subject to formal and unannounced audits by the DOE or the NRC.

QA activities for ground water monitoring will cover the policy, organization, functional activities, and QA and quality control (QC) protocols needed to achieve the data quality objectives of the intended use of the data. Specifically, QA activities do the following:

- Identify the organizations involved with ground water monitoring activities and describe their operational, field, laboratory, and QA responsibilities.
- Discuss procedures for field and laboratory analysis of environmental samples and sample custody, handling, packaging, shipping, and documentation. Laboratory analyses of environmental samples include the following:
  - Inorganic, organic, and radiological constituents.
  - Other chemical and physical water quality parameters.
- Discuss QA of field measurements. QA procedures for field and laboratory methods appear in standard operating procedures, which follow best management practices (standard industry procedures).
- Describe data validation, QA/QC, and data reporting procedures, and the calibration and preventive maintenance procedures for field and laboratory equipment.

- Establish guidance on internal QC checks and data reduction, validation, and reporting requirements for field and laboratory environmental samples.

- Present UMTRA Project system audit procedures and technical, field, and laboratory performance audit procedures.

- Recommend field and laboratory corrective action and update procedures for corrective action resulting from audits.

- Present QA reporting procedures, outlining reporting requirements to management.

- Describe the record-keeping system.

13.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this report.

Name	Contribution
S. Wright	Site manager, document review
A. Vollmer	Document coordinator
J. Carman, R. Heydenburg	Hydrology
D. Erskine	Geochemist
P. Martinez	Real estate
J. Crain	Engineering
A. Holm, R. Neri Zagal, E. Artiglia	Document review
J. Torline	Technical editing, document production coordination
L. Sanchez	Word processing
K. DeGruyter	Graphic design

TUBA CITY, ARIZONA
Sampled December 1995

DATA MANAGEMENT NARRATIVE

RADIOCHEMICAL ANALYSIS

No radiochemical analyses were required.

GENERAL INORGANIC ANALYSIS

Several analytical spike analyses outside the control limit of ± 15% were reported for selenium. All selenium results associated with these analytical spike analyses are considered as estimated and have been qualified as such in the database.

ORGANIC ANALYSIS

Eight groundwater samples and a field blank sample were analyzed using USEPA SW846 method 8015 modified for diesel range organics (DRO) and volatile organic compounds (VOCs) using USEPA SW846 method 8021. The laboratory reports for these analyses are included in this data package since the current UMTRA Project TAC database is not capable of maintaining data of this type.

USEPA SW846 Method 8015 Modified for DRO:

All daily quality control criteria were met for the method 8015 DRO analyses. Reported results for all of the samples were below the contract required quantitation limit (CRQL) of 0.50 mg/L DRO. However, DRO below the CRQL but above the method detection limit (MDL) was measured in three samples and is reported below in Table I. These results are considered as estimated and only qualitative in nature.

Table I. Results for the USEPA SW846 method 8015 modified for DRO. Only results for parameters measured above the MDL are presented.

JEG Sample ID	Sample Date	Parameter	Result	PQL	MDL	Units	Qual.
TUB01-0909-0101	12/8/95	Diesel Range Organics	0.25	0.5	0.02	mg/L	UJ
TUB01-0938-0101	12/8/95	Diesel Range Organics	0.45	0.5	0.12	mg/L	UJ
TUB01-0940-0101	12/9/95	Diesel Range Organics	0.20	0.5	0.12	mg/L	UJ

UJ	The parameter was identified but not detected above the PQL or estimated PQL. The reported result is an estimated value.

ORGANIC ANALYSIS

Since no DRO was measured in the field duplicate sample TUB01-0909-0102 or the field blank sample TUB01-0999-0001, it is my opinion that the DRO measured in the above three samples most likely represents analytical carry-over or other laboratory contamination.

USEPA SW846 Method 8021, VOC Analysis:

Trace levels of the paramaters methylene chloride, chloroform, and 1,1,2,2-tetrachloroethane were measured in the field blank sample TUB01-0999-0001. Since these materials were not used by the field sampling team, it is my opinion that the reported concentrations for these three compounds represent laboratory contamination. Reported results for these parameters have been qualified as UJ (below the estimated PQL) since all results were less than ten times the concentration which was measured in the field blank sample.

Table II, below, lists the results for the method 8021 analyses which were reported above the MDL. Results reported between the MDL and the PQL are considered as estimated and only qualitative in nature. In addition, it is my opinion that all VOC results reported above the MDL most likely represent analytical carry-over or other laboratory contamination.

Table II. Results for the USEPA SW846 method 8021 analyses. Only results for parameters measured above the MDL are presented.

JEG Sample ID	Sample Date	Parameter	Result	PQL	MDL	Units	Qual.
TUB01-0909-0101	12/8/95	Chloroform	0.59	1.0	0.25	µg/L	UJ
		1,4-Dichlorobenzene	0.39	1.0	0.32	µg/L	UJ
TUB01-0909-0102	12/8/95	Chloroform	0.56	1.0	0.25	µg/L	UJ
		1,4-Dichlorobenzene	0.39	1.0	0.32	µg/L	UJ
TUB01-0934-0101	12/10/95	Chloroform	0.99	1.0	0.25	µg/L	UJ
TUB01-0935-0101	12/10/95	Chloroform	2.1	1.0	0.25	µg/L	UJ
TUB01-0938-0101	12/8/95	Chloroform	0.82	1.0	0.25	µg/L	UJ
		1,2-Dichlorobenzene	0.22	1.0	0.21	µg/L	UJ
		1,1,2,2-Tetrachloroethane	1.4	1.0	0.49	µg/L	UJ
TUB01-0940-0101	12/9/95	Chloroform	1.5	1.0	0.25	µg/L	UJ
		1,1,2,2-Tetrachloroethane	1.3	1.0	0.49	µg/L	UJ

ORGANIC ANALYSIS

Table II. (continued) Results for the USEPA SW846 method 8021 analyses. Only results for parameters measured above the MDL are presented.

JEG Sample ID	Sample Date	Parameter	Result	PQL	MDL	Units	Qual.
TUB01-0942-0101	12/9/95	Chloroform	3.0	1.0	0.25	µg/L	UJ
		Tetrachloroethene	0.29	1.0	0.26	µg/L	UJ
TUB01-0999-0001 (Field Blank Sample)	12/8/95	Methylene chloride	0.28	5.0	0.17	µg/L	UJ
		Chloroform	0.72	1.0	0.25	µg/L	UJ
		1,1,2,2-Tetrachloroethane	1.3	1.0	0.49	µg/L	

UJ	The parameter was identified but not detected above the PQL or estimated PQL. The reported result is an estimated value.

FIELD ANALYSIS

Reported field specific conductivity (E_c) results for the samples TUB01-0906-N001, TUB01-0915-N001, and TUB01-0929-N001 differed significantly from previous measured E_c values and/or a theoretical E_c value based on the TDS result for the field filtered sample. The E_c results for these three samples have been qualified as unusable in the database.

Several reported field dissolved oxygen (DO) results were greater than the calculated saturated DO value for the monitor well's altitude and measured groundwater temperature. All such results have been qualified as unusable in the database. Since this is indicative of a serious error in the DO measurement or sampling procedure, the remaining DO results have been qualified as estimated.

Trace TDS contamination was observed in the field blank or equipment blank samples. All TDS results ≤ 300 mg/L are considered as estimated and have been qualified as such in the database. Reported results for the field duplicate samples were in good agreement.

SUMMARY

No chain-of-custody documentation was received by the subcontract laboratory performing the general inorganic analyses for the samples TUB01-0901-0002 and TUB01-0901-N002. However, the laboratory reported that these samples were received in a secure cooler with the custody seal intact.

SUMMARY

Location definition information, such as location coordinates, for 19 locations have not been made available for entry into the UMTRA Project database. As a result, all analytical data associated with samples collected at these location are considered as unusable and have been qualified as such in the database (RX).

The meaning of all other data qualifiers is as defined on the UMTRA database printout or as defined in the USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media Multi-Concentration, Document Number ILMO2.0, 1991.

Except as discussed above, all data in this package meet the validation criteria and may be treated as final results.

Paul Zietz
Database Administrator

CLIENT SAMPLE N.

909101

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951236801

Sample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_0

Level: (low/med) LOW Date Received: 12/11/95

% Moisture: not dec. _____ Date Analyzed: 12/21/95

GC Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____( ) Soil Aliquot Volume: _____(uL

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	U
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	U
74-83-9	Bromomethane	0.27	1.0	1.0	U
75-00-3	Chloroethane	0.39	1.0	1.0	U
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	U
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	U
75-09-2	Methylene Chloride	0.17	5.0	5.0	U
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	U
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	U
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	U
67-66-3	Chloroform	0.25	1.0	0.59	J
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	U
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	U
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	U
79-01-6	Trichloroethene	0.29	1.0	1.0	U
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	U
75-27-4	Bromodichloromethane	0.36	1.0	1.0	U
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	U
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	U
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	U
127-18-4	Tetrachloroethene	0.26	1.0	1.0	U
124-48-1	Dibromochloromethane	0.32	1.0	1.0	U
108-90-7	Chlorobenzene	0.27	1.0	1.0	U
75-25-2	Bromoform	0.41	1.0	1.0	U
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.0	U
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	U
106-46-7	1,4-Dichlorobenzene	0.32	1.0	0.37	J
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0	U
71-43-2	Benzene	0.24	1.0	1.0	U
108-88-3	Toluene	0.18	1.0	1.0	U
100-41-4	Ethylbenzene	0.17	1.0	1.0	U
1330-20-7	Xylenes, Total	0.50	2.0	2.0	U

CLIENT SAMPLE

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

909101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951236801

Sample wt/vol: 500 (g/mL) ML Lab File ID: FID1122695_02

% Moisture: _____ Date Received: 12/11/95

GC Column: RTX-5 Date Analyzed: 12/27/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 500(uL) Date Extracted: 12/14/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	<0.50	0.50	
----------#2-Fuel Oil	0.023	0.50	0.25	
----------Varsol	0.057	0.50	0.50	

REVISED DATA

CLIENT SAMPLE N

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

900102

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951236802

Sample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_(

Level: (low/med) LOW Date Received: 12/11/95

% Moisture: not dec. _____ Date Analyzed: 12/21/95

GC Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____( ) Soil Aliquot Volume: _____(u

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	
74-83-9	Bromomethane	0.27	1.0	1.0	
75-00-3	Chloroethane	0.39	1.0	1.0	
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	
75-09-2	Methylene Chloride	0.17	5.0	5.0	
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	
67-66-3	Chloroform	0.25	1.0	0.56	
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	
79-01-6	Trichloroethene	0.29	1.0	1.0	
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	
75-27-4	Bromodichloromethane	0.36	1.0	1.0	
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	
127-18-4	Tetrachloroethene	0.26	1.0	1.0	
124-48-1	Dibromochloromethane	0.32	1.0	1.0	
108-90-7	Chlorobenzene	0.27	1.0	1.0	
75-25-2	Bromoform	0.41	1.0	1.0	
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.0	
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	
106-46-7	1,4-Dichlorobenzene	0.32	1.0	0.39	
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0	
71-43-2	Benzene	0.24	1.0	1.0	
108-88-3	Toluene	0.18	1.0	1.0	
100-41-4	Ethylbenzene	0.17	1.0	1.0	
1330-20-7	Xylenes, Total	0.50	2.0	2.0	

CLIENT SAMPLE N.

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

909102

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951236802

Sample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_025

% Moisture: _____ Date Received: 12/11/95

GC Column: RTX-5 Date Analyzed: 12/27/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 1000(uL) Date Extracted: 12/14/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.50	U
----------#2-Fuel Oil	0.023	0.50	0.50	U
----------Varsol	0.057	0.50	0.50	U

CLIENT SAMPLE

934101

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951259805

Sample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_

Level: (low/med) LOW Date Received: 12/15/95

% Moisture: not dec. _____ Date Analyzed: 12/21/95

GC Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____( ) Soil Aliquot Volume: _____(u

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	
74-83-9	Bromomethane	0.27	1.0	1.0	
75-00-3	Chloroethane	0.39	1.0	1.0	
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	
75-09-2	Methylene Chloride	0.17	5.0	5.0	
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	
67-66-3	Chloroform	0.25	1.0	0.99	
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	
79-01-6	Trichloroethene	0.29	1.0	1.0	
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	
75-27-4	Bromodichloromethane	0.36	1.0	1.0	
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	
127-18-4	Tetrachloroethene	0.26	1.0	1.0	
124-48-1	Dibromochloromethane	0.32	1.0	1.0	
108-90-7	Chlorobenzene	0.27	1.0	1.0	
75-25-2	Bromoform	0.41	1.0	1.0	
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.0	
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	
106-46-7	1,4-Dichlorobenzene	0.32	1.0	1.0	
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0	
71-43-2	Benzene	0.24	1.0	1.0	
108-88-3	Toluene	0.18	1.0	1.0	
100-41-4	Ethylbenzene	0.17	1.0	1.0	
1330-20-7	Xylenes, Total	0.50	2.0	2.0	

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

934101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 1236

Matrix: (soil/water) WATER Lab Sample ID: 951259805

Sample wt/vol: 500 (g/mL) ML Lab File ID: FID1122695_0

% Moisture: _____ Date Received: 12/15/95

GC Column: RTX-5 Date Analyzed: 12/26/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 500(uL) Date Extracted: 12/21/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.50	
----------#2-Fuel Oil	0.023	0.50	0.50	
----------Varsol	0.057	0.50	0.50	

CLIENT SAMPLE I

935101

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

ab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

ab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

atrix: (soil/water) WATER Lab Sample ID: 951259806

ample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_08

evel: (low/med) LOW Date Received: 12/15/95

Moisture: not dec. _____ Date Analyzed: 12/22/95

C Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

oil Extract Volume: _____( ) Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	U
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	U
74-83-9	Bromomethane	0.27	1.0	1.0	U
75-00-3	Chloroethane	0.39	1.0	1.0	U
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	U
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	U
75-09-2	Methylene Chloride	0.17	5.0	5.0	U
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	U
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	U
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	U
67-66-3	Chloroform	0.25	1.0	2.1	
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	U
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	U
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	U
79-01-6	Trichloroethene	0.29	1.0	1.0	U
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	U
75-27-4	Bromodichloromethane	0.36	1.0	1.0	U
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	U
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	U
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	U
127-18-4	Tetrachloroethene	0.26	1.0	1.0	U
124-48-1	Dibromochloromethane	0.32	1.0	1.0	U
108-90-7	Chlorobenzene	0.27	1.0	1.0	U
75-25-2	Bromoform	0.41	1.0	1.0	U
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.0	U
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	U
106-46-7	1,4-Dichlorobenzene	0.32	1.0	1.0	U
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0	U
71-43-2	Benzene	0.24	1.0	1.0	U
108-88-3	Toluene	0.18	1.0	1.0	U
100-41-4	Ethylbenzene	0.17	1.0	1.0	U
1330-20-7	Xylenes, Total	0.50	2.0	2.0	U

1A

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

CLIENT SAMPLE NO

935101

ab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

ab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

atrix: (soil/water) WATER Lab Sample ID: 951259806

ample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_019

Moisture: _____ Date Received: 12/15/95

C Column: RTX-5 Date Analyzed: 12/26/95

D: 0.53 Dilution Factor: 1.0

oncentrated Extract Volume: 1000(uL) Date Extracted: 12/21/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.50	U
----------#2-Fuel Oil	0.023	0.50	0.50	U
----------Varsol	0.057	0.50	0.50	U

CLIENT SAMPLE NO.

938101

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

b Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

b Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

trix: (soil/water) WATER Lab Sample ID: 951236804

mple wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_076

vel: (low/med) LOW Date Received: 12/11/95

Moisture: not dec. _____ Date Analyzed: 12/21/95

Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

oil Extract Volume: _____( ) Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	U
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	U
74-83-9	Bromomethane	0.27	1.0	1.0	U
75-00-3	Chloroethane	0.39	1.0	1.0	U
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	U
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	U
75-09-2	Methylene Chloride	0.17	5.0	5.0	U
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	U
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	U
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	U
67-66-3	Chloroform	0.25	1.0	0.82	J
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	U
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	U
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	U
79-01-6	Trichloroethene	0.29	1.0	1.0	U
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	U
75-27-4	Bromodichloromethane	0.36	1.0	1.0	U
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	U
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	U
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	U
127-18-4	Tetrachloroethene	0.26	1.0	1.0	U
124-48-1	Dibromochloromethane	0.32	1.0	1.0	U
108-90-7	Chlorobenzene	0.27	1.0	1.0	U
75-25-2	Bromoform	0.41	1.0	1.0	U
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.4	
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	U
106-46-7	1,4-Dichlorobenzene	0.32	1.0	1.0	U
95-50-1	1,2-Dichlorobenzene	0.21	1.0	0.22	J
71-43-2	Benzene	0.24	1.0	1.0	U
108-88-3	Toluene	0.18	1.0	1.0	U
100-41-4	Ethylbenzene	0.17	1.0	1.0	U
1330-20-7	Xylenes, Total	0.50	2.0	2.0	U

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

938101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951236804

Sample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_027

% Moisture: _____ Date Received: 12/11/95

GC Column: RTX-5 Date Analyzed: 12/27/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 1000(uL) Date Extracted: 12/14/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.45	J
----------#2-Fuel Oil	0.023	0.50	0.50	U
----------Varsol	0.057	0.50	0.50	U

REVISED DATA

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

940101

ɔ Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

ɔ Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

trix: (soil/water) WATER Lab Sample ID: 951259807

mple wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_077

vel: (low/med) LOW Date Received: 12/15/95

Moisture: not dec. _____ Date Analyzed: 12/21/95

Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

il Extract Volume: _____( ) Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
4-87-3----	Chloromethane	0.49	1.0	1.0	U
5-01-4----	Vinyl-Chloride	0.18	0.50	0.50	U
4-83-9----	Bromomethane	0.27	1.0	1.0	U
5-00-3----	Chloroethane	0.39	1.0	1.0	U
5-69-4----	Trichlorofluoromethane	0.17	1.0	1.0	U
5-35-4----	1,1-Dichloroethene	0.16	1.0	1.0	U
5-09-2----	Methylene Chloride	0.17	5.0	5.0	U
56-60-5---	trans-1,2-Dichloroethene	0.14	1.0	1.0	U
5-34-3----	1,1-Dichloroethane	0.18	1.0	1.0	U
56-59-2---	cis-1,2-dichloroethene	0.20	1.0	1.0	U
7-66-3----	Chloroform	0.25	1.0	1.5	
1-55-6----	1,1,1-Trichloroethane	0.18	1.0	1.0	U
6-23-5----	Carbon Tetrachloride	0.22	0.50	0.50	U
07-06-2---	1,2-Dichloroethane	0.22	0.50	0.50	U
9-01-6----	Trichloroethene	0.29	1.0	1.0	U
8-87-5----	1,2-Dichloropropane	0.31	1.0	1.0	U
5-27-4----	Bromodichloromethane	0.36	1.0	1.0	U
0061-01-5-	cis-1,3-Dichloropropene	0.18	0.50	0.50	U
0061-02-6-	trans-1,3-Dichloropropene	0.23	0.50	0.50	U
9-00-5----	1,1,2-Trichloroethane	0.46	1.0	1.0	U
27-18-4---	Tetrachloroethene	0.26	1.0	1.0	U
24-48-1---	Dibromochloromethane	0.32	1.0	1.0	U
08-90-7---	Chlorobenzene	0.27	1.0	1.0	U
5-25-2----	Bromoform	0.41	1.0	1.0	U
27-18-4---	1,1,2,2-Tetrachloroethane	0.49	1.0	1.3	
41-73-1---	1,3-Dichlorobenzene	0.23	1.0	1.0	U
06-46-7---	1,4-Dichlorobenzene	0.32	1.0	1.0	U
5-50-1----	1,2-Dichlorobenzene	0.21	1.0	1.0	U
1-43-2----	Benzene	0.24	1.0	1.0	U
08-88-3---	Toluene	0.18	1.0	1.0	U
00-41-4---	Ethylbenzene	0.17	1.0	1.0	U
330-20-7--	Xylenes, Total	0.50	2.0	2.0	U

CLIENT SAMPLE

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

940101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951259807

Sample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_020.

% Moisture: _____ Date Received: 12/15/95

GC Column: RTX-5 Date Analyzed: 12/26/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 1000(uL) Date Extracted: 12/21/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.20	J
----------#2-Fuel Oil	0.023	0.50	0.50	U
----------Varsol	0.057	0.50	0.50	U

REVISED DATA

CLIENT SAMPLE

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

941101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951259808

Sample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_(

Level: (low/med) LOW Date Received: 12/15/95

% Moisture: not dec. _____ Date Analyzed: 12/22/95

GC Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____( ) Soil Aliquot Volume: _____(ul

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	
74-83-9	Bromomethane	0.27	1.0	1.0	
75-00-3	Chloroethane	0.39	1.0	1.0	
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	
75-09-2	Methylene Chloride	0.17	5.0	5.0	
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	
67-66-3	Chloroform	0.25	1.0	1.0	
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	
79-01-6	Trichloroethene	0.29	1.0	1.0	
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	
75-27-4	Bromodichloromethane	0.36	1.0	1.0	
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	
127-18-4	Tetrachloroethene	0.26	1.0	1.0	
124-48-1	Dibromochloromethane	0.32	1.0	1.0	
108-90-7	Chlorobenzene	0.27	1.0	1.0	
75-25-2	Bromoform	0.41	1.0	1.0	
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.0	
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	
106-46-7	1,4-Dichlorobenzene	0.32	1.0	1.0	
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0	
71-43-2	Benzene	0.24	1.0	1.0	
108-88-3	Toluene	0.18	1.0	1.0	
100-41-4	Ethylbenzene	0.17	1.0	1.0	
1330-20-7	Xylenes, Total	0.50	2.0	2.0	

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

941101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951259808

Sample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_021

% Moisture: _____ Date Received: 12/15/95

GC Column: RTX-5 Date Analyzed: 12/27/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 1000(uL) Date Extracted: 12/21/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.50	U
----------#2-Fuel Oil	0.023	0.50	0.50	U
----------Varsol	0.057	0.50	0.50	U

SW-846 VOLATILE ORGANICS DATA ANALYSIS SHEET

942101

ab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

ab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 12368

atrix: (soil/water) WATER Lab Sample ID: 951259809

ample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL3121695B_07

evel: (low/med) LOW Date Received: 12/15/95

Moisture: not dec. _____ Date Analyzed: 12/21/95

Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

oil Extract Volume: _____( ) Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L	Q
74-87-3	Chloromethane	0.49	1.0	1.0	U
75-01-4	Vinyl-Chloride	0.18	0.50	0.50	U
74-83-9	Bromomethane	0.27	1.0	1.0	U
75-00-3	Chloroethane	0.39	1.0	1.0	U
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0	U
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0	U
75-09-2	Methylene Chloride	0.17	5.0	5.0	U
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0	U
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0	U
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0	U
67-66-3	Chloroform	0.25	1.0	3.0	
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0	U
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50	U
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50	U
79-01-6	Trichloroethene	0.29	1.0	1.0	U
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0	U
75-27-4	Bromodichloromethane	0.36	1.0	1.0	U
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50	U
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50	U
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0	U
127-18-4	Tetrachloroethene	0.26	1.0	0.29	J
124-48-1	Dibromochloromethane	0.32	1.0	1.0	U
108-90-7	Chlorobenzene	0.27	1.0	1.0	U
75-25-2	Bromoform	0.41	1.0	1.0	U
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.0	U
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0	U
106-46-7	1,4-Dichlorobenzene	0.32	1.0	1.0	U
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0	U
71-43-2	Benzene	0.24	1.0	1.0	U
108-88-3	Toluene	0.18	1.0	1.0	U
100-41-4	Ethylbenzene	0.17	1.0	1.0	U
1330-20-7	Xylenes, Total	0.50	2.0	2.0	U

CLIENT SAMPLE

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

942101

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951259809

Sample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_02

% Moisture: _____ Date Received: 12/15/95

GC Column: RTX-5 Date Analyzed: 12/27/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 1000(uL) Date Extracted: 12/21/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.50	
----------#2-Fuel Oil	0.023	0.50	0.50	
----------Varsol	0.057	0.50	0.50	

SW 846 VOLATILE ORGANICS DATA ANALYSIS SHEET

999001

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8021 SDG No.: 1

Matrix: (soil/water) WATER Lab Sample ID: 951236803

Sample wt/vol: 5.0 (g/mL) mL Lab File ID: HALL31213

Level: (low/med) LOW Date Received: 12/11/95

% Moisture: not dec. _____ Date Analyzed: 12/21/95

GC Column:RTX-502.2 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____( ) Soil Aliquot Volume: ___

CAS NO.	COMPOUND	MDL	PQL	RESULTS UG/L
74-87-3	Chloromethane	0.49	1.0	1.0
75-01-4	Vinyl-Chloride	0.18	0.50	0.50
74-83-9	Bromomethane	0.27	1.0	1.0
75-00-3	Chloroethane	0.39	1.0	1.0
75-69-4	Trichlorofluoromethane	0.17	1.0	1.0
75-35-4	1,1-Dichloroethene	0.16	1.0	1.0
75-09-2	Methylene Chloride	0.17	5.0	0.28
156-60-5	trans-1,2-Dichloroethene	0.14	1.0	1.0
75-34-3	1,1-Dichloroethane	0.18	1.0	1.0
156-59-2	cis-1,2-dichloroethene	0.20	1.0	1.0
67-66-3	Chloroform	0.25	1.0	0.72
71-55-6	1,1,1-Trichloroethane	0.18	1.0	1.0
56-23-5	Carbon Tetrachloride	0.22	0.50	0.50
107-06-2	1,2-Dichloroethane	0.22	0.50	0.50
79-01-6	Trichloroethene	0.29	1.0	1.0
78-87-5	1,2-Dichloropropane	0.31	1.0	1.0
75-27-4	Bromodichloromethane	0.36	1.0	1.0
10061-01-5	cis-1,3-Dichloropropene	0.18	0.50	0.50
10061-02-6	trans-1,3-Dichloropropene	0.23	0.50	0.50
79-00-5	1,1,2-Trichloroethane	0.46	1.0	1.0
127-18-4	Tetrachloroethene	0.26	1.0	1.0
124-48-1	Dibromochloromethane	0.32	1.0	1.0
108-90-7	Chlorobenzene	0.27	1.0	1.0
75-25-2	Bromoform	0.41	1.0	1.0
127-18-4	1,1,2,2-Tetrachloroethane	0.49	1.0	1.3
541-73-1	1,3-Dichlorobenzene	0.23	1.0	1.0
106-46-7	1,4-Dichlorobenzene	0.32	1.0	1.0
95-50-1	1,2-Dichlorobenzene	0.21	1.0	1.0
71-43-2	Benzene	0.24	1.0	1.0
108-88-3	Toluene	0.18	1.0	1.0
100-41-4	Ethylbenzene	0.17	1.0	1.0
1330-20-7	Xylenes, Total	0.50	2.0	2.0

SW-846 PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

999001

Lab Name: INDUSTRIAL & ENVIRONMENTAL ANALYSTS

Lab Code: IEA Case No.: 1718-142 Method: 8015 Modified SDG No.: 12368

Matrix: (soil/water) WATER Lab Sample ID: 951236803

Sample wt/vol: 1000 (g/mL) ML Lab File ID: FID1122695_02

% Moisture: _____ Date Received: 12/11/95

GC Column: RTX-5 Date Analyzed: 12/27/95

ID: 0.53 Dilution Factor: 1.0

Concentrated Extract Volume: 1000(uL) Date Extracted: 12/14/95

COMPOUND	MDL	CRQL	RESULTS MG/L	Q
----------Kerosene	0.12	0.50	0.50	
----------#2-Fuel Oil	0.023	0.50	0.50	
----------Varsol	0.057	0.50	0.50	

14.0 REFERENCES

Cooley et al. (M. E. Cooley, J. W. Harshbarger, J. P. Akers, and W. F. Hardt), 1969. "Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah," U.S. Geological Survey Professional Paper 521-A, Reston, Virginia.

DOE (U.S. Department of Energy) 1996a. *Guidance for Implementing the Long-Term Surveillance Program for UMTRA Project Title I Disposal Sites, February 1996, DOE/AL/62350-189, Rev. 0, DOE UMTRA Project, DOE Environmental Restoration Division, Albuquerque, New Mexico.*

DOE (U.S. Department of Energy), 1996b. *UMTRA Project Water Sampling and Analysis Plan, Tuba City, Arizona*, DOE/AL/62350-214, Rev. 0, prepared for the U.S. Department of Energy, Grand Junction Projects Office, Grand Junction, Colorado.

DOE (U.S. Department of Energy) 1995. *Site Observational Work Plan for the UMTRA Project Site at Tuba City, Arizona*, July 1995, DOE/AL/62350-11, Rev. 0, DOE UMTRA Project, DOE Environmental Restoration Division, Albuquerque, New Mexico.

DOE (U.S. Department of Energy) 1994. *Baseline Risk Assessment of Ground Water Contamination at the Uranium Mill Tailings Site Near Tuba City, Arizona*, June 1994, DOE/AL62350 - 31F, Rev. 0, DOE UMTRA Project, DOE Environmental Restoration Division, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1992a. *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program*, final, UMTRA-DOE/AL-350125.0000, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1992b. *1991 Annual Prelicensing Inspection of the Tuba City, Arizona, UMTRA Project Disposal Site*, draft, DOE/ID/12584-00, prepared for the U.S. Department of Energy by Chem-Nuclear Geotech, Inc., DOE Grand Junction Projects Office, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 1992c. *Long-Term Surveillance and Maintenance Program Quality Assurance Program Plan*, P-GJPO-152, July 1992, prepared for the U.S. Department of Energy by Chem Nuclear Geotech, Inc., DOE Grand Junction Projects Office, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 1989. *Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings Site at Tuba City, Arizona*, UMTRA-DOE/AL-050518.0000, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1988. "Tuba City Test Fills, Construction and Laboratory Test Data," letter transmitted by the DOE to the NRC, dated 13 September 1988.

DOE (U.S. Department of Energy), 1986a. *Environmental Assessment-Remedial Action at the Tuba City Uranium Mill Tailings Site, Tuba City, Arizona*, DOE/EA-0317, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1986b. *Uranium Mill Tailings Remedial Action Project*, Tuba City, Arizona, Subcontract Documents, Final Design for Review, Calculations, Volume IV, prepared for the U.S. Department of Energy by Morrison-Knudsen Engineers, Inc., Albuquerque, New Mexico.

EPA (U.S. Environmental Protection Agency), 1989. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities-Interim Final Guidance*, EPA/530-SW-89-026, Office of Solid Waste, Waste Management Division, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 1986. *RCRA Ground water Monitoring Technical Enforcement Guidance Document (TEGD)*, OSWER Directive 9950.1.

Eychaner, J. A., 1983. "Geohydrology and Effects of Water Use in the Black Mesa Area, Navajo and Hopi Indian Reservations, Arizona," U.S. Geological Survey Water-Supply Paper 2201, Tucson, Arizona.

Faure, G., 1977. *Principles of Isotope Geology*, John Wiley and Sons, New York, New York.

Freeze, R. A. and J. A. Cherry, 1979. Ground Water, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Harshbarger et al. (J. W. Harshbarger, C. A. Repenning, and J. H. Irwin), 1957. "Stratigraphy of the Uppermost Triassic and Jurassic Rocks of the Navajo Country," U.S. Geological Survey Professional Paper 291, U.S. Government Printing Office, Washington, D.C.

MK-F (MK-Ferguson), 1995. *Tuba City, Arizona, Final Completion Report*, prepared by MK-F for the U.S. Department of Energy, UMTRA Project Office, Contract No. DE-AC04-83AL18796, Albuquerque Operations Office, Albuquerque, New Mexico.

MK-F (MK-Ferguson), 1989. *Surveillance and Maintenance Subcontract Documents*, UMTRA Project, Tuba City, Arizona.

NRC (U.S. Nuclear Regulatory Commission), 1989. *Technical Evaluation Report for the Proposed Remedial Action at the Tuba City Tailings Site, Tuba City, Arizona*, transmitted by letter to the DOE UMTRA Project Office, 18 July 1989.

USGS (U.S. Geological Survey), 1969. "Moenkopi, Arizona," U.S. Geological Survey, 7.5-Minute Topographic Map, AMS 3756 II SW - Series V898, Denver, Colorado.

CODE OF FEDERAL REGULATIONS

10 CFR Part 40, *Domestic Licensing of Source Material*, U.S. Nuclear Regulatory Commission.

36 CFR Parts 1220-1238, *National Archives and Records*, Subchapter B, Records Management.

40 CFR Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*, U.S. Environmental Protection Agency.

41 CFR Part 101, *Federal Property Management Regulations*, General Services Administration.

DOE ORDERS

Order 1324.5B, *Records Management Program*, 25 January 1995, U.S. Department of Energy, Washington, D.C.

Order 5700.6C, *Quality Assurance*, U.S. Department of Energy, 21 August 1991, U.S. Department of Energy, Washington, D.C.

UNITED STATES CODE

42 USC §7901 *et seq.*, *Uranium Mill Tailings Radiation Control Act*, 8 November 1978.

ATTACHMENT 1

NRC CONCURRENCE AND LICENSING DOCUMENTATION

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
URANIUM RECOVERY FIELD OFFICE
BOX 25325
DENVER, COLORADO 80225

JUL 18 1989

URFO:DLJ
Docket No. WM-73
040WM073140E

Mark Matthews, Acting Project Manager
Uranium Mill Tailings Project Office
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Matthews:

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the Remedial Action Plan and Site Conceptual Design (RAP) and all associated documentation pertinent to the proposed remedial action for the uranium mill tailings site at Tuba City, Arizona. Our review is documented in the enclosed Technical Evaluation Report (TER), which discusses the NRC staff's evaluation of the proposed remedial action for compliance with the EPA standards.

Based on our review, we are prepared to conditionally concur in DOE's proposed remedial action. The NRC staff has identified one open issue. This issue is related to DOE's deferral of ground-water cleanup until after promulgation of EPA's final ground-water protection standards. While the NRC staff considers DOE's deferral to be acceptable, it precludes us from being able to fully concur in the proposed remedial action. Therefore, our concurrence will be conditional until the staff determines that DOE has adequately addressed this issue. You will note that the enclosed signature pages have been annotated to indicate that the concurrence is conditional.

If you have any questions regarding information in the enclosed TER, please contact me at FTS 236-2805.

Sincerely,

Ramon E. Hall, Director
Uranium Recovery Field Office

Enclosures: Technical Evaluation Report and Signature Pages

cc: C. Cormier, DOE
M. Abrams, DOE
Hopi Tribe
Navajo Tribe

U.S. Department of Energy
Agreement No. DE-FC04-85AL 26
Appendix B (Remedial Action P

SIGNATURE PAGE

THE UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY

BY: 11-3-87
James R. Anderson Date
Project Manger, Uranium
Mill Tailings Project Office

NAVAJO NATION

BY: JUN
Navajo Nation Date
Navajo Tribal Council

HOPI TRIBE

BY: 6/8/87
Hopi Tribe Date

CONCURRENCE

NUCLEAR REGULATORY COMMISSION

BY:
Ramon E. Hall Date 7/18/89
Director, Uranium Recovery Field Office
Region IV

(See transmittal letter dated July 18, 1989, for conditions of concurrence)

DEPARTMENT OF INTERIOR

BY:
For: Wilson Barber, Jr. Date
Area Director
Navajo Area Office
Bureau of Indian Affairs

BY: JUN
Walter R. Mills Date
Acting Area Director
Phoenix Area Office
Bureau of Indian Affairs

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
URANIUM RECOVERY FIELD OFFICE
BOX 25325
DENVER, COLORADO 80225

MAR 26 1992

Docket No. WM-73

A
MAR 1992
RECEIVED

Albert R. Chernoff, Project Manager
Uranium Mill Tailings Remedial
Action Project Office
Albuquerque Operations Office
U.S. Department of Energy
P.O. Box 5400
Albuquerque, New Mexico 87005

Dear Mr. Chernoff:

We have completed our review of DOE's draft Completion Report for the Tuba City, Arizona, Remedial Action Project. Our review is documented in the enclosed Completion Report Review (CRR) which discusses our evaluation of the completed remedial action in light of the previously approved plans and specifications. The goal of our review is to find if the remedial action complies with the Environmental Protection Agency's (EPA) standards in 40 CFR Part 192, Subparts A-C. We have identified several items that require clarification in the completion documentation.

To summarize our findings, certain data regarding bedding-layer placement do not verify that the approved specifications were met. More importantly, cleanup standards for radium-226 and thorium-230 apparently were not met at a number of locations. No justification for these deficiencies was provided in the Completion Report. In addition, most of the testing frequency data are incomplete and insufficient because only average testing frequencies are provided. Data are not provided showing that minimum testing frequencies were achieved. This deficiency applies to all material types used at Tuba City.

To expedite the review and concurrence process, the CRR text provides an overview of our findings, while Appendix B provides an itemized checklist of the remedial action requirements versus our determination. With resolution of the open items, we will issue a final finding concurring that the remedial action at Tuba City is complete. As usual, verification of ground-water cleanup will be addressed separately after DOE submits the ground-water corrective action plan.

On a general note, our review process includes verifying the remedial action requirements by referring back to the Remedial Action Plan, Remedial Action Inspection Plan, or the Design Specifications and drawings. Finding each pertinent requirement was a lengthy task. Thus, our review could become

considerably more efficient if each requirement stated in DOE's Completion Report cited the source of the requirement.

If you have any questions regarding this review, please contact me at FTS 554-5800 or the NRC Project Manager, Dawn Jacoby at FTS 554-5815.

Sincerely,

for Ramon E. Hall
Director

Enclosure:
As stated

cc:
B. Huskon, Navajo Nation
D. Lucero, The Hopi Tribe
M. Abrams, DOE
P. Mann, DOE
C. Tedford, RCPD, AZ

ATTACHMENT 2

LEGAL DESCRIPTION

LEGAL DESCRIPTION

The Tuba City disposal site is located on a 145-acre (59-hectare) parcel of land in Sections 17 and 20, Township 32 North, Range 12 East, Gila and Salt River Meridian, Coconino County, Arizona. The location is more fully described in the following paragraph.

Beginning at a point South 89° 49' East 1302.8 feet from the northwest corner of Section 20, Township 32 North, Range 12 East, Gila-Salt River Meridian, said point being located on the north line of Section 20 from which the northeast corner bears South 89° 49' East 3986.5 feet; and running:

Thence	North	66°43'42"	East	2283.5	Feet;
Thence	South	0°02	West	908.0	Feet;

To North line of said Section 20;

Thence	South 0°02'	West	1741.1	Feet;
Thence	North 89°	West	3250.0	Feet;
Thence	North 0°02'	East	1250.0	Feet;
Thence	North 66°43'42"	East	1255.2	Feet;

To the point of beginning.

The U.S. Department of Energy is currently negotiating a permanent easement agreement with the Navajo Nation, Hopi Tribe, and Bureau of Indian Affairs to provide perpetual access to the site for long-term care. Once the permanent easement agreement is executed, it will be incorporated into the final long-term surveillance plan.

ATTACHMENT 3

AGENCY NOTIFICATION AGREEMENTS

Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque New Mexico 87115

NOV 1 6 1992

Sergeant Jimmy Benally
Arizona Department of Public Safety
1100 West Kaibab
Flagstaff, Arizona 86001

Dear Sergeant Benally:

The U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project Office is requesting notification of any unusual activities or events in or around the uranium tailings disposal cell located approximately five miles northeast of Tuba City, Arizona. The purpose of the notification request is to assist DOE in surveying and maintaining the integrity of its disposal cell, and to ensure public safety.

If, during the course of routine activities, anything out of the ordinary is observed by your staff or reported to your office, we would appreciate immediate notification to the DOE Grand Junction Projects Office's 24-hour phone line at (303) 248-6070. The enclosed map provides directions to the site if you are not familiar with its location.

If the notification request discussed above is agreeable to you, please sign and return the enclosed reply letter for our records as soon as possible.

Should you have any questions, please contact Russel Edge of my staff at (505) 845-6130. Thank you for your attention in this matter.

Sincerely,

Albert R. Chernoff
Project Manager
Uranium Mill Tailings Remedial Action
Project Office

Enclosure

cc:
See page 2

NOV 1 6 1992

cc w/o enclosure:
J. Virgona, GJPO
C. Jones, GJPO
R. Edge, UMTRA
F. Bosiljevac, UMTRA
M. Day, TAC
E. Artiglia, TAC

Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque New Mexico 87115

NOV 16 1992

Captain Thomas Yazzie
Navajo Division of Public Safety
P.O. Box 518
Tuba City, Arizona 86045

Dear Captain Yazzie:

The U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project Office is requesting notification of any unusual activities or events in or around the uranium tailings disposal cell located approximately 5 miles northeast of Tuba City, Arizona. The purpose of the notification request is to assist DOE in surveying and maintaining the integrity of its disposal cell, and to ensure public safety.

If, during the course of routine activities, anything out of the ordinary is observed by your staff or reported to your office, we would appreciate immediate notification to the DOE Grand Junction Projects Office's 24-hour phone line at (303) 248-6070. Additionally, we would appreciate it if you could provide concurrent notification to Bernadine Martin in the Navajo UMTRA Project Office at (602) 871-6359. The enclosed map provides directions to the site if you are not familiar with its location.

If the notification request discussed above is agreeable to you, please sign and return the enclosed reply letter for our records as soon as possible.

Should you have any questions, please contact Russel Edge of my staff at (505) 845-6130. Thank you for your attention in this matter.

Sincerely,

Albert R. Chernoff
Project Manager
Uranium Mill Tailings Remedial Action
Project Office

Enclosure

cc:
See page 2

Captain Thomas Yazzie

cc w/o enclosure:
J. Virgona, GJPO
C. Jones, GJPO
R. Edge, UMTRA
F. Bosiljevac, UMTRA
M. Day, TAC
E. Artiglia, TAC

Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque New Mexico 87115

NOV 1 6 1992

Chief Duane Honanhie
Hopi BIA Police
Clifford Honahnie Bldg.
Box 1229
Tuba City, Arizona 86045

Dear Chief Honanhie:

The U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project Office is requesting notification of any unusual activities or events in or around the uranium tailings disposal cell located approximately five miles northeast of Tuba City, Arizona. The purpose of the notification request is to assist DOE in surveying and maintaining the integrity of its disposal cell, and to ensure public safety.

If, during the course of routine activities, anything out of the ordinary is observed by your staff or reported to your office, we would appreciate immediate notification to the DOE Grand Junction Projects Office's 24-hour phone line at (303) 248-6070. Additionally, we would appreciate it if you could provide concurrent notification to Diane Lucero in the Hopi UMTRA Project Office at (602) 734-2441. The enclosed map provides directions to the site if you are not familiar with its location.

If the notification request discussed above is agreeable to you, please sign and return the enclosed reply letter for our records as soon as possible.

Should you have any questions, please contact Russel Edge of my staff at (505) 845-6130. Thank you for your attention in this matter.

Sincerely,

Albert R. Chernoff
Project Manager
Uranium Mill Tailings Remedial Action
Project Office

2 Enclosures

cc:
See page 2

cc w/o enclosures:
J. Virgona, GJPO
C. Jones, GJPO
R. Edge, UMTRA
F. Bosiljevac, UMTRA
M. Day, TAC
E. Artiglia, TAC

Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque New Mexico 87115

NOV 2 0 1992

Mr. Byron Peterson
National Weather Service Office
Rural Route 7
Pulliam Airport
Flagstaff, Arizona 86001

Dear Mr. Peterson:

The U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action Project Office is requesting notification in the event of issuance of flash flood or tornado warnings in Coconino County, Arizona. We would appreciate notification to the DOE Grand Junction Projects Office's 24-hour phone line at (303) 248-6070 within eight hours of issuance of a warning or episode of warnings.

The purpose of this notification request is to assist the DOE in surveying and maintaining the integrity of its radioactive waste disposal site located approximately five miles northeast of Tuba City, Arizona.

If the notification request discussed above is agreeable to you, please sign and return the attached reply letter for our records as soon as possible.

Should you have any questions, please contact Russel Edge of my staff at (505) 845-6130. Thank you for your attention in this matter.

Sincerely,

Albert R. Chernoff
Project Manager
Uranium Mill Tailings Remedial Action
Project Office

Enclosure

cc w/o enclosure:
J. Virgona, GJPO
C. Jones, GJPO
R. Edge, UMTRA
F. Bosiljevac, UMTRA
M. Day, TAC
E. Artiglia, TAC

Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque New Mexico 87115

NOV 2 4 1992

Mr. Bruce Presgrave
U.S. Geological Survey
National Earthquake Information Center
P.O. Box 25046
Mail Stop 967
Denver Federal Center
Denver, CO 80225

Dear Mr. Presgrave:

The U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project is requesting notification if a seismic event is recorded in Coconino County, Arizona. The purpose of this request is to assist DOE in surveying and maintaining the integrity of its radioactive waste disposal site located approximately 5 miles northeast of Tuba City, Arizona (Latitude 111° 08'/Longitude 36° 08' 30", T32N, R12E, Sections 17 and 20).

We would appreciate notification to the DOE Grand Junction Projects Office's 24-hour phone line at (303) 248-6070 if a seismic event(s) occurs that fits any of the following descriptions:

- Any earthquake centered within a 9-mile radius of the site.
- Any earthquake of magnitude 4.0 or greater, centered between a 9-mile radius and a 19-mile radius.
- Any earthquake of magnitude 6.2 or greater, centered between a 19-mile radius and a 40-mile radius.

If the notification request discussed above is agreeable to you, please sign and return the enclosed reply letter for our records as soon as possible.

NOV 2 4 1995

Should you have any questions, please contact Mike Abrams of my staff at (505) 845-5758. Thank you for your attention in this matter.

Sincerely,

Albert R. Chernoff
Project Manager
Uranium Mill Tailings Remedial Action
Project Office

Enclosure

cc w/o enclosure:
J. Virgona, GJPO
C. Jones, GJPO
R. Edge, UMTRA
F. Bosiljevac, UMTRA
M. Day, TAC
E. Artiglia, TAC

ATTACHMENT 4

SITE INSPECTION CHECKLIST

SITE INSPECTION CHECKLIST FOR THE TUBA CITY, ARIZONA,

URANIUM MILL TAILINGS DISPOSAL SITE

Date of Last Inspection: Reason for Last Inspection:

Responsible Agency*: U.S Department of Energy (DOE) Grand Junction Projects Office (GJPO)

Address: P.O. Box 2567, Grand Junction, Colorado 81502-2657

Responsible Agency Official:

Inspection Start Date and Time:

Weather Conditions at Site:

Inspection Completion Date and Time:

Chief Inspector: _____
Name Title Organization

Assistant Inspector: _____
Name Title Organization

A. GENERAL INSTRUCTIONS

1. All checklist items must be completed and detailed comments made to document the results of the site inspection. The completed checklist is part of the field record of the inspection. Additional pages should be used, as necessary, to ensure that a complete record is made. Attach the additional pages and number all pages upon completion of the inspection.

2. Inspectors are to provide an up-to-date résumé or vitae for inclusion in the inspection report.

3. Any checklist line item marked by an "*" that is checked by an inspector must be fully explained or an appropriate reference to previous reports provided. The purpose of this requirement is to provide a written explanation of inspector observations and the inspector's rationale for conclusions and recommendations. Explanations are to be placed on additional attachments and cross-referenced appropriately. Explanations, in addition to narrative, will take the form of sketches, measurements, and annotated site atlas overlays.

---

*Responsibility for site inspections assigned by DOE UMTRA Project Office, Albuquerque, to DOE GJPO, November 6, 1990.

4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to inspect the entire surface and all features specifically described in this checklist. Every monument, site marker, sign, monitoring well, and erosion control marker will be inspected.

5. A set of color print 35-mm photographs is required. Sufficient photographs will be taken to compare to baseline photographs and determine if there are any significant differences in site appearance. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

6. Field notes taken to assist in completion of this checklist will become part of the inspection record. No form is specified; the field notes must be legible and in sufficient detail to enable review by succeeding inspectors and the responsible agency.

B. PREPARATION (to be completed prior to site visit)

	Yes	No
1. License (includes long-term surveillance and maintenance plan) reviewed.		
2. Site as-built plans reviewed and base map with copies of the following site atlas overlays obtained:		
a. Adjacent off-site features and land use; fences, gates, and signs; access roads and paths.		
b. Survey boundary monuments, boundary monument, site markers, settlement plates, aerial photo ground controls, ground photo locations.		
c. Monitoring wells, site drainage, diversion channels.		
d. Planned inspection transects and vegetation cover.		
e. Others.		
These overlays will be used to identify site features and record, as appropriate, field data.		
3. Previous inspection reports reviewed.		
a. Were anomalies or trends in modifying processes detected on previous inspections?		
b. Was a Phase II inspection conducted?		
c. Was custodial maintenance performed?		

	Yes	No
d. Was contingency repair work done as a result of the Phase II inspection?		
4. Site custodial maintenance and contingency repair records reviewed.		
a. Has site contingency repair resulted in a change from as-built conditions?		
b. Are reviewed as-builts available that reflect contingency repair changes?		
5. Adjacent property entry approval obtained (attach signed access agreement).		
6. Aerial photos, if taken since last inspection, reviewed. For each set, enter date taken, scale, and if interpreted.		

Set	Date	Scale	Interpreted Yes	Interpreted No
1.	_____	_____	___	___
2.	_____	_____	___	___
3.	_____	_____	___	___

	Yes	No
7. Were any of the following suggested by examination of aerial photographs? (If yes, give photo set date and indicate if item noted by interpreter or inspector):		
a. Intrusion by man?		
b. Intrusion by animals?		
c. Channelized erosion on slopes?		
d. Change in area drainage?		
e. Landslides?		
f. Creep on slopes?		
g. Obstruction of diversion channels?		
h. Bank erosion of diversion channels?		

	Yes	No
i. Seepage?		
j. Cracking?		
k. Change in vegetative cover?		
l. Displacement of fences, site markers, boundary markers, or monuments?		
m. Change in adjacent land use?		
n. Evidence of tailings exposure or transport?		

8. From as-builts, or subsequent inspection reports, note distance and azimuth from designated site location, such as a monument, to adjacent off-site features that could eventually affect integrity of site.

Off-site feature	Site monument no.	Distance	Azimuth
1._____	_____	_____	_____
2._____	_____	_____	_____
3._____	_____	_____	_____

9. Assemble and check out the following equipment, as needed, to conduct inspections:

   a. Cameras, film, and miscellaneous support equipment.
   b. Binoculars.
   c. Tape measure.
   d. Optical ranging device.
   e. Brunton compass.
   f. Photo scale stick.
   g. Erasable board.
   h. Plant press, plastic bags for vegetation.
   i. Keys to locks.
   j. Bolt cutters.
   k. Hand lens.
   l. Clipboard.
   m. Others.

C. SITE INSPECTION

	Yes	No
1. Adjacent off-site features [within 0.4 meter (0.25 mile) of site boundary]		
a. Have there been any changes in use of adjacent areas (grazing, construction, agriculture)?		
b. Are there any new roads or trails?		
c. Has there been a change in the position of nearby stream channels?		
d. Has there been headward erosion of nearby gullies?		
e. Are there new drainage channels?		
f. Others?		
2. Access roads and paths, fences, gates, and signs.		
a. Is there a break in the fence?		
b. Have any posts been damaged or their anchoring weakened?		
c. Is there evidence of erosion or digging beneath the fence?		
d. Does the gate show evidence of tampering or damage?		
e. Is there any evidence of human intrusion?		
f. Is there any evidence of large animal intrusion?		
g. Have any signs been damaged or removed? (Number of signs replaced: ____)		
h. Are access roads and paths passable?		
i. Others?		

	Yes	No
3. Monuments and other permanent features.		
a. Have the survey or boundary monuments been defaced or disturbed?		
b. Have the site markers been disturbed by man or natural processes?		
c. Do natural processes threaten the integrity of any monument or site marker?		
d. Others?		
4. Crest.		
a. Is there evidence of uneven settling? (depressions, scarps)		
b. Is there cracking?		
c. Has the outer cover layer been breached?		
d. Is there evidence of erosion?		
1) By water? (rills, rivulets)		
2) By wind? (pedestal rocks, ripple marks)		
e. Is there evidence of animal burrowing?		
f. Others?		
5. Slopes.		
a. Is there evidence of gradual downslope movement (creep)? (terraces, deflection of plants)		
b. Is there cracking?		
c. Can depressions or bulges on the slope be seen?		
d. Has the outer cover layer been breached?		

	Yes	No
e. Is there evidence of erosion:		
1) By water?		
2) By wind?		
f. Has water runoff become channelized? (rivulets, gullies)		
g. Is there evidence of seepage? (moisture, color, vegetation)		
h. Is there evidence of animal burrowing?		
i. Is there evidence of deterioration of riprap or gravel cover?		
j. Others?		
6. Periphery (within site boundaries).		
a. Is there evidence of seepage such as wet areas or localized change of vegetation?		
b. Is there evidence of sediment transport from the tailings pile by water or wind?		
c. Is the vegetative cover as described in the as-builts?		
d. Is the drainage as described in the as-builts?		
e. Others? Burrowing animals; erosion.		
7. Diversion channels.		
a. Is there evidence of bank erosion?		
b. Has the integrity of riprap structures been disturbed by people or natural processes?		
c. Is there evidence of channel erosion?		
d. Is there evidence of sedimentation in the channel?		

	Yes	No
e. Is the channel obstructed in any way?		
f. Is there any evidence that the diversion channels are not performing their function?		
g. Others?		
8. Photography.		
a. Have all photos required by the site atlas photo overlay been taken?		
b. Has a photo log sheet been prepared for each roll of film exposed?		
c. Number of rolls of film exposed: ____		
d. Others?		
9. Monitor wells.		
a. Have any monitor wells been disturbed by man or natural processes?		
b. Does any natural process threaten the integrity of any monitor well?		
c. Are all monitor wells capped and locked?		
d. Others?		

D. FIELD CONCLUSIONS

	Yes	No
1. Is there an imminent hazard to the integrity of the tailings pile? (Immediate report required) Person _____ Agency to whom report made: _____		
2. Are more frequent Phase I inspections required?		
3. Are existing contingency repair actions satisfactory?		
4. Is a Phase II inspection required?		
5. Is a contingency report or custodial maintenance required?		
6. Rationale for field conclusions are documented as the text of this report.		

E. CERTIFICATION

I have conducted a prelicensing inspection of the Tuba City uranium mill tailings site in accordance with the procedures of the license (includes the site surveillance plan) as recorded on this checklist, attached sheets, field notes, photo log sheets, and photos.

Chief Inspector's Signature	Printed Name
Title	Date

(Stamp or Seal)

ATTACHMENT 5

SITE INSPECTION PHOTO LOG

SITE INSPECTION PHOTO LOG

Site: _____ Site Activity: _____

Date: _____ Time of Day: From _____ to _____

Weather Conditions: _____

Roll Number: _____ Film Type: _____ Number of Exposures _____

Photo Number	Location	Description

SITE INSPECTION PHOTO LOG (CONT.)

Photo Number	Location	Description

Photographer: _____ _____

Printed Name Signature

SITE INSPECTION PHOTO LOG (CONT.)

Page ___ of ___

Site _____
Date _____

Photo Number	Location	Description

SITE INSPECTION PHOTO LOG (CONT.)

Photo Number	Location	Description

ATTACHMENT 6

PERMANENT SITE FILE INDEX

1.0 REPORTS

- 1.1 Long-term surveillance plan
- 1.2 Environmental assessment and Finding of No Significant Impact
- 1.3 Disposal site characterization report
- 1.4 Final remedial action plan and final design for construction
- 1.5 Site certification report
- 1.6 Groundwater monitoring reports and records
- 1.7 Additional monitoring reports and records
- 1.8 Annual reports to the U.S. Nuclear Regulatory Commission
- 1.9 Annual inspection reports and records
- 1.10 Follow-up or contingency inspection preliminary assessments, reports, and records
- 1.11 Custodial maintenance or repair reports and records
- 1.12 Corrective action plans, reports, and records

2.0 QUALITY ASSURANCE PROGRAM PLAIN

3.0 DOCUMENTATION

- 3.1 Licensing documentation
- 3.2 Disposal site legal description, title, custody documentation, or cooperative agreements
- 3.3 Interagency agreements, authorizations, and access agreements
- 3.4 Monitor well permits and well abandonment records
- 3.5 Pertinent design and construction documents

4.0 DRAWINGS AND PHOTOGRAPHS

- 4.1 Site atlas
  - 4.1.1 Disposal site vicinity map
  - 4.1.2 Disposal site topographic map
  - 4.1.3 Disposal site map
  - 4.1.4 Disposal site as-built drawings
  - 4.1.5 Design and construction drawings
- 4.2 Baseline and aerial photographs

ATTACHMENT 7

SUPPORTING DOCUMENTATION

UMTRA PROJECT STANDARD OPERATING PROCEDURES

Section and SOP Number	Title
16.1.1	Monitor Well Installation
16.1.2	Well Development
16.1.3	Slug Testing
16.1.4	Packer Testing
16.1.5	Aquifer Pump Testing
16.1.6	Soil-Water Sampler Installation and Sample Collection
16.1.7	Installation and Servicing of Tensiometers
16.1.8	Batch and Column Testing
16.1.9	Gravimetric Moisture Content of Drill Bit Cuttings
16.1.10	Field Measurements for TEMP, COND, pH, ALK, and TTL Acid
16.1.11	Sample Collection for Organic Substances
16.1.12	Measuring Sub-surface Content Using Neutron Moisture Meter
16.1.13	Field Determination of OX/Reduction Potential (ORP)
16.1.14	Field Determination of Dissolved Oxygen in Water Samples
16.1.15	Neutron Probe Access Hole Closure
16.1.16	Alternate Method for Determination of Dissolved Oxygen
16.1.17	Well Decommissioning Procedure
16.1.18	Assessment of Inherited Groundwater Wells for UMTRA Site
16.1.19	Permitting Procedures for Installation of Monitoring Wells
16.1.20	Well Repair Procedures
16.1.21	Measurement of Water Turbidity
16.1.22	Controlled Disposal of Potentially Contaminated Materials
16.2.1	Sample Collection, Preservation, and Shipment of Water Samples
16.2.2	Water Sampling for Tritium Analysis
16.2.3	Evaluation of Chemical Analysis of Water Samples
16.2.4	Sampling Radon in Water
16.2.5	Monitor Well Sampling with an Electric Submersible Pump
16.2.6	Monitor Well Sampling with a Bladder Pump
16.2.7	Monitor Well Sampling with a Peristaltic Pump
16.2.8	Quality Control Samples for Water Sampling
16.3.1	Completion of Well and Spring Inventory

ATTACHMENT 8

ACRONYMS

ACRONYMS

BIA	Bureau of Indian Affairs
bls	below land surface
BMP	best management practices
CFR	U.S. Code of Federal Regulations
CLP SOW	Contract Laboratory Program Statement of Work
DOE	U.S. Department of Energy
DQO	data quality objective
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
GJPO	Grand Junction Projects Office
HAZWRAP	Hazardous Waste Remedial Actions Program
LTSP	Long-term surveillance plan
MCL	maximum concentration limit
NRC	U.S. Nuclear Regulatory Commission
NWS	National Weather Service
QA	quality assurance
QC	quality control
RAP	remedial action plan
RCRA	Resource Conservation and Recovery Act
SOP	standard operating procedure
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
USGS	U.S. Geological Survey