Reference Only

DOE/AL-62350-235
REV. 1

United States Department of Energy

-RFL-LTSP 11-97-

LONG-TERM SURVEILLANCE PLAN FOR THE ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

November 1997

Uranium Mill Tailings Remedial Action Project

DOE/AL/62350-235
REV. 1

LONG-TERM SURVEILLANCE PLAN
FOR THE
ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

November 1997

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

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

LIST OF ACRONYMS

Acronym	Definition
BLM	Bureau of Land Management
DOE	U.S. Department of Energy
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
HDPE	high density polyethylene
LTSP	long-term surveillance plan
MCL	maximum concentration limit
MK-F	Morrison Knudsen-Ferguson
NGVD	National Geodetic Vertical Datum
NRC	U.S. Nuclear Regulatory Commission
POC	point of compliance
QA	quality assurance
RAP	remedial action plan
TAC	Technical Assistance Contractor
TDS	total dissolved solids
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act

DOE F 1325.8

United States Government — Department of Energy

Albuquerque Operations Office

memorandum

NOV 19 1997

DATE: November 17, 1997

REPLY TO: ERD:SJA

SUBJECT: Page Changes to the Long-Term Surveillance Plan for the Estes Gulch Disposal Site

TO: Russel Edge, Grand Junction Office

Attached are page changes to the *Long-Term Surveillance Plan for the Estes Gulch Disposal Site Near Rifle, Colorado*, dated July 1997. These changes were made as a result of the Department of Energy's responses to comments (attached) made by the Nuclear Regulatory Commission and the Colorado Department of Public Health and the Environment. In responding to the comments it was necessary to modify paragraph 4 on page 2-11. In addition, the Plate Map was revised to show all long-term surveillance features.

Please give me a call at (505) 845-5668 if you have any questions.

Sharon J. Arp
Site Manager
Uranium Mill Tailings Remedial Action Team
Environmental Restoration Division

Attachments

cc w/o attachments:
S. Cox, TAC

1.0 PURPOSE AND SCOPE

This long-term surveillance plan (LTSP) describes the U.S. Department of Energy's (DOE) long-term care program for the Uranium Mill Tailings Remedial Action (UMTRA) Project Estes Gulch disposal site located near Rifle, Colorado, in Garfield County.

The U.S. Nuclear Regulatory Commission (NRC) has developed regulations for the issuance of a general license for the custody and long-term care of UMTRA Project disposal sites in 10 CFR Part 40. The purpose of this general license is to ensure that the UMTRA Project disposal sites are cared for in a manner that protects the public health and safety and the environment. For disposal sites to be licensed, the NRC requires the DOE to submit a site-specific LTSP; the DOE prepared this LTSP to meet that requirement for the Estes Gulch disposal site. The general license becomes effective when the NRC concurs with the DOE's determination of completion of remedial action for the Estes Gulch site and the NRC formally accepts this LTSP.

This document describes the long-term surveillance program the DOE will implement to ensure that the Estes Gulch disposal site performs as designed. The program is based on site inspections to identify threats to disposal cell integrity. The LTSP is based on the UMTRA Project long-term surveillance program guidance (DOE, 1996a) and meets the requirements of 10 CFR §40.27(b) and 40 CFR §192.03.

RESPONSE TO NRC COMMENTS
LONG-TERM SURVEILLANCE PLAN
ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

1. Comment: DOE has not explicitly stated that NRC approval will be obtained before the monitoring in the three monitoring wells (standpipes) within the disposal cell is ceased, and the standpipes are abandoned. According to the logic flow chart on page 3-10 of the Appendix, (Figure 3), DOE could abandon the standpipes after four consecutive quarters of a downward trend. Given that these standpipes are the only monitoring being performed to meet the Environmental Protection Agency requirements and this is occurring under the general license, NRC approval should be obtained before the wells are abandoned. DOE should explicitly state in the LTSP (page 2-11, fourth paragraph) that decommissioning the standpipes will occur after NRC approval is obtained. The flow chart in the Appendix should also be modified to reflect that NRC approval should be obtained before closing the monitoring wells.

   Response: LTSP page 2-11, fourth paragraph of Section 2.4, has been modified to require state review and NRC approval for closure of the standpipes. In addition, Figure 3 in the Appendix has been change to show a state review and NRC approval step for decommissioning the standpipes.

2. Comment: Paragraph 3.2 states that the inspectors will be qualified to "inspect disposal cell integrity and make preliminary assessments of modifying processes that could adversely affect the disposal cell." However, previous LTSP documents have elaborated on the qualifications of the inspection team. For example, the Shiprock LTSP (1994) stated that "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 the processes that could adversely affect the site (e.g., geomorphic agents of changes)." Similar qualifications should apply to the inspection team for Rifle. DOE should modify paragraph 3.2 for consistency with the Shiprock LTSP, or provide reasons why such requirements are necessary.

   Response: Early LTSPs were very prescriptive regarding who would perform inspections, how they would be performed, and how they would be documented. These requirements went above and beyond the requirements outlined in 10 CFR 40.27. In order to maintain flexibility the DOE GJO office requested that information not specifically required by 10 CFR 40.27 be removed. In streamlining the LTSPs it was not felt necessary to specifically specify inspector qualifications. The DOE feels that it is adequate to state that the inspector will be qualified to inspect disposal cell integrity and make preliminary assessments. Based on the results of the preliminary assessment, personnel from specific disciplines would be utilized to perform follow-up inspections. This change gives the GJO the ability to choose the appropriate individuals for each inspection. This change was implemented in the Gunnison and Mexican Hat LTSP; both of which have been approved by NRC. Therefore, no changes will be made to the Rifle LTSP.

RESPONSE TO NRC COMMENTS
LONG-TERM SURVEILLANCE PLAN
ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

1. Comment. The monitor wells in the disposal cell are not shown on the site map in the document rear pocket. Since about one half of the document discusses closure of these wells, they should probably be labeled on the maps.

   Response. The Plate Map that was provided in the LTSP for your review was a draft. A revised map is enclosed that shows the standpipes as well as other long-term surveillance features.

2. Comment. The LTSP indicates that a linear regression will be plotted and when a zero or negative slope for four consecutive quarters is observed, the wells will be closed. The CDPHE previously had commented that a statistical test such as the Mann-Kendall test be run to test for a significant trend. We do not object to using the linear regression, but are not sure the regression can detect a trend if the slope is zero or only slightly negative. My understanding is that this indicates no trend at all. CDPHE still feels that there will still be a need for detecting and estimating statistically significant trends by using a test such as Mann-Kendall or Sen's nonparametric estimator. Whichever method is used would have to analyze data for two wells and multiple data points.

   Response. As committed in response to NRC Comment 1, the LTSP page 2-11, fourth paragraph of Section 2.4, has been modified to require state review and NRC approval prior to closure of the standpipes. In addition, Figure 3 in the Appendix has been change to show this step. This change will provide CDPHE the ability to provide comments and concerns prior to well closure.

2.0 FINAL SITE CONDITIONS

Remedial action at the former uranium processing sites in Rifle, Colorado, consisted of excavating and relocating the residual radioactive materials to the Estes Gulch disposal site. The DOE constructed a disposal cell to control the residual radioactive materials in accordance with 40 CFR Part 192. The Estes Gulch disposal site is partially fenced, and its perimeter is marked with warning signs. The site completion report (DOE, 1997) contains a detailed description of the final site conditions.

2.1 SITE HISTORY

The Estes Gulch disposal cell was constructed to stabilize waste from the two former processing sites near Rifle, Colorado. Both processing sites (named Old Rifle and New Rifle) are located on the floodplain of the Colorado River valley and are north of the Colorado River. Old Rifle is just east of the city limits of Rifle, in Garfield County, Colorado. New Rifle is west of the city of Rifle, approximately 2 miles (mi) (3 kilometers [km]) from Old Rifle. The Estes Gulch disposal cell is located approximately 6 mi (9 km) north of Rifle.

Both processing sites were once owned by Union Carbide Corporation, but now are owned by the state of Colorado. The Old Rifle plant was built by the Standard Chemical Company in 1924 and in 1928 was bought by the United States Vanadium Corporation (an eventual subsidiary of the Union Carbide Corporation). The mill operated from 1924 to 1932, and again from 1942 to 1946 for recovery of vanadium. In 1946, uranium processing was added to the vanadium recovery circuit and recovery of both vanadium and uranium continued until 1958. In 1958, operations were transferred to the New Rifle mill and the Old Rifle mill was shut down.

About 761,000 short tons (tons) of ore from the nearby Meeker and Rifle Creek mines, as well as ore from the Uravan mineral belt, were processed at the Old Rifle mill. Tailings and spent processing solutions were deposited at the site. About 411,000 tons of these tailings were later reprocessed at the New Rifle mill and deposited there. Approximately 350,000 tons of tailings (approximately 259,000 cubic yards [yd^3], or 197,000 cubic meters [m^3]) remained at Old Rifle. In 1967, Union Carbide moved the southern edge of this tailings pile away from the Colorado River and partially stabilized the pile with a 6-inch (15-centimeter [cm]) cover of earth seeded with grasses.

In July 1958, operations began at the New Rifle mill, which produced both uranium and vanadium until December 1972. After 1972, only vanadium was produced and milling operations ceased in 1981. In addition to tailings from the Old Rifle site, uranium ores and upgrader products were processed at the New Rifle mill. A total of 2.7 million tons of tailings, ores, and upgrader products were processed at this mill.

Upgrader products came from other Union Carbide mills at Slick Rock, Colorado, and Green River, Utah. Upgrader products from Slick Rock were dried fines. dried slime concentrates, green sludge, and uranium-bearing chemical precipitates. The Green River upgrader products consisted of dried slimes and asphaltic uranium-bearing concentrates. Uranium bearing lignite ash from Belfield, North Dakota, was supplied to the New Rifle mill. Union Carbide partially stabilized the New Rifle pile with mulch, fertilizer, and native grasses.

At the Old Rifle mill, a salt roasting process initially was used to recover vanadium. Water, sodium chloride, and sulfuric acid were used in this process. When uranium processing was added to the vanadium recovery circuit in 1946, additional reagents were used: hydrochloric acid, sodium hypochlorate, sodium carbonate, ferric iron sulfate, ammonia, and ammonium chloride.

The New Rifle mill used a solvent extraction method to recover uranium. Reagents used in the process included water, sodium chloride, sulfuric and hydrochloric acid, kerosene, di(2-ethylhexyl) phosphoric acid, sodium hypochlorate, sodium carbonate, sodium hydroxide, and ammonia.

The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 (42 USC §7901 *et seq.)* gave the DOE authority to perform remedial action at both Rifle sites. The DOE evaluated the environmental impacts associated with site remedial action in an environmental impact statement (EIS) (DOE, 1990. The NRC and the state of Colorado concurred with the DOE's remedial action plan (RAP) (DOE, 1992a) to comply with the requirements of 40 CFR Part 192, Subparts A through C.

The DOE began constructing the Estes Gulch disposal cell in 1993. During 1994 and 1995, the DOE relocated uranium mill tailings and other residual radioactive materials (such as contaminated mill buildings and associated debris, windblown materials, and about 24,000 yd^3 [18,400 m^3] of vicinity property materials) and placed them in the Estes Gulch disposal cell. Disposal cell construction was completed in 1996 with placement of a radon/infiltration barrier and frost- and erosion-protection layers. A completion report documents compliance with the RAP and the site as-built conditions (DOE, 1997). In addition, the DOE prepared a final audit report and certification summary and submitted it along with the completion report to the NRC for concurrence. Concurrence from the NRC on the completion report is included in the permanent site file.

2.2 GENERAL DESCRIPTION OF THE SITE VICINITY

The Estes Gulch disposal site is in Garfield County in west-central Colorado on the western slope of the Rocky Mountains. The site is approximately 6 mi (10 km) north of the town of Rifle, Colorado (Figure 2.1) in Township 5 South, Range 93 west, Section 14. This section briefly describes the site vicinity. Detailed descriptions can be found in the site EIS (DOE, 1990) and the RAP (DOE, 1992a).

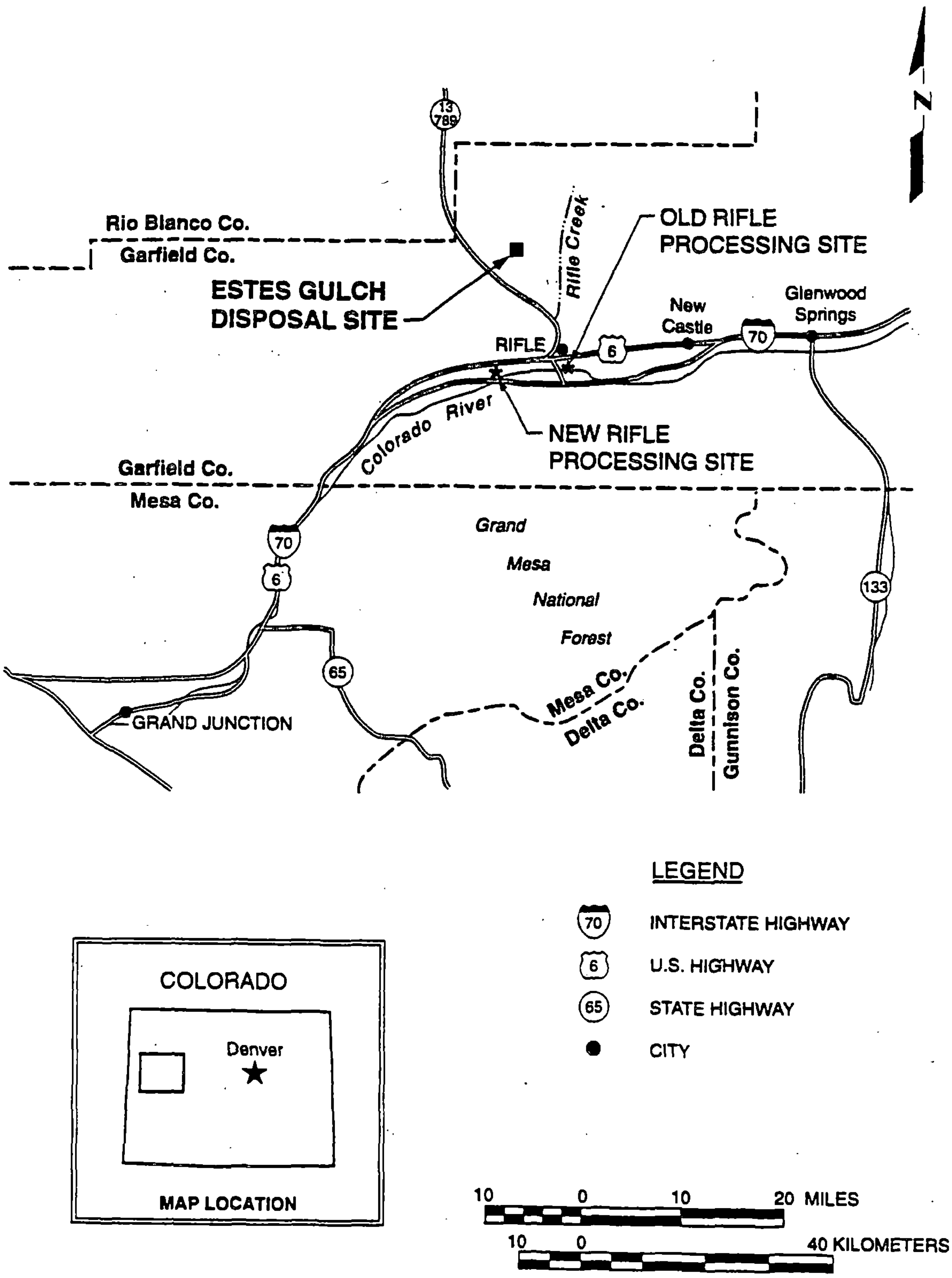


FIGURE 2.1
LOCATION OF THE ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

AC: SITE/RFL/LTSP/SITELOC

The general climatic regime in the vicinity of the Estes Gulch disposal site is semiarid. North of Estes Gulch at significantly higher elevations, precipitation is much heavier. The area is characterized by low humidity, frequent sunny days, and large diurnal and seasonal temperature ranges. The average annual precipitation in the region is 11 inches (28) centimeters [cm]) and the average temperatures range from 23 to 71 degrees Fahrenheit (°F) (-5 to 22 degrees Celsius [°C]) (Yeend, 1969). Snowfall averages 37 inches (94 cm) a year. The highest monthly rainfall usually occurs during July and August, while the least rainfall occurs from April through June. Summer rainfall occurs as intense, scattered thunderstorms.

Site-specific precipitation, temperature, and wind-related data were collected from October 1993 to September 1996. Average annual precipitation ranged from about 14.3 to 18.5 inches (36 to 47 cm). Annual snowfall ranged from 22.3 to 34 inches (57 to 86 cm). The site-specific average daily temperature ranged from 15 to 86°F (-9.4 to 30°C).

Site-specific wind data indicate that wind direction was predominately from the west and northwest over 50 percent of the period of record. Winds were from the south 10 percent of the time. Wind intensity data are available from Morrison Knudsen-Ferguson (MK-F) (MK-F, 1996).

The Estes Gulch site ranges from about 5960 to 6200 feet (ft) (1820 to 1890 meters [m]) above mean sea level. The Grand Hogback rises to an elevation of about 7850 ft (2400 m) north of the site. To the south, 3300 ft (1000 m) the dissected pediment surfaces drop down to the alluvial valley of Government Creek at an elevation of about 5750 ft (1750 m).

The Estes Gulch site is at the head of a small drainage basin on a dissected pediment and alluvial fan surface sloping southwest toward Government Creek from the foot of the Grand Hogback monocline.

Off-site runoff water that could have affected the integrity of the cell previously came from a 20-acre (ac) (8-hectare [ha]) watershed north of the cell. Runoff from about 6 ac (2 ha) of the uppermost part of this watershed was diverted from the disposal cell by an interceptor ditch. The other 14 ac (5.6 ha) of the watershed between the interceptor ditch and the cell were graded and covered with erosion-resistant material. The graded area has a slight crown to shed some runoff away from the cell and onto the adjacent ground. Precipitation falling on top of the cell will drain to a toe ditch at the south end and will discharge eastward into Estes Gulch (DOE, 1992a).

There is little potential for future natural resource development in the immediate site vicinity.

2.3 DISPOSAL SITE DESCRIPTION

This section briefly describes the disposal site; detailed descriptions can be found in the site RAP (DOE, 1992a) and completion report (DOE, 1997).

2.3.1 Site ownership and legal description

The government currently owns the Estes Gulch disposal site and most of the surrounding area. The Bureau of Land Management (BLM) permanently transferred administration of public land to the DOE in August 1991 for use as the Estes Gulch disposal site. The BLM administers the adjacent surrounding lands. Attachment 1 provides a legal description of the disposal site. Plate 1 shows the final site boundary and identifies ownership of the site and surrounding areas at the time of licensing.

2.3.2 Directions to the disposal site

The Estes Gulch disposal site can be reached by automobile via paved and gravel roads (Figure 2.2) by following these directions.

1. From Rifle, Colorado, at the intersection of U.S. Highway 6 (also called U.S. Highway 24) and the State Highway 13 by-pass, go north.
2. Take the State Highway 13 bypass to State Highway 13 north; go approximately 5 mi (8 km).

Turn right onto a paved road. The paved section of the road extends about 30 ft (9 m) to a gate. After the gate, the road becomes a gravel road. Follow this gravel road about a mile to the disposal site.

Entry to the disposal site is restricted by a fence at the site entrance. The south access gate is kept locked and the key needed to enter the site may be obtained from the DOE Grand Junction Office.

2.3.3 Description of surface conditions

The Estes Gulch disposal site is located on approximately 205 ac (83 ha) (Plate 1). The completion report contains a detailed description of the final site conditions, including the results of the final site topographic survey.

During the final site grading, all areas were contoured to promote drainage away from the disposal cell. A mix of grasses and sagebrush was used to revegetate all disturbed areas of the disposal site not covered by riprap (DOE, 1997).

At the completion of remedial action, the DOE documented final disposal site conditions with site maps, as-built drawings, and ground and aerial photographs.

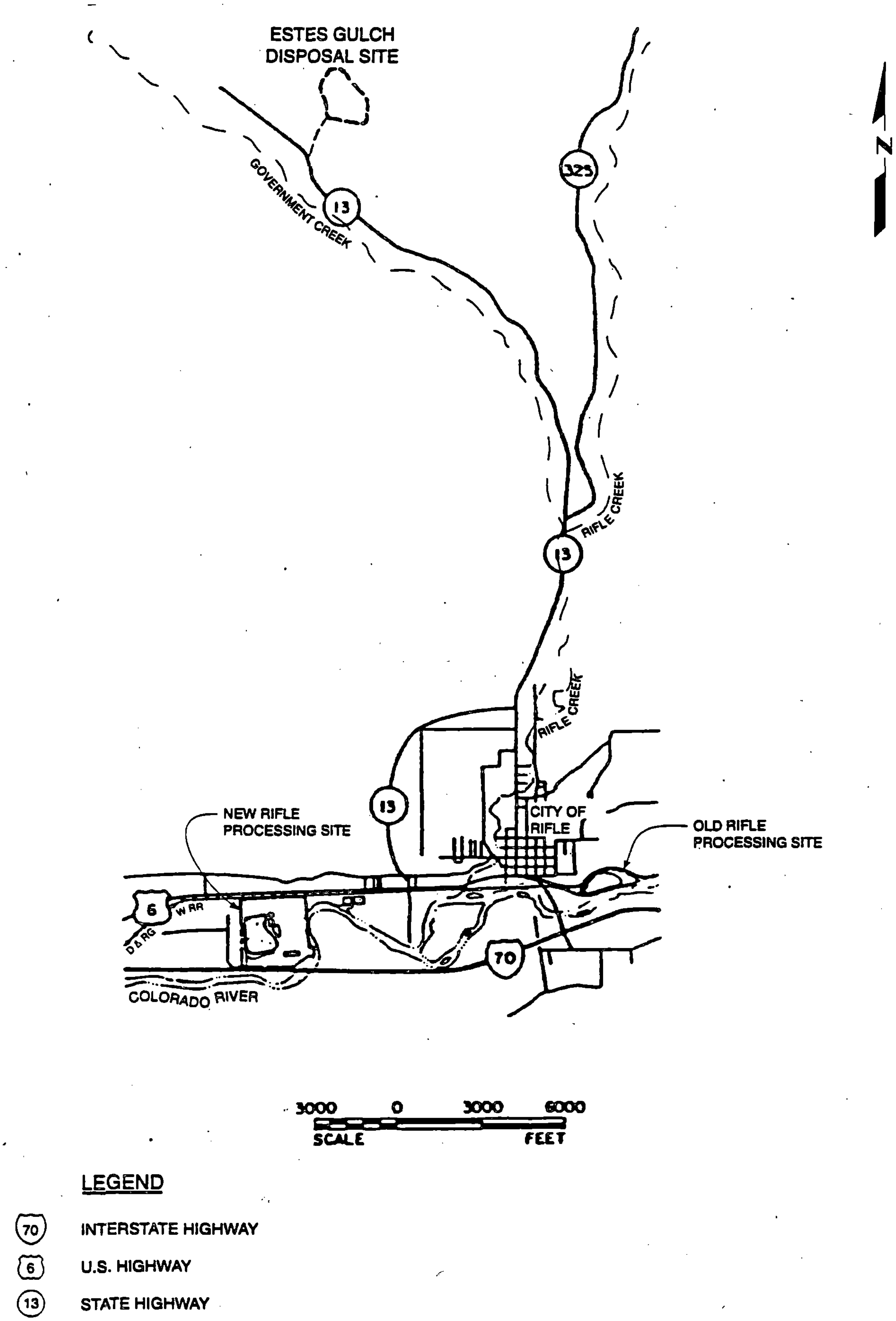


FIGURE 2.2
ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

MAC: SITE/RFL/LTSP/SITE-ESTES

2.3.4 Permanent site-surveillance features

Survey and boundary monuments, site markers, and warning signs are the permanent long-term surveillance features of the Estes Gulch disposal site. Plate 1 shows the locations of these features and Table 2.1 provides survey coordinates for the monuments and markers. Typical construction and installation specifications for these features are shown in the long-term surveillance guidance (DOE, 1996a) and subcontract documents (DOE, 1996b).

Table 2.1 Locations of permanent surveillance features, Rifle, Colorado, disposal site

Feature	Location coordinates[a]	
Survey monuments		
SM-1	N 56,000	E 53,400
SM-2	N 56,500	E 52,100
SM-3	N 59,600	E 52,600
Site markers		
SMK-1	N 56,000	E 53,550
SMK-2	N 57,200	E 52,550
Boundary monuments		
BM-1	N 55,900	E 54,270
BM-2	N 57,205	E 54,280
BM-3	N 57,220	E 53,655
BM-4	N 59,140	E 53,680
BM-5	N 59,170	E 54,000
BM-6	N 60,070	E 53,985
BM-7	N 60,080	E 53,360
BM-8	(No monument.)	
BM-9	(No monument.)	
BM-10	N 59,245	E 52,350
BM-11	N 59,250	E 52,050
BM-12	N 58,945	E 52,045
BM-13	(No monument.)	
BM-14	N 58,250	E 51,690
BM-15	N 58,250	E 51,385
BM-16	N 57,270	E 51,360
BM-17	(No monument.)	
BM-18	N 56,645	E 51,185
BM-19	N 56,620	E 52,010
BM-20	(No monument.)	

[a]Coordinates in feet based on Project Survey Control Points: CP-13, N 58,634.94, E 54,353.21; CP-15, N 59,208.41, E 52,222.98; CP-19, N 59,856.50, E 53,526.86.

Three survey monuments establish permanent horizontal control based on the Colorado State Plane Coordinate System (Central Zone) and are referenced to the Project Survey Control Points. These control points are shown on Plate 1 and their location coordinates are given in Table 2.1. The three permanent survey monuments (SM-1, SM-2, and SM-3) are Berntsen RT-1 markers set in concrete, with the monument about 4 inches (10 cm) above ground level. Magnets in the markers permit easier detection if the markers become buried over time. The survey monument identification number is stamped on the top of the metal cap.

The site boundary has 20 corners; 15 are marked by boundary monuments (Plate 1 and Table 2.1). Boundary monuments were not installed at five corners (BM-8, BM-9, BM-13, BM-17, and BM-20) because of steep terrain. Five of the boundary monuments are Berntsen A-1 markers set in reinforced concrete. These markers extend about 1 inch (2.5 cm) above the ground surface. The remaining 10 monuments have been modified for area conditions and are placed to a depth of 3 ft (1 m) or to 6 inches (15 cm) below the top of rock. These modified markers extend a minimum of 1 foot (30 cm) above the ground surface. Magnets in the A-1 markers will allow easier detection if they become buried. The boundary monument identification number is stamped on the top of the metal cap.

Two unpolished granite markers with an incised message identify the Estes Gulch disposal site. The message includes a drawing showing the general location of the stabilized disposal cell within the site boundaries, the date of closure (26 April 1996), the weight of the tailings (4,967,451 dry tons of tailings), and the amount of radioactivity (2738 curies). Site marker SMK-1 near the south access gate to the site is set in reinforced concrete that extends 6 ft (1.8 m) below the ground surface. Site marker SMK-2 at the crest of the disposal cell is set in reinforced concrete that extends down 18 inches (46 cm) to the top of the frost protection barrier.

The site entrance sign is at the south access gate near site marker SMK-1. The entrance sign also displays the DOE 24-hour phone number. In addition, the DOE has posted property use warning signs (18 by 24 inches [610 x 460 mm]) around the disposal site perimeter at approximately 200-ft (60-m) intervals along the south side of the site and approximately 500 ft (150 m) intervals elsewhere. The warning signs are mounted on steel posts set back about 5 ft (1.5 m) inside the site fence, except on the south were they are attached to the fence. Warning signs on posts are mounted with the tops of the signs about 6 ft (1.8 m) above the ground surface. The sign posts are embedded in concrete to a depth of about 3 ft (1 m) below the ground surface.

2.4 DISPOSAL CELL DESIGN

The 71-ac (29-ha) disposal cell is located on a gently sloping pediment between the Grand Hogback and Government Creek. The area of the disposal cell is not subject to any significant hazard from slope failure processes such as landslides,

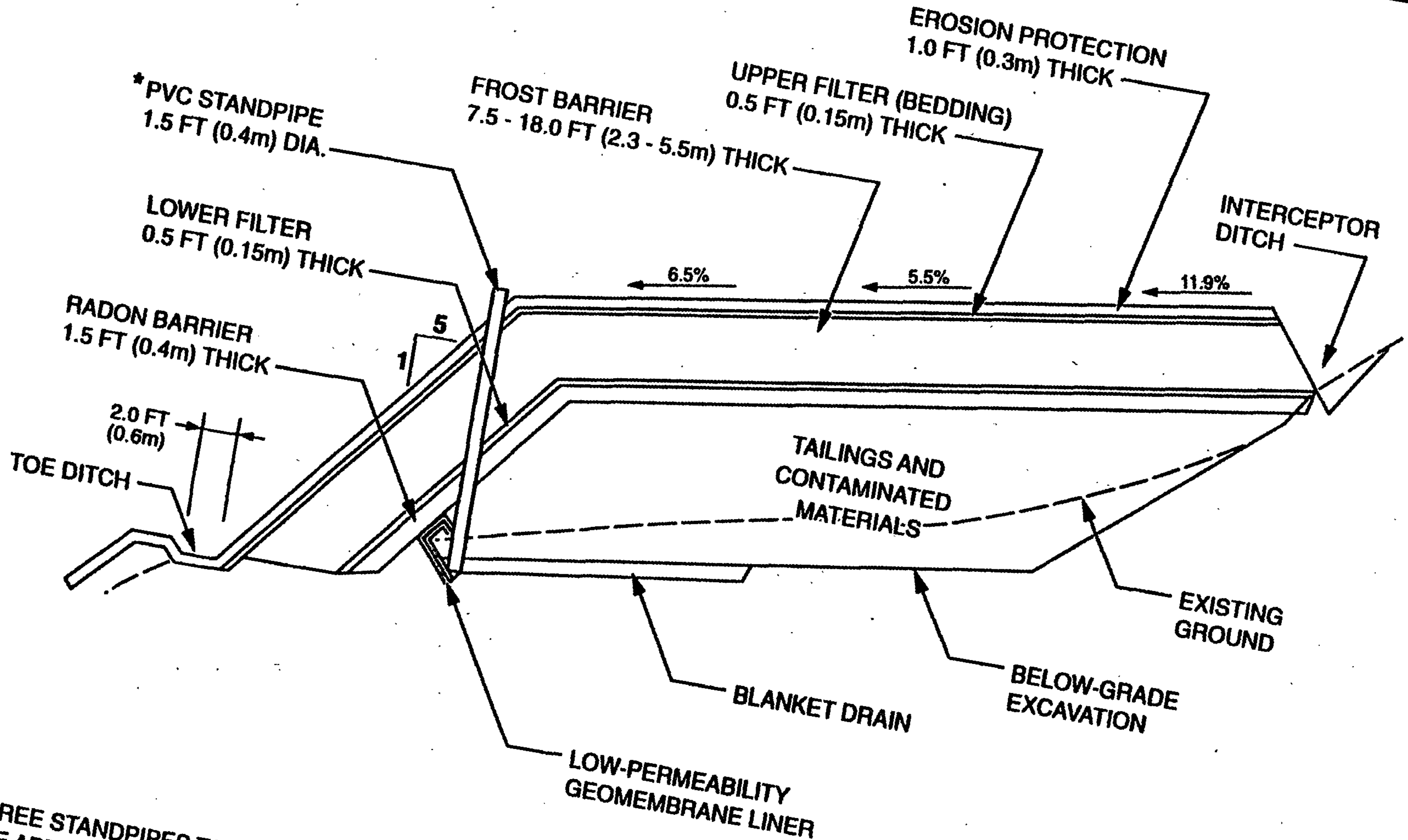
debris flows, mud flows, and rock falls. The geomorphic processes posing a potential hazard to the stabilized disposal cell are ephemeral drainage channel changes, low-gradient slope erosion, and wind erosion; however, these processes are not reasonably expected to affect the disposal cell within the next 1000 years, or in any case for at least 200 years.

The disposal cell is constructed partially below grade. The disposal cell is located on a hillside and generally follows the same slope. The highest elevation of the cell and that of the adjacent ground surface is about 6240 ft (1900 m) above National Geodetic Vertical Datum (NGVD). From this location the cell slopes at 11.9 percent to an elevation of 6160 ft (1880 m) NGVD, where the grade changes to 5.5 percent. At this point, the surface of the cell is about 3 ft (0.9 m) above the adjacent ground surface. After the slope reaches an elevation of 6107 ft (1860 m) NGVD, the slope changes to a grade of 6.5 percent. At this point the cell surface is about 17 ft (6 m) above the adjacent ground surface. There is a major grade break at elevation 6087.2 ft (1855.4 m) NGVD, where the cell surface is about 30 ft (9 m) above the adjacent ground surface. At this point the slope continues at 20 percent to the toe of the cell.

The disposal cell contains approximately 3.7 million yds^3 (2.8 million m^3) of relocated tailings and other residual radioactive materials, primarily contaminated soils and demolition debris. The disposal cell is capped with a multiple-component cover (Figure 2.3).

A 1.5-ft (0.45-m)-thick radon/infiltration barrier is placed over the contaminated materials. The radon barrier is constructed of two layers: a 0.5-ft (0.15-m) compacted clay layer and a 1-ft (0.3-m) layer of bentonite-amended clay. The barrier is designed to reduce the radon-222 flux from the disposal cell to less than 20 picocuries per square meter per second and minimize water infiltration into the tailings. Over much of the radon/infiltration barrier an additional 0.5- to 0.7-ft (0.1- to 0.2-m) layer was placed to prevent drying. A 0.5-ft (0.15-m)-thick coarse-grained filter layer is placed on top of the radon/infiltration barrier to provide a capillary break and promote drainage of infiltrating water away from the radon barrier. A layer of compacted soil lies on top of the filter layer to insulate the radon/infiltration barrier and keep it from being adversely affected by freeze-thaw cycles. The typical thickness of this layer is 7.5 ft (2.3 m), and it has a maximum thickness of 18 ft (5.5 m) where the cell joins the natural slope. The topslopes and sideslopes of the disposal cell are capped with rock (riprap) to protect against wind and water erosion and prevent damage to the underlying frost protection and radon/infiltration layers.

The erosion-protection layer is 1-ft (0.3-m) thick. A 0.5-ft (0.15-m)-thick bedding layer is beneath the erosion-protection layer to prevent damage to the underlying frost protection layer from rocks and soil loss from runoff water. These grades, in conjunction with the bedding layer, will allow excess surface water to run off the disposal cell and be conveyed to adjacent site grades, thereby minimizing the risk of significant erosion. The components of both the



* THREE STANDPIPES TO BE REMOVED.
SEE APPENDIX A.

MAC: SITE/RFL/LTSP/XSECESTES

FIGURE 2.3
COVER CROSS SECTION TYPICAL THICKNESS
ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

SCHEMATIC - NOT TO SCALE

topslope and sideslope covers are intended to minimize the potential for deep percolation of precipitation into the residual radioactive material. A riprap apron and toe ditch at the toe of the disposal cell carry water away from the cell and provide erosion protection from gullying. An unlined interceptor ditch abuts the upslope portion of the disposal cell to divert surface flow away from the cell.

Detailed engineering drawings of the disposal cell are in the site completion report (DOE, 1997).

During design and analysis of the Rifle disposal cell in 1990 and 1991, the UMTRA Project team and the NRC were concerned that transient drainage and surface infiltration might collect near the toe of the cell and build up excessively. If tailings drainage water built up above the rim of the excavation, a surface expression (i.e., seep) along the south slope of the disposal cell could inadvertently allow radionuclides to escape. It was concluded in the RAP that to prevent a surface expression (i.e., seep) a temporary high density polyethylene (HDPE) liner would be constructed inside the toe of the disposal cell, and that a temporary leachate collection system would be constructed. The HDPE liner and a leachate collection system (standpipes), consisting of three 18-inch (46 cm)-diameter monitor wells and a granular under-drain layer beneath the tailings (see MK-F Rifle site construction drawings RFL-DS-10-0724, RFL-DS-10-0731, and RFL-DS-10-0732).

Monitoring and analysis of the standpipes will be required under the Long-Term Surveillance Program until it is determined that after review by the State and approval by NRC the standpipes can be decommissioned. The operation and contingency plan for monitoring well closure (see appendix) contains detailed requirements for monitoring the water level in the standpipes and analyzing the data to determine when the standpipes can be decommissioned.

Several phases of permeability testing of the Wasatch Formation bedrock at the Estes Gulch disposal site have been conducted. These include field studies by the Technical Assistance Contractor (TAC), Morrison Knudsen-Ferguson Environmental Services with support by Morrison Knudson-Ferguson, and Daniel B. Stephens & Associates. Laboratory permeability testing was conducted by the University of Arizona, Lambert and Associates, and Herzog Associates. A summary of testing results is presented below.

The TAC estimated a mean hydraulic conductivity of 7×10^{-10} cm per second for the saturated deep Wasatch Formation using water level recovery data (Calculation RFL09-89-14-02-9). However, hydrostatic equilibrium in these wells, which varied in depth from 300 to 440 ft (91 to 134 m), was never achieved.

To improve sandstone and siltstone permeability estimates in the extreme upper Wasatch Formation at the bottom of the disposal cell excavation, a number of short-, intermediate-, and long-term infiltrometer tests were conducted in 1992

and 1993. This testing defined the saturated vertical permeability of sandstones at the low portion of the disposal cell and the saturated vertical permeability of siltstone in the cell foundation. The sandstone's geometric mean permeability was found to be 4×10^{-7} cm per second. The geometric mean permeability of the siltstone was determined to be 7×10^{-8} cm per second.

2.5 GROUND WATER CHARACTERIZATION

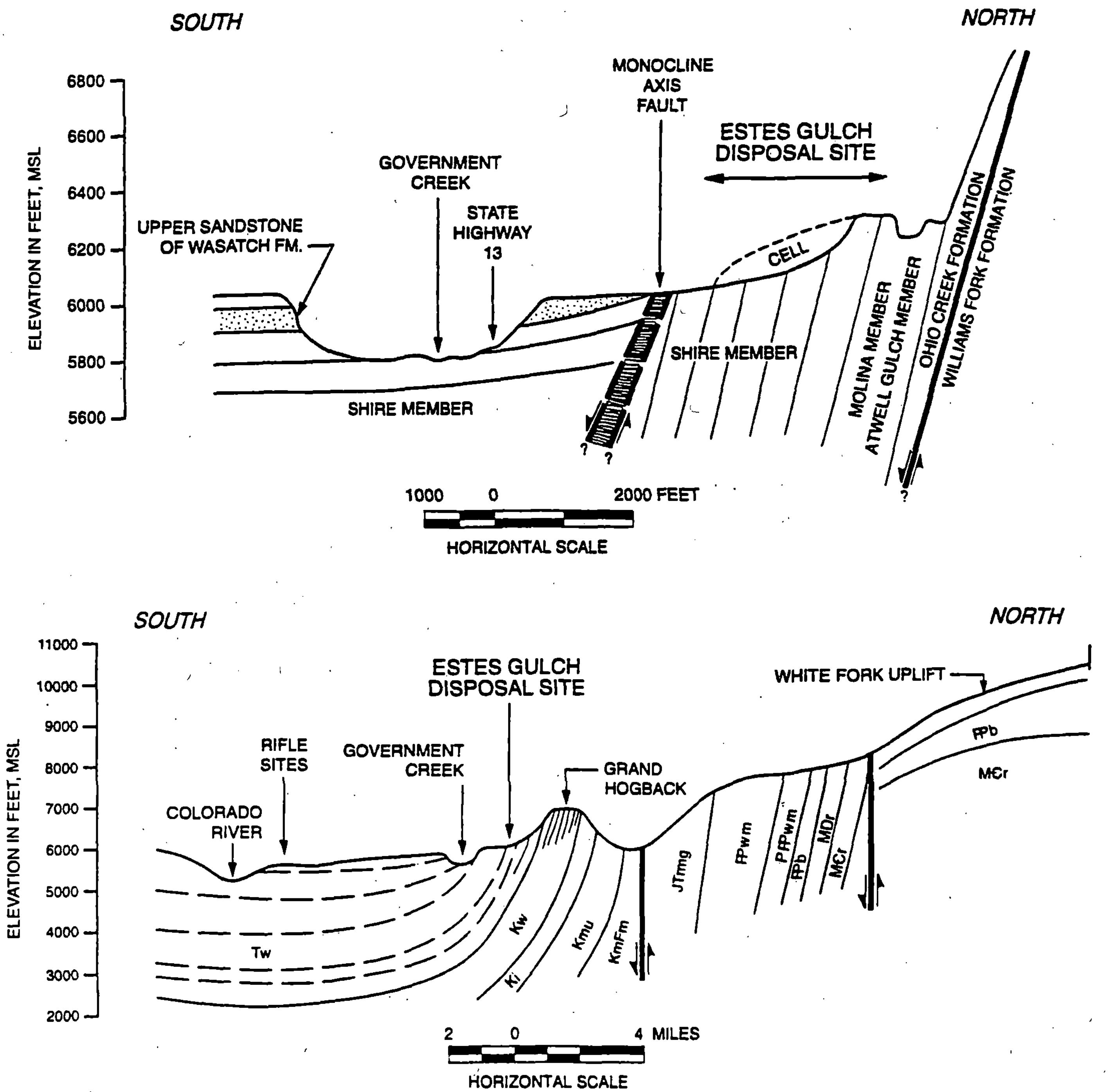
This section briefly describes the hydrogeologic units and background ground water quality at the Estes Gulch disposal site and identifies the constituents of concern at the site. More detail on ground water characterization of the site is found in the Rifle RAP (DOE, 1992a). The justification for no ground water monitoring is provided in Section 2.6.

2.5.1 Hydrogeology

The hydrogeology of the Estes Gulch disposal site was characterized during preparation of the RAP (DOE, 1992a). The Estes Gulch disposal site is underlain by the Wasatch Formation, which consists of approximately 5000 ft (1525 m) of siltstones, shales, and fine-grained sandstones Figure 2.4. The Mesaverde Group (Ohio Creek and William's Fork Formations) underlies the Wasatch Formation, and is the uppermost useable aquifer beneath the disposal cell. The Williams Fork Formation of the Mesaverde Group is approximately 4500 ft (1370 m) thick, and consists of light-brown to white sandstones, gray to black shale, and coal beds (Tweto et al., 1978). The resistant beds of the formation comprise the Grand Hogback north of the disposal site. The thin Ohio Creek Formation is considered by some to be the uppermost member of the Mesaverde Group (and Williams Fork Formation). However, the kaolinitic sandstone Ohio Creek unit is less than 100 ft (30 m) thick near Estes Gulch and is not known to be a regional aquifer. Near the Estes Gulch disposal site, the Ohio Creek unit contains a high percentage of clay and appears to be quite impermeable.

Exploratory drilling conducted during characterization of the Estes Gulch disposal site encountered several faults paralleling the bedding planes and occurring randomly in the steeply-dipping strata beneath the site. Exploratory drilling shows that these faults are filled with clay gouge having a hydraulic conductivity of approximately 1×10^{-9} cm per second. Therefore the faults do not appear to be a significant ground water transport pathway. Closely spaced fractures sometimes occur near these minor faults, becoming widely spaced within a few feet of the faults.

The Wasatch Formation is generally an aquitard, and does not contain significant quantities of ground water (Wright Water Engineers, 1979; Giles, 1980; Coffin et al., 1968, 1971). The limited ground water in the Wasatch Formation beneath the site flows primarily through fractures and joints in the siltstone and sandstone beds. Localized recharge to the bedrock occurs through weathered zones and fractures, and in areas where more permeable beds crop out at the surface. Recharge percolates down to limited zones of saturation,



LEGEND

Tw	WASATCH FORMATION	PPwm	WEBER SANDSTONE AND MAROON FORMATION
Kw	WILLIAMS FORK FORMATION, MESAVERDE GROUP	PPm	MINTURN FORMATION
Ki	ILES FORMATION, MESAVERDE GROUP	PPb	BELDEN FORMATION
Kmu	UPPER UNIT OF MANCOS SHALE	MDr	MISSISSIPPIAN AND DEVONIAN ROCKS
KmFm	FRONTIER SANDSTONE AND MOWRY SHALE MEMBER OF MANCOS SHALE	MЄr	MISSISSIPPIAN AND CAMBRIAN ROCKS
JTmrg	MORRISON, ENTRADA, AND GLEN CANYON FORMATIONS		FAULT/FRACTURE ZONE

FIGURE 2.4
GEOLOGIC CROSS SECTIONS, ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

AC: SITE/RFL/LTSP/GEOXSECS-ESTES

then ground water generally flows slowly along the strike and down dip of the nearly vertical beds. Because ground water saturation is localized and because ground water levels appear to be approaching hydrostatic equilibrium within completed wells, the potentiometric surface and potentiometric gradient cannot be accurately defined in the disposal cell vicinity.

The DOE installed a total of 13 monitor wells at the Estes Gulch disposal site prior to disposal cell construction (Table 2.2). In 1986, the DOE installed 10 monitor wells at the Estes Gulch site. The wells ranged from 60 to 301 ft (18 to 92 m) deep. Nine of the wells are dry and one found ground water. Water was encountered in the deepest well (well 963) at a depth of 270 ft (82 m) below ground surface. The water level then slowly rose to a depth of 150 ft (46 m) below ground surface when last measured. In 1988, the DOE installed three additional wells (wells 701, 702, and 703) completed to depths of 500 to 545 ft (150 to 165 m). These three wells showed little or no water at completion; however, water levels rose in these wells following completion until 1990. When last measured in March 1992, ground water levels ranged from 274 to 434 ft (84 to 132 m) below ground surface in the three wells (Figure 2.5).

Ground water levels in two of the four wells that produced water appeared to reach hydrostatic equilibrium during the 6-year sampling period, reflecting the very low permeability of the bedrock beneath the disposal site. After periods of more than 4 years, water level elevations differed by 130 ft (40 m) or more between completed wells and showed no defined piezometric surface. All wells at the Estes Gulch site will be abandoned in accordance with state ground water protection laws at the earliest practicable date after the site is licensed for long-term custody.

These 13 wells are no longer sampled and are not point of compliance (POC) wells. All monitor wells will be abandoned and ground water monitoring will not occur. Nine of the monitor wells were either dry or produced too little water (less than 1 gallon [gal] or 3.8 liter [L]) to sample properly. Four of the deep wells (963, 701, 702, and 703) produced sufficient water for sampling. Ground water quality sampling of these wells was conducted at the Estes Gulch disposal site from 1986 through 1992.

2.5.2 Background ground water quality

The pH values in ground water sampled from monitor wells completed in the Wasatch Formation beneath the site range from 7.3 to 12.8. Although it is known that well 964 is grout-contaminated, samples from three of the four wells also may be cement-grout contaminated, with pH values ranging from 10.9 to 12.8. However, it is also possible that this pH is natural (DOE, 1992a).

Water levels did not reach hydrostatic equilbrium during the 4-year sampling period, reflecting the very low permeability of the bedrock beneath the disposal

Table 2.2 Completion intervals and ground water levels in monitor wells, Estes Gulch site near Rifle, Colorado

Monitor well number[a]	Ground level elevation	Completion interval (depth in ft)[b]	Date	Ground water level (ft above mean sea level)
952	6257.6	245.75 to 250.75	01/14/86	Dry
955	6013.8	55.00 to 60.00	01/14/86	Dry
			10/20/87	Dry
956	5995.2	58.00 to 73.00	01/14/86	Dry
			10/20/87	Dry
958[c]	6024.7	106.40 to 116.40	01/14/86	Dry
			10/20/87	Dry
959	6016.3	97.35 to 102.25	01/14/86	Dry
			10/20/87	Dry
962[c]	6061.1	67.25 to 72.25	01/14/86	Dry
			10/20/87	Dry
963[c]	6043.8	296.0 to 301.0	01/14/86	5773.55[d]
			10/20/87	5860.75[d]
964[c]	6046.4	212.50 to 217.50	01/14/86	Dry
			10/20/87	Dry
965	5987.0	97.25 to 102.75	01/14/86	Dry
			10/20/87	Dry
969	6003.8	97.50 to 102.50	01/14/86	Dry
			10/20/87	Dry
701	5979.0	180 to 545	07/28/88	5455
			12/10/88	5581.81
			03/24/89	5640.50
			3/8/90	5710.10
			3/19/92	5705.48
702	6008.0	355 to 543	07/28/88	5521
			12/10/88	5519.91
			03/24/89	5529.55
			3/8/90	5542.38
			3/19/92	5573.60
703	6006.0	420 to 502	07/28/88	5516
			12/10/88	5553.52
			03/24/89	5580.80
			3/8/90	5634.57
			3/19/92	5630.64

[a]Monitor well locations are shown on Figure 2.5. All are RFL-08-0XXX.
[b]All monitor wells are completed in the Wasatch Formation and have casing diameters of 4 inches.
[c]Decommissioned May 1997
[d]The depth from the land surface to ground water in monitor well 963 was 270.2 ft on 01/14/86 and 183 ft on 10/20/87.

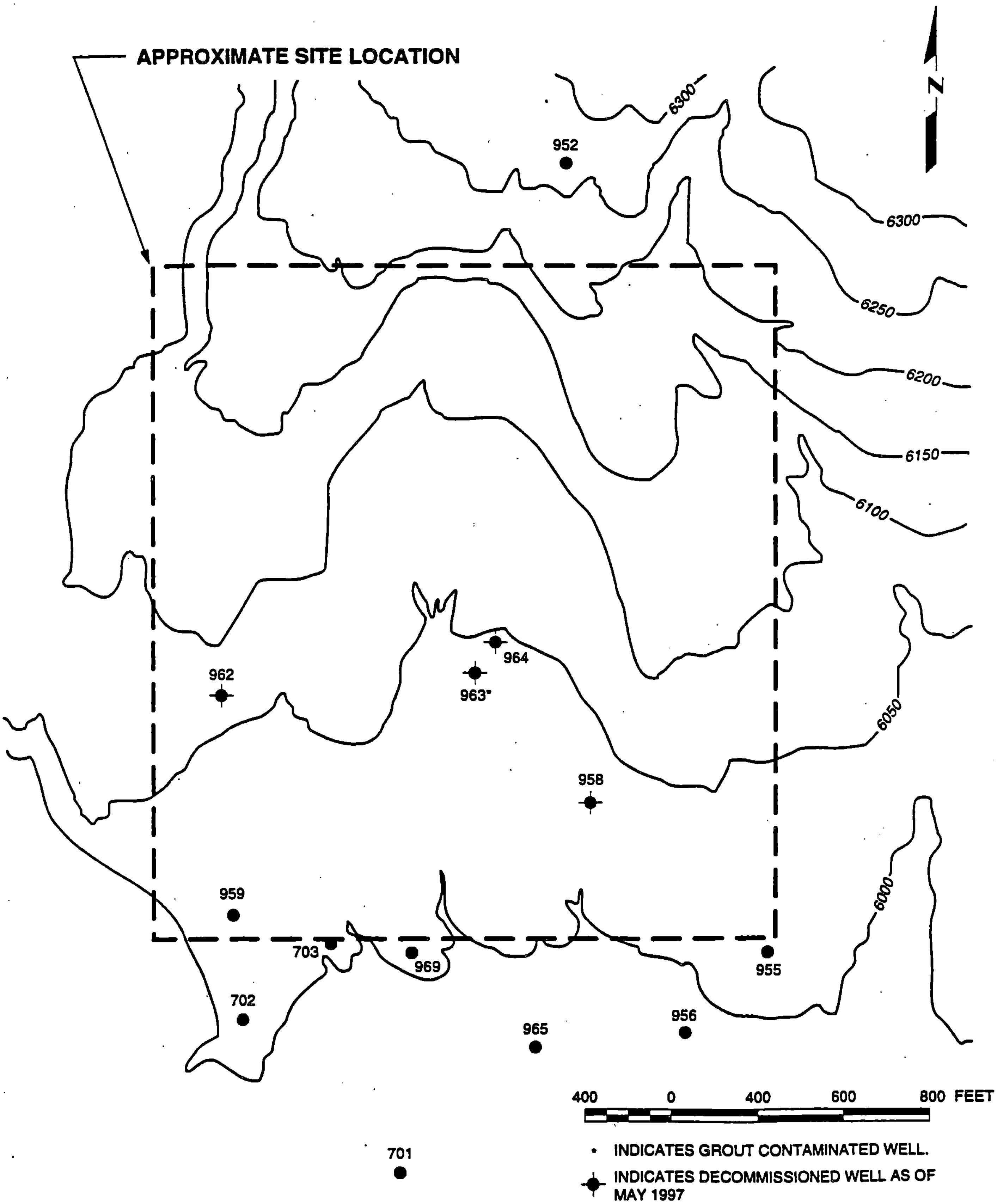


FIGURE 2.5
MONITOR WELL LOCATIONS
ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

MAC: SITE/RFL/LTSP/MONWELL

site. In wells 963, 701, 702, and 703 water levels slowly increased over periods of more than 2 years, reflecting slow recharge to the wells from ground water. However, even after periods of more than two years, water level elevations differed by 75 ft (23 m) or more between completed wells and showed no clear piezometric surface (Table 2.3).

Thus background water quality is difficult to characterize for the Wasatch Formation because the wells recharged slowly, grout could possibly contaminate three wells, and the chemistry of water sampled from all wells varied with changes in water levels. This variance is especially true of trace metals such as selenium, cadmium, and radium, which were at high levels (greater than maximum concentration limits [MCL]) during the first sampling rounds, but which decreased to levels below detection or MCLs as water levels in the wells increased.

Well 963, which has a 5-ft (1.5-m) screened interval, produced very little water and water quality varied from one sampling round to the next. This, in conjunction with evidence for grout contamination, indicates that samples from this well may not reflect ground water quality in the Wasatch. By contrast, major element concentrations were relatively constant during the entire 4-year sampling period for wells 701, 702, and 703. These three wells screen large intervals of the Wasatch Formation. Thus the chemistry of ground water from these three wells likely is typical of Wasatch Formation ground water beneath the site.

In wells 701, 702, and 703, the average total dissolved solids (TDS) concentrations were 20,300; 20,400; and 10,900 milligrams (mg) per liter respectively. In these three wells, the high TDS is due primarily to high levels of sodium chloride in the ground water.

Median levels of barium exceeded the U.S. Environmental Protection Agency (EPA) MCL in wells 701, 702, and 703 and tended to increase as water levels in the wells increased. Median levels of selenium exceeded the EPA MCL in the same three wells, though over the sampling period, concentrations decreased to levels less than the MCL. Cadmium and lead slightly exceeded the EPA MCLs in a few samples from the three wells, though median concentrations were below the MCL. Median levels of chromium and molybdenum exceeded the EPA MCL (0.1 mg per liter) in wells 702 and 703. The average combined radium-226 and -228 for samples from well 701 slightly exceeded the UMTRA MCL (5 picocuries [pCi] per liter). Based on these data, ground water in the Wasatch Formation beneath the disposal cell is of limited use and is not a potential source of drinking water because it contains more than 10,000 mg per liter TDS and because ambient levels of barium, cadmium, chromium, lead, molybdenum, selenium, and combined radium-226 and -228 have exceeded EPA MCLs (40 CFR Part 192).

Table 2.3 Summary of background water quality at the Estes Gulch disposal site near Rifle, Colorado

Parameter	MCL	No. of samples	No. of nondetects	Median	Maximum
Barium	1	5	0	1.05	2
Cadmium	0.01	5	2	0.005	0.011
Chromium	0.05	5	0	0.07	0.99
Lead	0.05	5	2	0.015	0.04
Molybdenum	0.1	5	0	0.24	1.26
Total Radium	5	5	0	3	3.9
Selenium	0.01	5	2	0.029	0.212
Total dissolved solids	NA	5	0	11900	12900

MCL - maximum concentration limit.
NA - not applicable.
Notes: 1. Based on data collected from wells 701, 702, and 703 during the time period 1988 to 1992.
2. All values reported in units of milligrams per liter, except for radium -226 + radium -228, which is reported in picocuries per liter.

2.5.3 Hazardous constituents

Analyses of tailings and tailings solutions, tailings leachates (Markos and Bush, 1983), and ground water samples from both the Old and New Rifle sites (DOE, 1990; TAC, 1996) were evaluated for hazardous constituents generally expected to be in or derived from the residual radioactive materials related to the uranium processing activities. After evaluating these existing data, the DOE identified the following hazardous constituents as associated with the tailings source term:

- alpha-BHC
- antimony
- arsenic
- barium
- benzo[a]anthracene
- benzo[a]pyrene
- beryllium
- cadmium
- chromium
- chrysene
- cobalt
- copper
- diethyl phthalate
- di-n-octylphthalate
- fluoranthene
- fluoride
- indeno(1,2,3-cd)pyrene
- methyl ethyl ketone
- lead
- molybdenum
- net gross alpha
- nickel
- nitrate
- pyrene
- radium-226 and -228
- selenium
- silver
- strontium
- tin
- toluene
- vanadium
- uranium
- zinc
- 2,4-D
- 2,4,5-T
- 2,4,5-TP (Silvex)

2.6 GROUND WATER PROTECTION

The ability of the disposal cell to meet ground water protection requirements depends on the following:

1. The multicomponent disposal cell cover will limit the amount of precipitation that infiltrates the cell, thereby minimizing long-term leaching of hazardous components from the tailings.

2. Wasatch Formation ground water quality beneath the Estes Gulch disposal site has been determined to have the characteristics of limited use (40 CFR §192.11(e)(1)).

3. The Estes Gulch disposal site is geologically isolated from the uppermost useable aquifer by 3800 ft (1160 m) or more of low-permeability siltstones, shales, and sandstones of the Wasatch Formation, which dips toward and beneath the Colorado River.

The DOE evaluated the need for ground water monitoring at the Estes Gulch disposal site in accordance with the licensing regulations in 10 CFR §40.27(b)(2); the ground water protection standards in 40 CFR Part 192, Subparts A and C; and the DOE's long-term surveillance program guidance (DOE, 1996a). POC monitoring is not required for the long-term surveillance program of the Estes Gulch disposal site.

Ground water monitoring of the uppermost aquifer at the Estes Gulch disposal cell is not required. Postclosure ground water monitoring will not be conducted in the Wasatch siltstone and sandstone aquifer beneath the site due to the limited use designation of ground water in the Wasatch Formation and due to the Wasatch Formation's considerable thickness (projected to be 3800 ft (1160 m) (40 CFR §192.11(e)(1)). Limited use ground water is ground water that is neither a current nor a potential source of drinking water because 1) the TDS concentration exceeds 10,000 mg per liter; 2) the existing widespread ambient contamination is unrelated to processing activities, and the contamination cannot be cleaned up using treatment methods reasonably employed in public water supply systems; or 3) the quantity of water available is less than 150 gal (570 L) per day.

3.0 SITE INSPECTIONS

The DOE will inspect of the Estes Gulch disposal site to detect progressive changes caused by slow-acting natural processes and to identify potential problems before there is a need for extensive maintenance, repairs, or corrective action. Inspections may also be conducted to follow up on events or conditions that have affected or potentially could affect the disposal site. The DOE will compare the findings from these inspections to initial baseline conditions to identify changes over time and to provide a basis for future inspections, repairs, and corrective actions. This process is shown in Figure 3.1.

Custodial maintenance or repair is discussed in Section 4.0. The corrective action process is outlined in Section 5.0.

3.1 INSPECTION FREQUENCY

The DOE will inspect the Estes Gulch disposal site annually. The DOE may schedule more frequent inspections if necessary. The DOE will notify the NRC of the inspection schedule.

3.2 INSPECTION TEAM

The inspection team will consist of a minimum of two inspectors qualified to inspect disposal cell integrity and make preliminary assessments of modifying processes that could adversely affect the disposal cell.

If problems are observed that require more investigation, follow-up inspections will be performed and teams will include one or more technical specialists in appropriate disciplines to assess the problems under investigation. For example, a follow-up inspection by a plant specialist may be required to evaluate reports of significant plant growth on the rock cover, or a soils scientist or geomorphologist may be needed to evaluate erosion processes.

3.3 ANNUAL INSPECTION

Before inspections, inspectors will perform a preinspection briefing. The long-term surveillance program guidance (DOE, 1996a) contains information useful in preparing for inspections.

Site inspections will cover the disposal cell, the surrounding disposal site area, and the immediate off-site areas. Site inspections must be thorough enough to identify significant changes or active modifying processes that potentially could adversely affect the disposal cell: gully formation, slope erosion, changes to the rock cover, ephemeral drainage channel changes, and significant modifications by humans, animals, or plants.

Inspectors will measure and evaluate the leachate level in the monitor well leachate collection system (stand pipes) located on the 5 to 1 slope of the disposal cell.

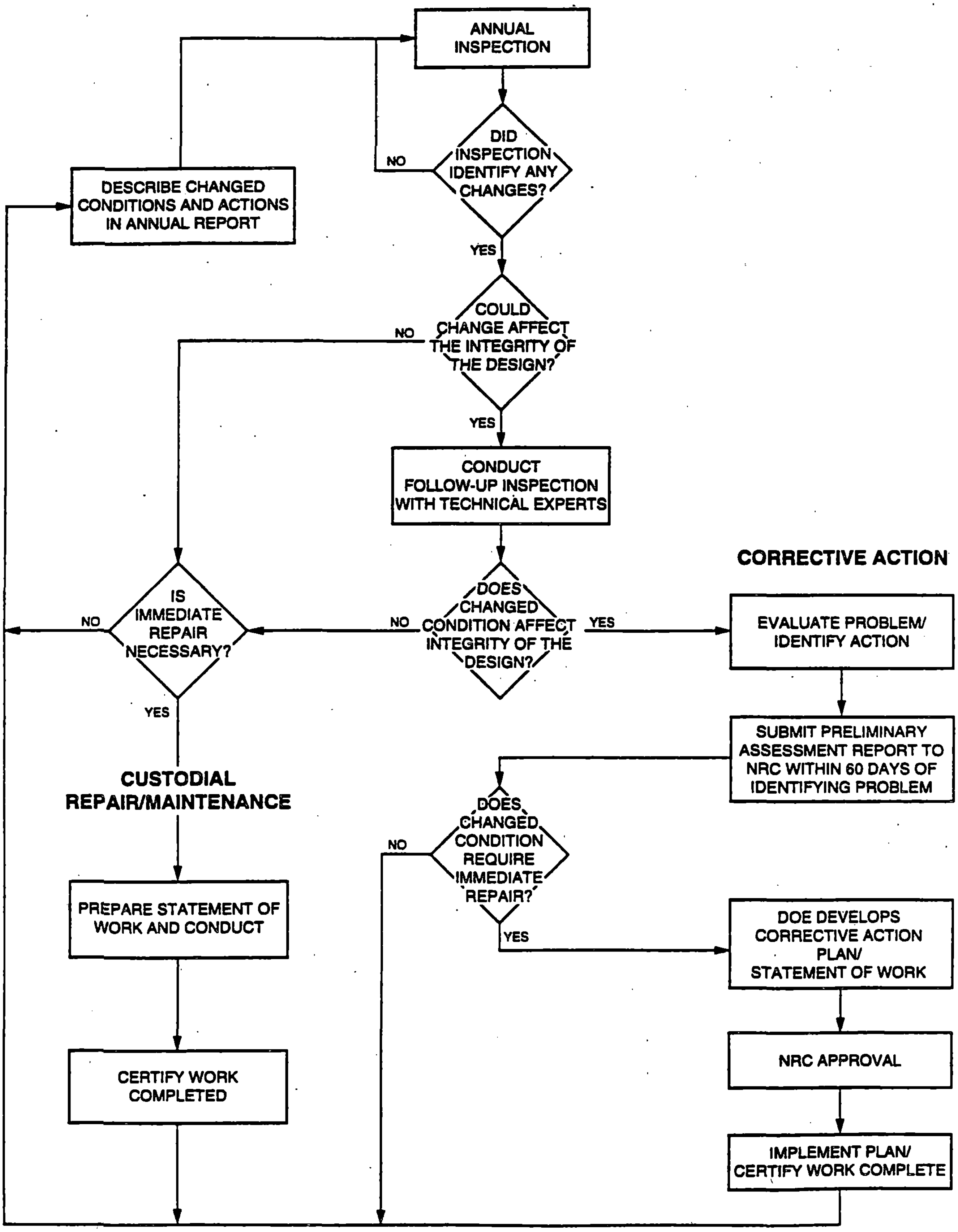


FIGURE 3.1
STEPS FOR FOLLOW-UP INSPECTIONS, CUSTODIAL MAINTENANCE, AND CORRECTIVE ACTION AT THE ESTES GULCH DISPOSAL SITE NEAR RIFLE, COLORADO

MAC: SITE/RFL/LTSP/STEPS2A

Monitoring, corrective action, and closure of these wells will be performed in compliance with the plan as provided in the operation and contingency plan (see appendix).

Inspectors will evaluate the integrity of the disposal cell by walking a series of transects around the perimeter and over the rock cover. Sufficient transects, at approximately 150-ft (46-m) intervals, must be walked so that the disposal cell is thoroughly covered and inspected. Diagonal transects of the topslopes will be made and the crest line will be walked. Additional transects will be walked along the sideslopes and rock apron. Transects along the entire length of the diversion ditch will be made to determine whether it is functioning as designed and can be expected to continue to function properly. Inspectors will make efforts to vary the path of transects from one inspection to the next to ensure small anomalies are not overlooked. The sample inspection checklist in the LTSP guidance document lists items that should be examined during inspections (DOE, 1996a).

The disposal cell has a rock cover and there is no planned vegetation on the disposal cell. However, remedial action of the areas surrounding the disposal cell included revegetation with grasses and sage brush. The area surrounding the disposal cell will be monitored to determine the success of the revegetation efforts. Inspectors also will inspect this area for evidence of erosion caused by wind, sheet wash, or changes in drainage patterns.

Site inspectors also will monitor damage to or disturbance of permanent site-surveillance features, ground water monitor wells (until they are decommissioned), fencing, locks, and the gate.

From inside the disposal site, inspectors will visually survey the area approximately 0.25 mi (0.40 km) outside the disposal site boundary for evidence of land-use changes that indicate increased human activity, such as land development or new roads and paths. Inspectors will note the condition of and changes to site access roads, surrounding vegetation, and relevant geomorphic features like gullies or ephemeral drainage channels; potential impacts to the site will be noted. Off-site DOE monitor wells will be inspected until they are properly decommissioned.

3.4 FOLLOW-UP INSPECTIONS

In addition to annual inspections, DOE may conduct follow-up inspections due to unusual or annual inspection findings or observations. DOE also may conduct follow-up inspections to investigate and quantify specific problems found during a previous inspection, other DOE-initiated activity, or confirmed reports of vandalism, intrusion, damage, unusual occurrences, or other significant threats to the disposal site. The DOE will monitor the disposal cell area for the occurrence of extreme natural events (e.g., earthquakes, tornadoes, floods) and vandalism to ensure such events are investigated in a timely manner to assess their effects on the disposal cell. To facilitate this, the DOE has requested notification from federal, state, and local agencies of discoveries or reports of any purposeful intrusion or damage at the disposal site as well as in the disposal site area.

Notification agreements with the Garfield County Sheriff's Office and the U.S. Geological Survey's National Earthquake Information Center are included in Attachment 2. The DOE will also monitor the weather for the occurrence of severe storms in the disposal cell vicinity. In addition, the DOE 24-hour telephone number is posted on the site entrance sign so the public can notify the DOE if problems are discovered. If an extreme natural event or vandalism has occurred, the DOE will inspect the cell to assess the damage. The notification, response, and follow-up activities will be documented. This documentation will be included in the annual site report to the NRC and become part of the permanent site file.

The nature of the occurrence and the amount of firsthand knowledge available will determine the DOE's response. If a situation is a threat to the public, the DOE will notify individuals who may be affected and appropriate federal, state, and local agencies, including the NRC. If necessary, the DOE will schedule a follow-up inspection to assess potential effects from the unusual occurrence, and will take necessary response action. Follow-up inspections will be conducted to determine whether processes currently active at or near the site threaten site security or stability and to evaluate the need for custodial maintenance, repair, or other corrective action. The scope of these follow-up inspections may be broad and similar in nature to routine site inspections or focused on specific areas of concern.

During the follow-up inspection, inspectors and technical specialists will investigate reported problems to determine whether the disposal cell has been damaged or threatened. The DOE will conduct additional site visits, if necessary to acquire data or plan maintenance and repairs.

3.5 QUALITY ASSURANCE

The DOE has developed and implemented a quality assurance plan (QA) (DOE, 1996d) for the site inspection program that meets the requirements of DOE Order 5700.6C. Site inspections will be conducted in accordance with this QA plan.

4.0 CUSTODIAL MAINTENANCE AND REPAIR

The DOE does not plan to conduct routine maintenance at the Estes Gulch disposal site. However, the DOE will perform needed custodial maintenance or repair as determined from site inspections.

Unscheduled custodial maintenance or repair required at the Estes Gulch disposal site may include the following:

- Repairing or replacing deteriorated or vandalized warning signs, fencing, gate, and locks.
- Removal of deep-rooted plants determined to be a threat to the integrity of the cover.
- Reseeding areas surrounding the disposal cell.

After the work is completed, and before the contractors are released, DOE will verify that work was performed according to specification. The annual report to the NRC will document repairs that are performed. Copies of records, reports, and certifications will be included in the permanent site file.

5.0 CORRECTIVE ACTION

Corrective action is repairs that are needed to address problems that affect the integrity of the disposal cell or compliance with 40 CFR Part 192. The NRC must approve the recommended action in advance.

Site inspections are designed to identify problems at the developmental stage. The following theoretical conditions are examples that might trigger corrective action:

- Surface rupture or subsidence of the disposal cell.
- Development of rills, gullies, or slope instability on the disposal cell.
- Deterioration of the erosion-protection rock on the disposal cell.
- Tailings fluid originating from the disposal cell.
- Gully development on or immediately adjacent to disposal site property that could affect the integrity of the disposal cell.
- Damage to the cell cover or disposal site property from natural catastrophic events or vandalism.
- Damage to the disposal cell cover from deep-rooted plant growth.

The DOE will evaluate the factors that caused the problem and identify actions to mitigate the impact and prevent recurrence. An on-site inspection or preliminary assessment will include, but is not limited to, the following:

- Identifying the nature and extent of the problem.
- Reevaluating germane engineering design parameters.

When a potential problem is identified, the DOE will submit a preliminary assessment report to the NRC for review no more than 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). If the problem requires immediate repair, the DOE will develop a corrective action plan for NRC approval. Once the NRC approves the corrective action, the DOE will implement the plan. In some cases, corrective action could include temporary emergency measures instituted prior to the completion of the normal approval process. If the problem does not require immediate repair, the problem will be documented in the annual report and assessed at the next annual inspection.

NRC regulations do not stipulate a time frame for implementing corrective action (except the finding of an exceedance in established ground water concentration limits, which does not apply to this site). The DOE does not consider assessing the extent of a problem and developing a corrective action plan to be initiation of the corrective action program.

In addition to the preliminary assessment report, the DOE may (as appropriate) prepare a progress report on corrective actions while they are under way or under evaluation.

After corrective action is complete, the DOE will certify work and submit a certification statement and supporting documentation to the NRC for review and concurrence. A copy of the certification statement will become part of the permanent site file, as will reports, data, and documentation generated during the corrective action.

6.0 RECORD KEEPING AND REPORTING

6.1 PERMANENT SITE FILE

The DOE will maintain a permanent site file containing site inspection reports and other supporting documentation of long-term surveillance program activities. The information placed in the site file will include:

- Documentation of disposal site performance.
- Demonstration that licensing provisions were met.
- Information needed to forecast future site-surveillance and monitoring needs.
- Reports to stakeholders regarding disposal cell integrity.

After the site is brought under the general license, the DOE will compile copies of site documentation required by the long-term surveillance program guidance for the disposal site permanent site file (DOE, 1996a). Copies of all deeds, custody agreements, and other property documents will be kept in this file.

The DOE will maintain the surveillance and maintenance documentation identified in other sections of this LTSP; it will become part of the permanent site file. The DOE will update the site file as necessary after disposal site inspections, maintenance activities, or corrective actions are complete. These records will be handled in accordance with DOE directives to ensure their proper handling, maintenance, and disposition. The archival procedures set forth in 41 CFR Part 101 and 36 CFR Parts 1220-1238, Subchapter B, will be followed. The permanent site file information will be available for NRC and public review.

6.2 INSPECTION REPORTS/ANNUAL REPORTS

During site inspections, activities and observations will be recorded and described using site inspection checklists, maps, photographs and photo logs, and field notes. Documentary evidence of anomalous, new, or unexpected conditions or situations must describe developing trends and enable the DOE to make decisions concerning follow-up inspections, custodial maintenance, and corrective action. This information will be contained in the permanent site file at the DOE office. The DOE will prepare a site inspection report documenting the findings and recommendations from field inspections.

Site inspection reports will be submitted to the NRC within 90 days of the annual site inspection. Inspection reports will summarize the results of follow-up inspections and maintenance completed since the previous annual site inspection.

If unusual damage or disruption is discovered at the disposal site during an inspection, a preliminary report assessing the impact must be submitted to the NRC within 60 days. If maintenance, repair, or corrective action is warranted, the DOE will notify the NRC. The NRC will receive a copy of corrective action

plans and corrective action progress reports, or the reports will be attached to the annual report.

The DOE also will provide copies of inspection reports and other generated under the long-term surveillance program to the state of Colorado as required in their cooperative agreement.

7.0 REFERENCES

Coffin et al. (D. L. Coffin, F. A. Welder, and R. K. Glanzman), 1971. *Geohydrology of the Piceance Creek Basin Between the White and Colorado Rivers, Northwestern Colorado*, U.S. Geological Survey Hydrologic Investigations Atlas HA-370, U.S. Geological Survey.

Coffin et al. (D. L. Coffin, F. A. Welder, and R. K. Glanzman), 1968. *Geohydrologic Data From the Piceance Creek Basin Between the White and Colorado Rivers, Northwestern Colorado*, U.S. Geological Survey Circular 12, Ground-Water Series, prepared by the U.S. Geological Survey in cooperation with the Colorado Water Conservation Board, Denver, Colorado.

DOE (U.S. Department of Energy), 1997. *Rifle, Colorado, Final Completion Report*, prepared for the U.S. Department of Energy by Morrison Knudsen Corporation, Albuquerque, New Mexico.

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

DOE (U.S. Department of Energy), 1996b. *Uranium Mill Tailings Remedial Action Project (UMTRAP), Rifle, Colorado, Long-Term Surveillance Plan Subcontract Documents, Final Design for Review*, prepared for the U.S. Department of Energy by Morrison Knudsen Corporation, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1996c. *UMTRA Project Rifle, Colorado, Operation and Contingency Plan for Monitoring Well Closure, Estes Gulch Disposal Cell*, UMT-79635, prepared for the U.S. Department of Energy by Morrison Knudsen Corporation, San Francisco, California.

DOE (U.S. Department of Energy), 1996d. *Long-Term Surveillance and Maintenance Program, Quality Assurance Program Plan*, MAC-2152, Rev. 0, prepared by MACTEC Environmental Restoration Services, for the U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 1992a. *Remedial Action Plan for Stabilization of the Inactive Uranium Mill Tailings Site at Rifle, Colorado*, UMTRA-DOE/AL-050506.0000, prepared for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1990. *Final Environmental Impact Statement, Remedial Actions at the Former Union Carbide Corporation Uranium Mill Sites, Rifle, Garfield County, Colorado*, DOE/EIS-0132-F, prepared for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

Giles, T. F., 1980. *Reconnaissance of Groundwater Resources in the Vicinity of Gunnison and Crested Butte, West-Central Colorado*, USGS Open File Report 80-12, January.

Markos, G., and K. J. Bush, 1983. *Data for the Geochemical Investigation of UMTRAP Designated Sites at Rifle, Colorado*, prepared by Geochemistry and Environmental Chemistry Research, Inc., Rapid City, South Dakota, for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

MK-F (Morrison Knudsen-Ferguson), 1996. Meteorological tower data, December 1993 through August 1996, Estes Gulch site, Rifle, Colorado, UMTRA Project site, UPDCC File Location No. 6.15.5., Albuquerque, New Mexico.

TAC (Technical Assistance Contractor), 1996. Data package for February 1996 Rifle, Colorado, sample analysis, unpublished report prepared by the Technical Assistance Contractor, Albuquerque, New Mexico, for the U.S. Department of Energy, Albuquerque, New Mexico.

Tweto et al. (O. Tweto, R. H. Moench, and J. C. Reed, Jr.), 1978. Geologic map of the Leadville 1' x 2' quadrangle, northwestern Colorado, U.S. Geological Survey Miscellaneous Series, Map I-999, Washington, D.C.

Wright Water Engineers, 1979. Garfield County water resource map, prepared by Wright Water Engineers, Glenwood Springs, Garfield County, Colorado.

Yeend, W. E., 1969. *Quaternary Geology of the Grand and Battlement Mesas Area, Colorado*, U.S. Geological Survey, Professional Paper 617, Washington, D.C.

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*, National Archives and Records Administration.

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 5700.6C, *Quality Assurance*, 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

SITE REAL ESTATE INFORMATION

SITE REAL ESTATE INFORMATION

GENERAL

The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978, as amended, required the Secretary of Energy to permanently acquire lands needed to carry out the purposes of the UMTRCA (42 USC §7901 *et seq.*). The U.S. Department of Energy (DOE) located the Rifle, Colorado, disposal site on public land administered by the U.S. Department of the Interior's BLM.

JURISDICTIONAL TRANSFER OF THE DISPOSAL SITE

Under the authority vested in the Secretary of the Interior by the UMTRCA, the BLM transferred administration of approximately 205 acres (83 hectares) of public land in Garfield County, Colorado, to the DOE. Publication in the *Federal Register* (Vol. 56, No. 167, p. 42450, FR Doc. 91-20555) of Public Land Order (PLO) 6873 established the effective date of the transfer as 28 August 1991. As a result of this permanent transfer, the land is no longer subject to the operation of the general land laws, including mining and mineral leasing. The transfer vested in the DOE the full management, jurisdiction, and liability for the land and all activities conducted thereon.

LEGAL DESCRIPTION

The legal description contained in the PLO describes the disposal site area as follows:

> Township 5 South, Range 93 West, Sixth Principal Meridian.
> Section 11: S1/2 S1/2 SW1/4 SW1/4 SE1/4; Section 14: NW1/4 NW1/4 NE1/4, W1/2 SW1/4 NW1/4 NE1/4, W1/2 W1/2 SW1/4 NE1/4, E1/2 NE1/4 NW1/4, E1/2 NW1/4 NE1/4 NW1/4, SW1/4 NE1/4 NW1/4, SE1/4 SE1/4 NW1/4 NW1/4, NE1/4 NE1/4 SW1/4 NW1/4, S1/2 NE1/4 SW1/4 NW1/4, SE1/4 SW1/4 NW1/4, SE1/4 NW1/4, NE1/4 SW1/4, NE1/4 NW1/4 SW1/4, E1/2 E1/2 NW1/4 NW1/4 SW1/4, W1/2 NW1/4 SE1/4, and W1/2 W1/2 NW1/4 SE1/4, containing approximately 205 acres (83 hectares).

References

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

ATTACHMENT 2

AGENCY NOTIFICATION AGREEMENTS

National Earthquake Information Center

World Data Center A for Seismology

Director (303) 236-1510
Research (303) 236-1506

U.S. Geological Survey
Box 25046, DFC, MS-967
Denver, Colorado 80225 USA
Telex: (WUTCO) 5106014123ESL UD

Operations (303) 236-1500
QED (800) 358-2663

Clinton C. Smythe
Engineering and Construction Group Leader
Uranium Mill Tailings Remedial Action
Project Office
2155 Louisiana NE, Suite 4,000
Albuquerque, NM 87110

Dear Mr. Smythe:

This letter is to confirm that the DOE Grand Junction Projects Office (24-hour phone line, (303) 248-6070 has been added to our notification list for the occurrence of earthquakes near the following locations:

Disposal Site	Latitude	Longitude
COLORADO		
Durango (Bodo Canyon)	N37.15	W107.90
Grand Junction	N38.91	W108.32
Gunnison (Landfill)	N38.51	W106.85
Maybell	N40.55	W107.99
Naturita (Dry Flats)	N38.21	W108.60
Rifle (Estes Gulch)	N39.60	W107.82
Slick Rock (Burro Canyon)	N38.05	W108.87
IDAHO		
Lowman	N44.16	W115.61
NEW MEXICO		
Ambrosia Lake	N35.41	W107.80
NORTH DAKOTA		
Bowman	N46.23	W103.55
OREGON		
Lakeview (Collins Ranch)	N42.2	W120.3
PENNSYLVANIA		
Canonsburg	N40.26	W80.25
Burrell VP	N40.62	W79.65
TEXAS		
Falls City	N28.91	W98.13
UTAH		
Mexican Hat	N37.10	W109.85
Salt Lake City (Clive)	N40.69	W113.11

National Earthquake Information Center
World Data Center A for Seismology

Director
(303) 236-1510
Research
(303) 236-1506

U.S. Geological Survey
Box 25046, DFC, MS-967
Denver, Colorado 80225 USA
Telex: (WUTCO) 5106014123ESL UD

Operations
(303) 236-1500
QED
(800) 358-2663

We have entered the following selection criteria into our notification program:

1. Any earthquake of magnitude 3.0 or greater, within 0.3 degrees (about 20 miles) of any site shown above, or

2. Any earthquake of magnitude 5.0 or greater, within 1.0 degrees (about 70 miles) of any site shown above..

Sincerely,

Bruce W. Presgrave

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

Please address future correspondence to Stuart Koyanagi at the above address. I have moved to a different project.

Thank you + best regards,

Bruce Presgrave

APPENDIX

OPERATION AND CONTINGENCY PLAN FOR MONITORING WELL CLOSURE, ESTES GULCH DISPOSAL CELL

UMTRA PROJECT

RIFLE, COLORADO

OPERATION AND CONTINGENCY PLAN FOR MONITORING WELL CLOSURE
ESTES GULCH DISPOSAL CELL

JUNE 1997

PREPARED BY

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL GROUP

ONE MARKET
STEUART TOWER, SUITE 400
SAN FRANCISCO, CA 94105

UMTRA PROJECT

RIFLE, COLORADO

OPERATION AND CONTINGENCY PLAN FOR MONITORING WELL CLOSURE
ESTES GULCH DISPOSAL CELL

CONTENTS

TABLES

FIGURES

SECTION 1
INTRODUCTION

1.1 BACKGROUND

Placement of approximately 3.8 million cubic yards of tailings in the Estes Gulch disposal cell at the UMTRA Rifle site began in May 1993 and was completed in November 1995. Three monitoring wells, MW-1, MW-2 and MW-3, have been installed near the toe to measure the leachate level within the cell. Pumping of well MW-2 to lower the water level in the cell has been carried out during construction and, if required, can also be carried out after construction is completed. A plan view of the cell with locations of the three monitoring wells is shown in Figure 1. These wells are connected to a leachate collection system consisting of finger and collector drains placed at the bottom of the cell under the tailings.

Leachate buildup has been observed in MW-2 and MW-3 since June 1993, and the leachate levels in these wells have been monitored regularly since August 1993. Accordingly, pumping at MW-2 to lower the water level in the cell has taken place intermittently since August 1993. Figure 2 shows the tailings and leachate level buildup and drawdown with time. Charts that depict the complete history of leachate buildup and removal by pumping are included in Appendix A. Monitoring well MW-1, whose base is at 6021.4 feet (approximately 30 feet above those of MW-2 and MW-3), has not indicated the presence of water to date.

The pumped leachate from monitoring well MW-2 was stored in a temporary retention basin. The leachate collected has been used for dust control and for moistening the tailings during compaction. This retention basin was decommissioned in December 1995. Pumping of the leachate was discontinued but periodic monitoring of the leachate level will continue.

SECTION 2
OPERATION PLAN

2.1 Monitoring Strategy

Figure 3 shows the monitoring strategy and well closure criteria, including the action triggered due to monitoring results. For example, pumping required at a well will be dependent on the leachate level at that well. However, well closure and change in monitoring frequency will be applied to all three wells at the same time provided each satisfies the respective requirements.

According to the results of UNSAT2 modeling study (Ref. 1), drainage of the tailings in the disposal cell will stabilize within one year after cell completion (see Figure 4, reproduced from Ref. 1). Therefore, quarterly monitoring of the wells is expected to be adequate starting in September 1996.

Model prediction and field measurements will be compared quarterly during the monitoring period following the construction of the disposal cell. Among all simulation runs performed to date, RUN 21EE (Figures 4 and 5) best represents the field conditions during the first one to two years after the construction of the disposal cell. The results of Run 21EE show that the maximum leachate level predicted at the beginning of this period reaches an elevation of 6015.4 ft. at Node 377 which is located just above the sandstone unit near MW-2 (Ref. 1). To be conservative, leachate levels will be evaluated and construction of a retention basin will be considered when the leachate level reaches an elevation of 6014 ft in MW-2. In the event that the measured level would rise above 6016 ft., construction and pumping to the retention basin will be started as described in Section 3.2.

Because the bottom of MW-1 is at elevation 6021.4 ft., leachate detection in this well will not be expected. However, should leachate accumulate in it for some unforeseeable reasons, a walk-through in the area will immediately be conducted, followed by a collection of leachate level data at wells MW-2 and MW-3 for engineering analyses. If leachate is not detected in MW-1 during the monitoring period, this well will be closed concurrently with MW-2 and MW-3.

Data loggers will be installed in monitor wells MW-2 and MW-3. Water level data will be collected at four hour intervals which will produce a near continuous stream of data over a 90 day period. Data will be down loaded and then input into a spread sheet program for plotting. A trend analysis should be performed by plotting a linear regression line through the data obtained from each measurement period (linear relationship plots are available with spread sheet programs). If pumping has occurred, a draw-down-recharge evaluation should be made to determine the portion of the data set that is outside the influence of pumping.

For trend analysis, a linear regression line with a zero or negative slope for four consecutive quarters is required for standpipe closure. To determine action water level readings, the mid point on the linear regression line should be used as the average for the quarter for comparison to Figure 3, flowchart values.

2.2 Setup for Data Collection

Leachate levels will be monitored in the wells MW-2 and MW-3 by two methods:
(i) installing automatic data logger to provide continuous leachate level. This would show trends in the leachate level. Additionally having data loggers in two wells would enable data to be checked for consistency.

(ii) manual leachate level measurement which would provide point-in-time leachate level elevations. These measurements would be conducted on a quarterly or monthly basis as described in Section 2.4.2 (Monitoring Procedure). Data loggers will be calibrated and checked by results of periodic manual measurements.

The leachate level will also be checked in MW-1 by a manual leachate level measurement at the same frequency of measurement as MW-2 and MW-3.

2.3 Data Loggers

Geoguard Model No. 54060 will be installed at Monitoring Well Nos. MW-2 and MW-3. Data loggers will be calibrated and checked by results of periodic manual measurements.

2.3.1 Installation of Data Loggers

Installation of data loggers will be according to manufacturer's directions. The data loggers are 1.7 inches in diameter and can be hung through a 2-inch diameter hole in the monitoring well cap. One data logger has 60 feet of cable and the other has 90 feet of cable. Special cable clamps can be used to hang the data logger at shallower depths.

If a pump is being left in MW-2, a 2-inch diameter PVC pipe will need to be installed to convey the data logger into the well and prevent tangling with pump riser and cables.

Radon contamination of low levels exist within the 60-foot cable on one data logger. This was caused by radon penetrating the insulation material as a gas, then decaying into a daughter product such as lead (Pb_{210}). Both data loggers will be tagged for having been used in a UMTRA disposal cell and possibly exposed to radon.

2.3.2 Monitoring Procedure Using Data Loggers

Leachate levels will be recorded every four hours to define the diurnal changes in water levels and collect adequate data for trend analysis.

Downloading of data loggers should be done quarterly, in compliance with the flow chart on Figure 3 to ensure data quality. Data should be transferred to a floppy disk and sent to DOE for analysis and use with prior data.

2.3.3 Removal of Data Loggers

1. Assume the data logger has been exposed to radon gas and may have become contaminated while in the well. Carefully wash off the data logger onsite with distilled water upon retrieval from the well.

2. Transport the data logger in a plastic bag to the health physics/radiation support for evaluation. Perform a rad-scan on the data logger and cable for alpha and beta/gamma. Soak the data logger and cable (not the hanger) in cleaning solution used for decontaminating ground water sampling equipment. After 24-hours, clean and dry the data logger and cable. Perform a second rad-scan to provide a baseline for further use of the data logger.

3. Report the number of days the data logger was used in the cell monitoring well and results of the two rad-scans. The change in radioactive contamination with exposure time of the data logger and cable will be essential to managing the further use of each data logger by UMTRA, while being protective of worker health and safety.

2.4 Manual Monitoring

2.4.1 Installation

A schematic of the water level indicator made by Slope Indicator Company (Model No. 51405316) is shown in Page 2-6. For Monitoring Well No. MW-2, a PVC tube inside the 18-inch diameter well casing has been used for lowering the sounder probe and the cable to the leachate surface. This prevents the cable from getting tangled up with the submersible pump riser and electrical connections. A PVC tube will not be required in Monitoring Well No. MW-3 as there is no pump installation in this well.

2.4.2 Manual Monitoring Procedure

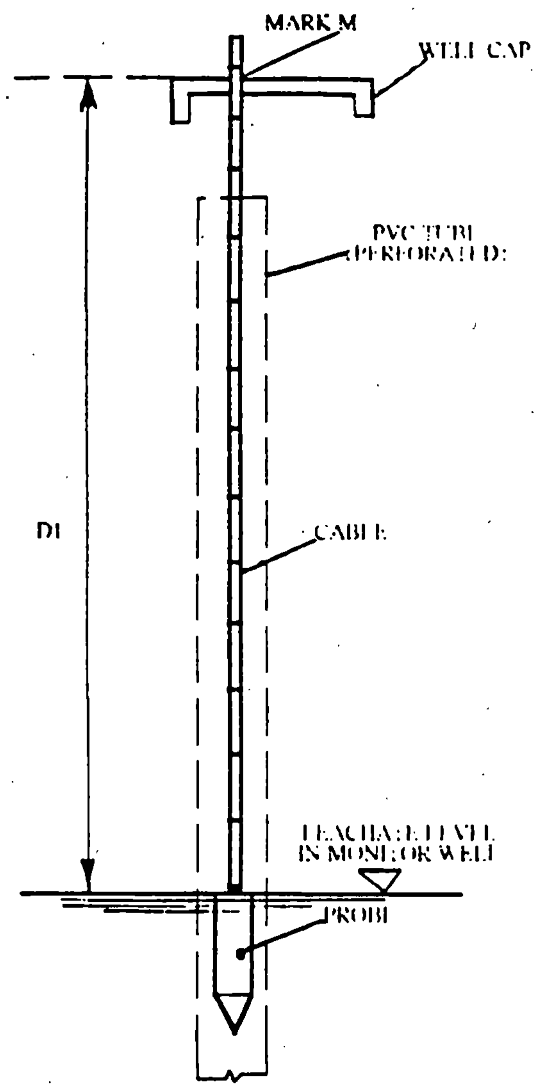
Following is a description of a procedure for recording the depth to the leachate surface by the manual method. A minimum of three measurements should be made to minimise operator error.

1. Lower the probe and the cable slowly through the hole in the well cap and then through the 3/4-inch diameter PVC tube. For MW-2, A 3/4-inch diameter PVC tube inside the 18-inch well casing is used for lowering the sounder probe and the cable to the leachate surface. This prevents the cable from getting tangled up with the pump riser and the electrical connections.

2. Continue lowering the probe until it enters the leachate surface, at which a beep will sound; do not read the markings on the cable at the first beep, but lift the cable up a few inches and lower it until there is a second beep. At this time, mark the position of the cable against the top of the well cap, by holding it at this spot (mark M in the figure).

3. The depth to the water surface from the mark M, indicated by D1 in the figure, is to be read in foot and inches, and within quarter on an inch.

4. Record two more depth readings by repeating the procedures 1 through 4. Report the depth to leachate as the two readings that agree. If all three are different, pull probe from hole and clean the probe. Then rerun it into the tube or well and record two more depth readings, at least, to verify an accurate reading.



DATE	TIME	DEPTH READING NUMBER	D1 (FT AND INCHES, see Figure)

NOTES:
A. A minimum of three depth readings to the leachate surface should be taken.
B. If the difference between the maxm. and the minm. readings is more than 1/10th of a foot (0.1), additional readings should be taken, until the difference between any of the three readings is no more than 0.1 foot.

SECTION 3
CONTINGENCY PLAN

The UNSAT2 modeling study (Ref. 1) shows that after the first year, the leachate level in the vicinity of MW-2 would never rise above elevation 6012 feet in the short term (30 years, see Figure 4, reproduced from Ref. 1). In the long-term simulation, the model assumes a continuous cover flux equal to the saturated permeability of the radon barrier (1.0E-7 cm/sec) from 20 years on after the construction of the cover. However, our UMTRA experience indicates there has not been any tendency for the cover to become saturated in those cells that have been built to date. Even if it were saturated, study shows that the long-term results (beyond 100 years) are not sensitive to when the radon barrier is determined to be saturated (Ref. 1).

With the above conservative assumption, the model predicts the leachate would not rise above elevation 6018 feet for both short- and long-term simulations. Among all simulation runs made to date, this is maximum leachate elevation ever achieved. To be more conservative, elevation 6016 feet instead of 6018 feet will be used as a trigger point to initiate pumping. Elevation 6014 feet is the maximum leachate level that resulted from another conservative case in which the lower liner is assumed to remain intact for 200 years and a cover flux of 5.0E-8 cm/sec is imposed. Results from the simulation runs also indicate that as long as the leachate level in the monitoring well is below elevation 6016 feet, the toe will remain unsaturated (Ref. 1).

The flow chart in Figure 3 indicates that pumping at a monitoring well will be required if the leachate level in the well rises above elevation 6016 feet. Pumping will be continued until the leachate level remains at or below elevation 6014 feet for approximately 90 days. Then the leachate level will be monitored at 2-day intervals for 8 days to ensure it is at or below elevation 6014 feet under no pumping condition. If this requirement is met, a monthly monitoring frequency will resume. Otherwise, pumping should be restarted and the above procedure should be repeated.

3.1 Estimate of Leachate Quantity

Estimates of leachate quantities for drawdown of the leachate elevation from 6016.0 ft to 6014.0 ft have been made as follows:

1. Saturated Zone Near the Cell Toe Only: As indicated by the UNSAT2 runs, a continuous saturated zone will not occur throughout the entire length of the cell. During the years 1 through 5 following the completion of the cell, a saturation zone occurs near the cell toe (Appendix B, Figures B-1, B-2). Since the pumping wells are located near the toe, drainage will occur primarily from the saturated zone surrounding the wells. The estimated drainage from this zone for lowering the phreatic surface from elevation 6016.0 ft to 6014.0 ft is 797,000 gallons. This is shown in Figure 6. Calculations for the total quantity of leachate at various elevations are shown in Table B-1, Appendix B.

   In Table B-1, a value of 0.272 has been assumed for the specific yield (difference between porosity and field capacity) for the tailings. A porosity of 0.441 was determined in the laboratory and a field capacity of 0.169 is based on published data for materials having approximately the same porosity as the tailings. This field capacity value is conservative in that it is about the lowest among those published and thus will result in a highest specific yield.

3.2 Leachate Pumping and Disposal Plan

A retention basin and spray evaporation system are proposed for the storage and disposal of the leachate pumped from the cell. The option of using a mobile or a fixed treatment plant was not considered beyond a cursory evaluation as this was found to be eight to ten times more expensive than a spray evaporation system (Ref. 3).

The advantages of a spray evaporation system are:

- During a given time, a spray system can evaporate relatively large quantities of leachate compared to a natural solar evaporation system.
- An effective spray evaporation system will avoid the need for an off-site discharge.
- Compared to an in-pond treatment method, a spray evaporation system would require relatively less time and labor. The in-pond treatment method requires a time cycle of at least one to two weeks to add chemicals, mix, precipitate, remove the sludge and test the effluent leachate by a laboratory to determine if it can be discharged. The spray evaporation system is relatively simpler to operate as no chemical addition or testing is required.

At the UMTRA Falls City site spray evaporation rates were as high as 200,000 gallons/day under relatively high humidity conditions (Ref. 4). Conditions favorable for relatively high spray evaporation rates are present at the Estes Gulch site - warm weather (especially during the late spring, summer and early fall months), relatively high wind and low humidity (all year-round). Spray evaporation data collected at the Estes Gulch retention basin during June/July 1995 show that the spray evaporation rate varied between 45 and 85 percent of the spray pumping rate (see Appendix B).

Leachate pumping records at MW-2 show that a maximum of about 40,000 gallons was pumped during one day in June 1994. The leachate pumping data are shown in Table A-2, Appendix A. Using a sustained pumping rate of 3 gpm from each of the monitoring wells MW-2 and MW-3 (which is the long-term average feasible pumping rate), it would take approximately 90 days to pump 797,000 gallons.

3.3 Design of Retention Basin and Spray Evaporation System

Should pumping be required during the monitoring period in accordance with the criteria stated in Figure 3, a retention basin will be constructed.

The retention basin capacity is governed mainly by (1) the rate at which the leachate can be pumped from the monitoring wells; and (2) the rate at which the leachates can be evaporated using the spray evaporation system. These are discussed below.

1. Pumping Rate from the Monitoring Wells: The 1994-95 leachate pumping records indicate that the average pumping rates were highest during the initial days of pumping followed by a gradual drop in the average pumping rate. The first 10 days of pumping in June 1994 averaged about 10 gpm, and the last few days of pumping in February 1995 averaged 3 gpm. For design purposes 10 gpm is assumed.

2. Evaporation Rate Using a Spray Evaporation System and Required Pump Capacity: Spray evaporation rates at the Estes Gulch site are available based on the data from the operation of a spray evaporation system at the Estes Gulch retention basin during 1995. Additional data are also available for the UMTRA Falls City site. These data are summarized in Table B-2, Appendix B. The measured average evaporation rate of 215 gpm at the Estes Gulch site is used for design.

The spray evaporation system can be designed to evaporate as much leachate as desired provided the equipment is available; however, freezing weather conditions would limit its use. The Estes Gulch site has freezing weather conditions several times a year, each lasting anywhere between 2 to 7 days (Ref. 3). Since the weather data at Estes Gulch is limited to only about two years, dating back to 1993 when construction began, it is proposed that for design purposes a factor of safety of 2 be used. This will make the number of freezing days = 2 x 7 = 14, say 15 days.

The use of a design value of 14 consecutive freezing days is sufficiently conservative. The temperature data recorded at the Estes Gulch West Station since 1993 indicate above-freezing temperatures during daylight hours for most of the winter days. Records do not indicate any consecutive days of freezing temperature during daylight hours. If spray evaporation is performed only at daytime, the leachate evaporation rate will be 215 gpm for 8 to 12 hours or 103,000 to 155,000 gallons a day. This is considerably more than the estimated leachate pumping rate of 10 gpm or 14,400 gallons a day.

Assuming that there will be no spray evaporation for 15 days (which also includes contingencies as stated above), but that the leachate needs to be pumped during these days, a detailed operation study with daily inflows and outflows into the retention basin including natural solar evaporation and precipitation was performed (Ref. 5). In this study, the required retention basin capacity was calculated to be 214,700 gallons, which is rounded off to 215,000 gallons. The leachate balance calculation is shown in Table B-3 of Appendix B. The proposed location of the retention basin is shown in Figure 7. The existing retention basin has been demolished, as indicated in Figure 7, following placement of all the contaminated materials.

Three nozzles connected to the pump discharge header are adequate, based on the operational data for the Estes Gulch retention basin. The nozzle/header assembly will be placed at one end of the proposed retention basin, along the 50-ft side with the pump delivery line connected to the header and will spray into the retention basin parallel to the 100-ft side.

3.4 Cost of Retention Basin and Spray Evaporation System

A summary of the cost estimate, based on detailed cost estimates (Ref. 6), is presented in Table 1. Depending on the particular alternative, the construction/installation cost would vary between $84,000 and $119,000, which include the following costs:

- the retention basin and liner
- a new electrical line extension from Highway 13 to the Estes Gulch site or a diesel generator, based on the alternative considered
- spray evaporation system including a pump, header, nozzles/sprinklers

The operating pump used in monitor well MW-2 is assumed to be available for use. However, if a new pump is to be furnished and installed an additional cost of about $5,000 should be added to the above costs.

The operation and maintenance cost (O & M) includes the following:

- one operator and one helper
- one pickup truck
- gasoline, diesel or electricity depending on the alternative selected

Table 1 costs also include contractor's mobilization, overhead and profit.

The costs of a mobile or fixed treatment plant were found to be considerably in excess of the spray evaporation system ($800,000 to $1,000,000 vs. about $120,000) and were not considered beyond a cursory evaluation stage.

3.5 Construction Schedule

Commencement of construction of the retention basin and the spray evaporation facilities will depend on the results of the periodic leachate level monitoring, discussed in Section 2.1. Since the rise in leachate level is relatively slow, there appears to be sufficient time to construct the facilities between the time the leachate level begins a rising trend and the time when the leachate level rises to the elevation at which pumping must begin. For example, between 7 February 1994 and 18 May 1994 (100 days), the leachate level rose 1.78 ft (elevation 6005.39 ft to 6007.17 ft) without any leachate being pumped during this period.

TABLE 1. COST OF RETENTION BASIN AND SPRAY EVAPORATION SYSTEM
(Cost Estimate conducted in June 1995)

ALTERNATIVE	DESCRIPTION	CONSTRUCTION/ INSTALLATION COST	O & M COST ($/Month)
A	Construct the retention basin and spray system after Green leaves the site, under a new bid package. Assume that the power line, currently available, will also be available after Green leaves the site.	$84,000	$18,300
B.	Same as Alternative A, except that a new electrical power line will be constructed from Hwy. 13 to the Estes Gulch site.	$119,000	$18,300
C	Same as Alternative A except that a diesel generator will be used to power the monitor well pump and the spray system pump.	$106,000	$18,800

FIGURE 1

ESTES GULCH DISPOSAL CELL SHOWING LOCATION OF MONITORING WELLS MW-1, MW-2 AND MW-3

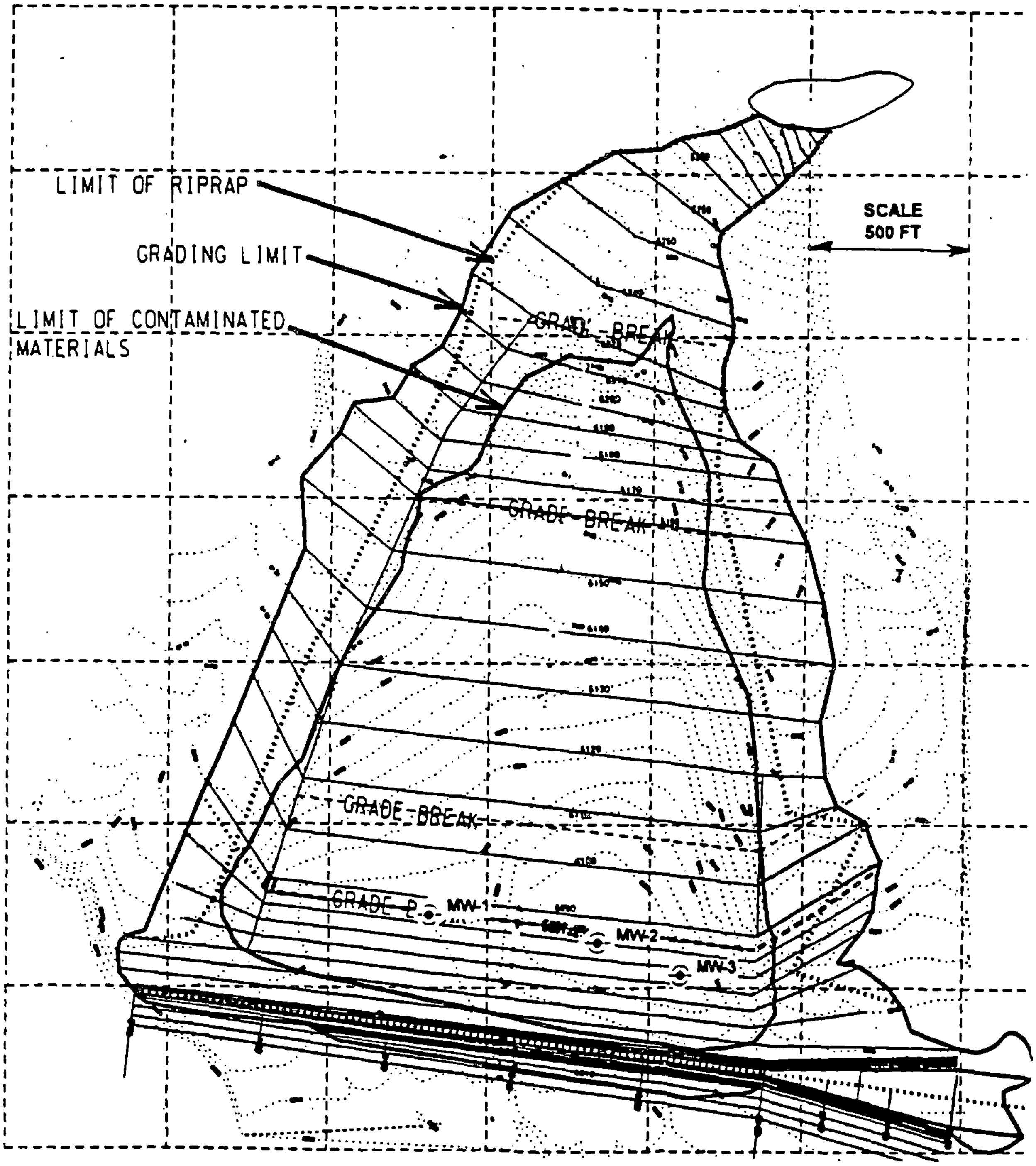
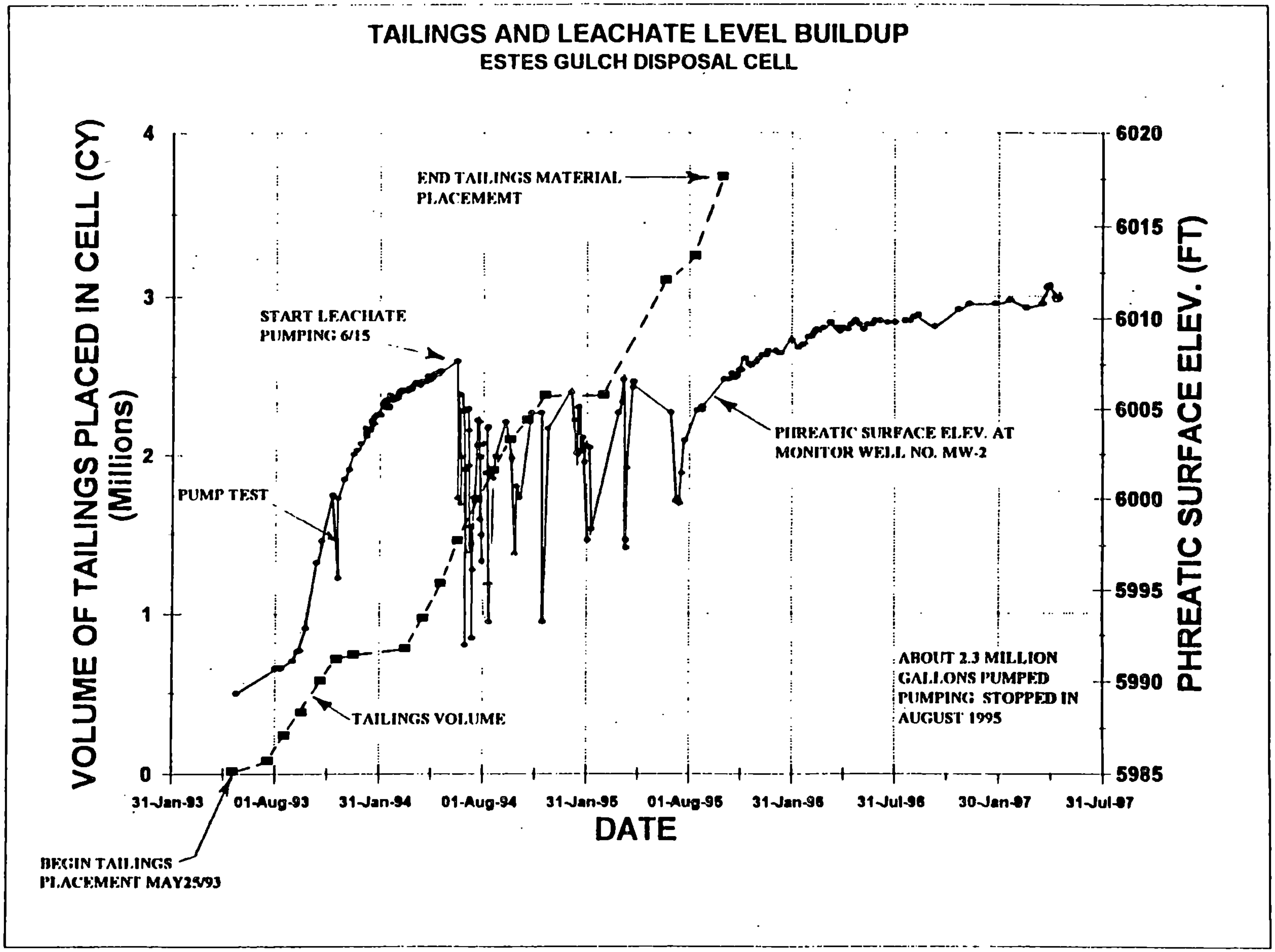


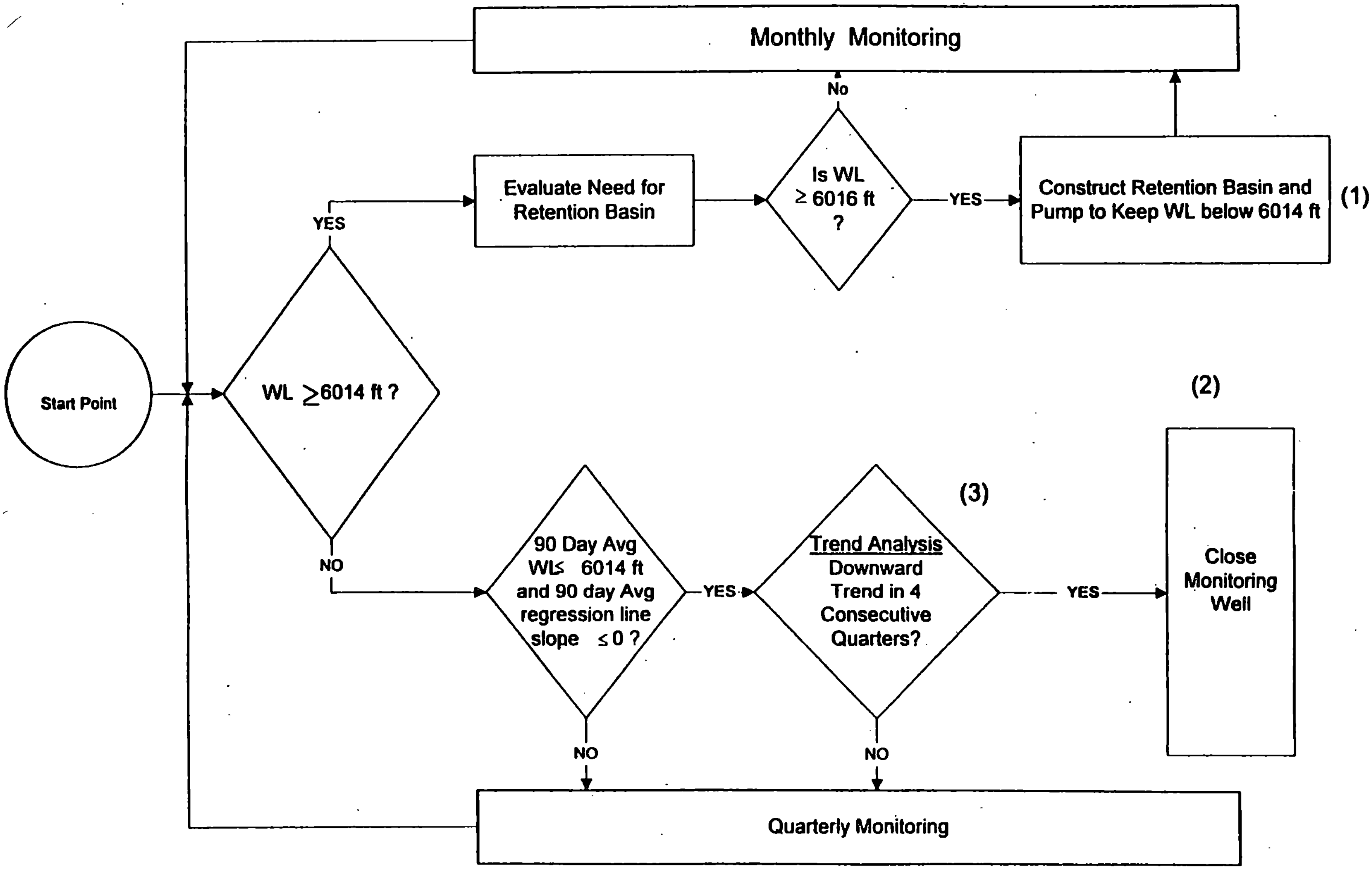
FIGURE 2



T-2 TAILI_PL.WB1:GRAPH25

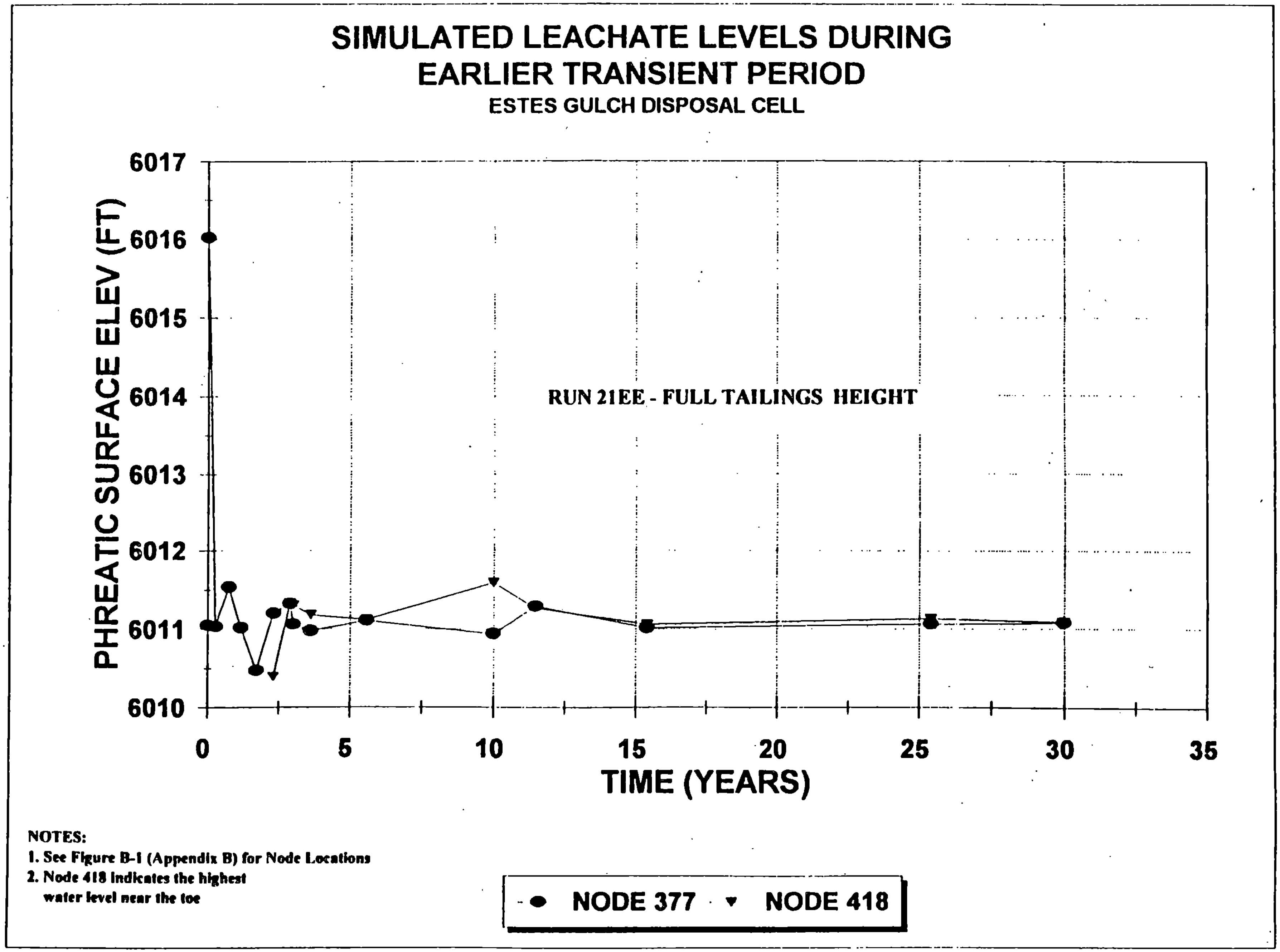
FIGURE 3

FLOWCHART OF FIELD ACTIVITIES
At MW-1, MW-2 and MW-3



(1) Pump intermittently as required to keep WL under 6014 ft for about 90 days and monitor WL at 2-day intervals for 8 days to ensure WL is below 6014 ft under no pumping condition.
(2) No well will be closed unless all three wells satisfy the closure requirements.
(3) Based on trend analysis.

FIGURE 4



3-11

W-38W RUN21EE.WB1 GRAPH3

FIGURE 5

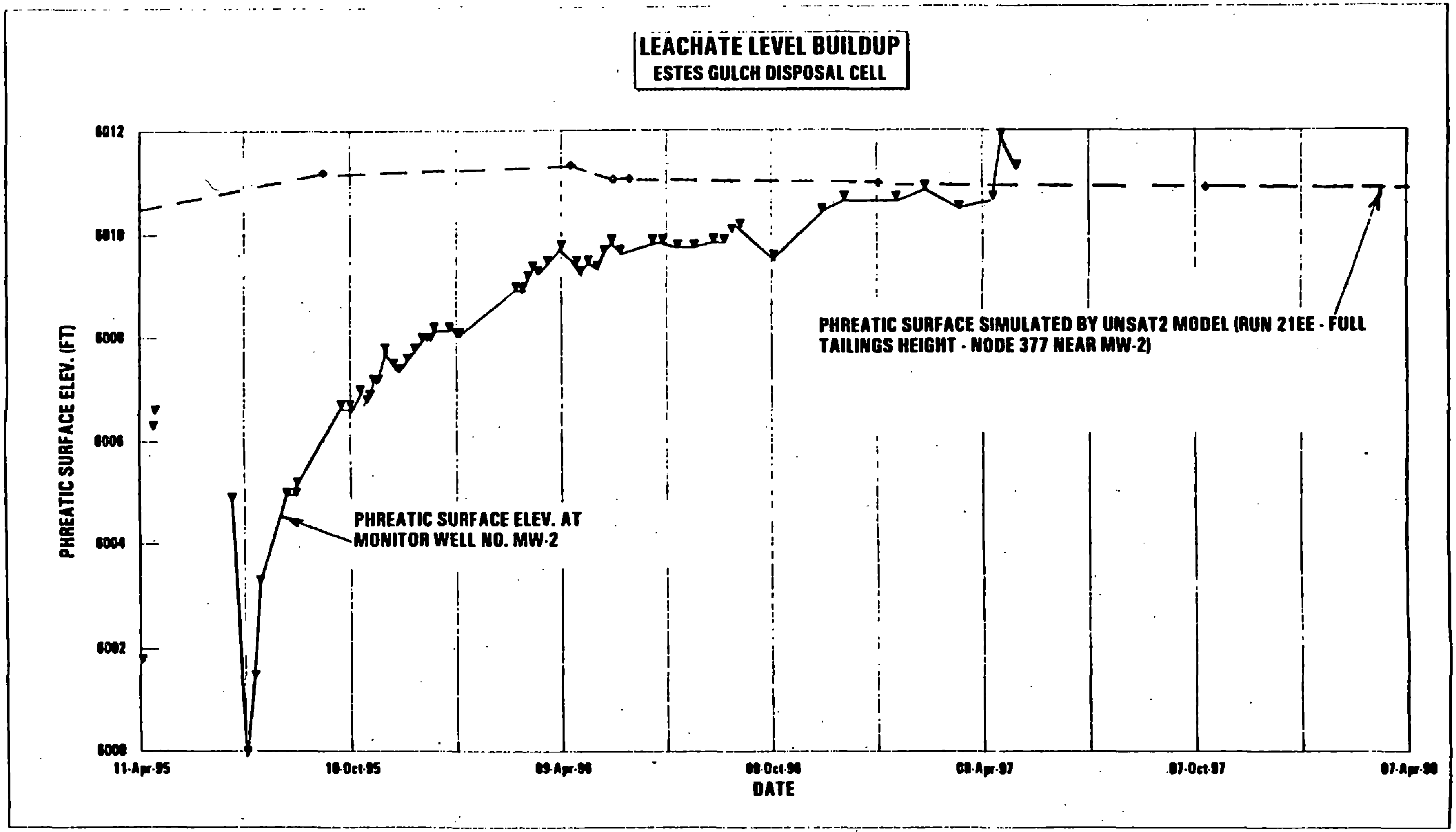
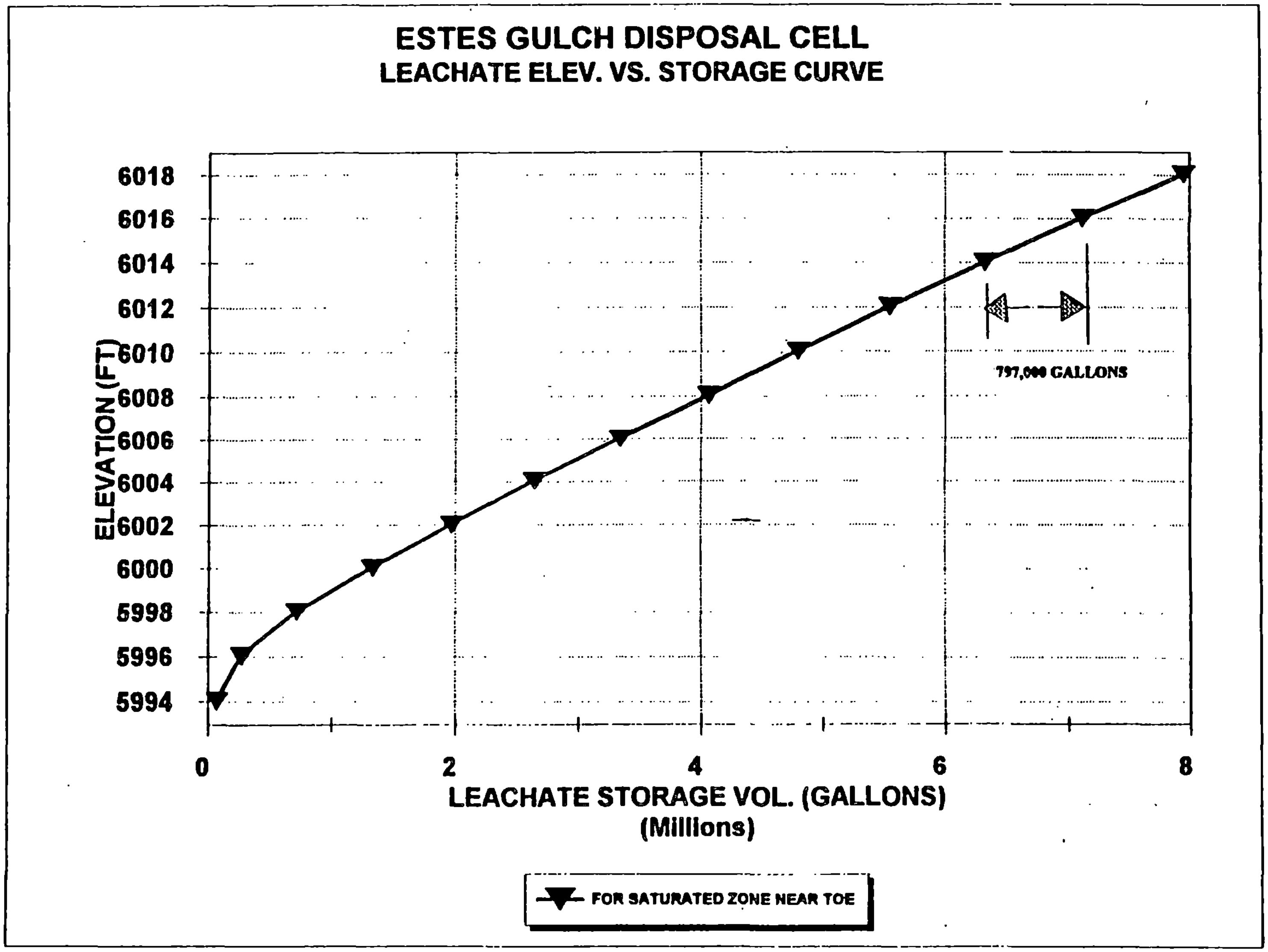
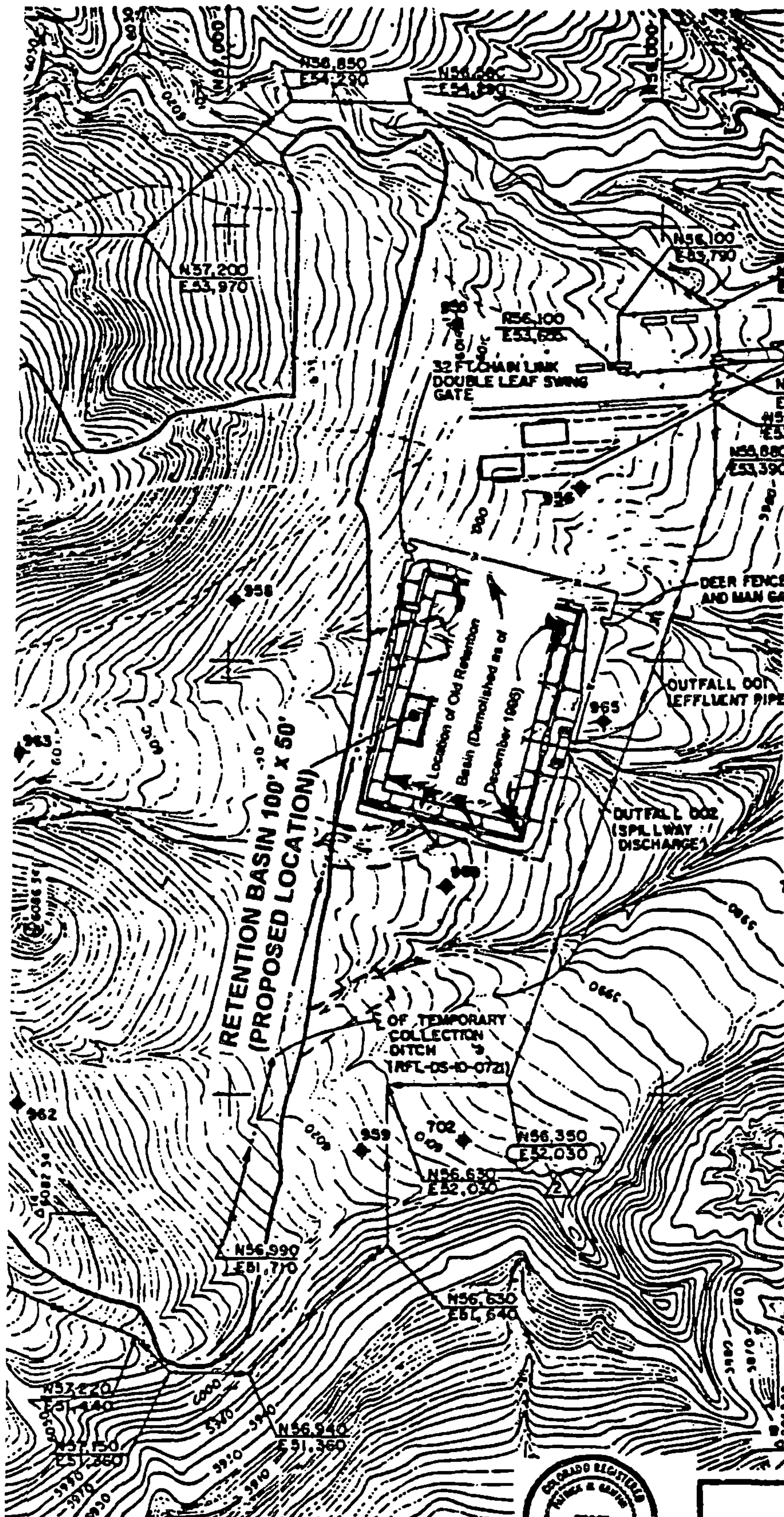

LEACHATE LEVEL BUILDUP
ESTES GULCH DISPOSAL CELL
6012
6010
6008
6006
6004
6002
6000
PHREATIC SURFACE ELEV. (FT)
11-Apr-95
10-Oct-95
09-Apr-96
08-Oct-96
08-Apr-97
07-Oct-97
07-Apr-98
DATE
PHREATIC SURFACE SIMULATED BY UNSAT2 MODEL (RUN 21EE - FULL TAILINGS HEIGHT - NODE 377 NEAR MW-2)
PHREATIC SURFACE ELEV. AT MONITOR WELL NO. MW-2

FIGURE 6



ESTES GULCH DISPOSAL CELL
LEACHATE ELEV. VS. STORAGE CURVE
ELEVATION (FT)
6018
6016
6014
6012
6010
6008
6006
6004
6002
6000
5998
5996
5994
797,000 GALLONS
0
2
4
6
8
LEACHATE STORAGE VOL. (GALLONS)
(Millions)
FOR SATURATED ZONE NEAR TOE

FIGURE 7
PROPOSED LOCATION OF RETENTION BASIN



NOTES:

1. COORDINATE POINTS AND BEARINGS ARE APPROXIMATE ONLY AND MAY BE ADJUSTED IN THE FIELD BY THE CONTRACTOR.
2. ALL FENCING TO BE REMOVED AT END OF SUBCONTRACT AS DIRECTED BY CONTRACTOR.
3. OUTFALLS ARE IN ACCORDANCE WITH CDPS PERMIT.

40'-0 WIDE CHAIN LINK, DOUBLE LEAF SWING GATE

REFERENCE DRAWINGS:

RFL-GE-10-0705	FENCE AND GATE DETAILS
RFL-DS-10-0717	ACCESS CONTROL AND STAGING AREA PLAN AND DETAILS
RFL-DS-10-0718	EMBANKMENT-FOUNDATION EXCAVATION
RFL-DS-10-0720	TEMPORARY SITE DRAINAGE RETENTION BASIN SECTION AND DETAILS
RFL-DS-10-0721	TEMPORARY SITE DRAINAGE PROFILE AND SECTIONS
RFL-DS-10-0722	FINAL SITE GRADING AND DRAINAGE PLAN
RFL-DS-10-0731	LEACHATE COLLECTION AND REMOVAL SYSTEM (SHEET 1 OF 2)
RFL-DS-10-0732	LEACHATE COLLECTION AND REMOVAL SYSTEM (SHEET 2 OF 2)

LEGEND:

6030	EXISTING SITE FEATURES & CONTOURS (1982 SURVEY)
N 58,000 / E 52,000	CONSTRUCTION GRID COORDINATES
	℄ TEMPORARY DRAINAGE DITCH
	EXCAVATION
	EMBANKMENT
	TEMPORARY CHAIN LINK FENCE
	TEMPORARY WOVEN WIRE FENCE
	TEMPORARY DEER FENCE
	MONITORING WELL

Chris R. Cook 04/30/97

NOTE: THIS SEAL IS NOT VALID IN THE STATE OF COLORADO UNLESS THE ORIGINAL SIGNATURE APPEARS BELOW.

COLORADO REGISTERED PROFESSIONAL ENGINEER 23086

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

ESTES GULCH DISPOSAL SITE
RIFLE, COLORADO
PHASE II CONSTRUCTION

TEMPORARY SITE DRAINAGE AND CONSTRUCTION FACILITIES PLAN

REVISIONS	BY	CH				
REMOVED COORDINATE POINT ALONG WEST BRANCH OF DITCH						
DELETED EMBANKMENT EXCAVATION; ADDED NOTE 2 AND REMOVED LEGEND AND LIMIT OF CONTAMINATED MATL; ADDED OUTFALLS						
ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

DRAWN BH
DATE 9/17/93

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. RFL-DS-10-0719

SECTION 4
REFERENCES

1. Morrison Knudsen Corporation, Environmental Group, UMTRA Project, UNSAT2 Modeling for Monitoring Well Closure, Estes Gulch Disposal Cell, Rifle, Colorado, MKES Doc. No. 3885-RFL-R-01-05671-02, November 1996.

2. Gilbert, Richard O. (Pacific Northwest Laboratory), Statistical Methods for Environmental Pollution Monitoring, Published by Van Nostrand Reinhold, New York, 1987.

3. Morrison Knudsen Corporation, Engineering, Construction & Environmental Group, Environmental Services Division, UMTRA Project, Telephone Conversation Record with MK-F Rifle site Engineers, MKES Doc. No. 3885-RFL-T-01-05705-00, May 19, 1995.

4. MK Environmental Services, UMTRA Project, Telephone Conversation Record with MK-F Falls City Site Engineers, MKES Doc. No. 3885-RFL-T-01-05191-00, Jan 20, 1994.

5. Morrison Knudsen Corporation, Engineering, Construction & Environmental Group, Environmental Services Division, Calculation No. 06-579-04-00, UMTRA Project, Disposal Cell Leachate at Estes Gulch - Design of Retention Basin and Spray Evaporation System for Leachate Pumped from the Disposal Cell, October 1995.

6. Morrison Knudsen Corporation, Engineering, Construction & Environmental Group, Environmental Services Division, UMTRA Project, Rifle - Estes Gulch Disposal Cell, Contingency Plan for Leachate Disposal - Cost Estimate for Spray Evaporation System, Rifle Binder No. 8, MKES Doc. No. 3885-RFL-R-01-05730-00, June 1995.

APPENDIX A

HISTORY OF LEACHATE BUILDUP AND REMOVAL
ESTES GULCH DISPOSAL CELL

TABLES

FIGURES

TABLE A-1.
UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
LEACHATE SURFACE ELEVATION AND VOLUME OF LEACHATE PUMPED IN MONITOR WELL NO. MW-2

DATE	LEACHATE SURFACE ELEV. IN MW-2 (FT)	VOL. OF LEACHATE PUMPED (GALLONS)	CUMULATIVE VOL. OF LEACHATE PUMPED (GALLONS)	PUMPING RATE (GPM)	REMARKS
02-Aug-93	5990.74	0	0		
09-Aug-93	5990.74		0		
11-Aug-93	5990.74	40000	40000		PUMPED BY GREEN
01-Sep-93	5991.13		40000		
10-Sep-93	5991.63		40000		
14-Sep-93	5991.70		40000		
24-Sep-93	5992.93		40000		
13-Oct-93	5996.60		40000		
22-Oct-93	5997.75		40000		
10-Nov-93	6000.27		40000		
18-Nov-93	6000.09		40000		
19-Nov-93	5995.74	57000	97000	58	DURING PUMP TEST
30-Nov-93	6001.14		97000		
08-Dec-93	6001.69		97000		
16-Dec-93	6002.54		97000		
22-Dec-93	6002.79		97000		
29-Dec-93	6003.17		97000		
05-Jan-94	6004.05		97000		
06-Jan-94	6003.79		97000		
07-Jan-94	6003.59		97000		
10-Jan-94	6003.87		97000		
11-Jan-94	6003.89		97000		
12-Jan-94	6003.89		97000		
13-Jan-94	6003.94		97000		
14-Jan-94	6004.04		97000		
17-Jan-94	6004.49		97000		
18-Jan-94	6004.39		97000		
19-Jan-94	6004.29		97000		
20-Jan-94	6004.29		97000		
21-Jan-94	6004.29		97000		
24-Jan-94	6004.69		97000		
25-Jan-94	6004.79		97000		
26-Jan-94	6004.79		97000		
27-Jan-94	6004.79		97000		
01-Feb-94	6004.79		97000		
07-Feb-94	6005.39		97000		
08-Feb-94	6005.49		97000		
10-Feb-94	6005.19		97000		
11-Feb-94	6005.59		97000		
14-Feb-94	6005.29		97000		
15-Feb-94	6005.19		97000		
16-Feb-94	6005.29		97000		
18-Feb-94	6005.89		97000		
22-Feb-94	6005.59		97000		
23-Feb-94	6005.59		97000		
24-Feb-94	6005.69		97000		
25-Feb-94	6005.69		97000		
28-Feb-94	6005.69		97000		
01-Mar-94	6005.69		97000		
02-Mar-94	6005.59		97000		
03-Mar-94	6005.69		97000		
04-Mar-94	6005.89		97000		

TABLE A-1.
UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
LEACHATE SURFACE ELEVATION AND VOLUME OF LEACHATE PUMPED IN MONITOR
WELL NO. MW-2

DATE	LEACHATE SURFACE ELEV. IN MW-2 (FT)	VOL. OF LEACHATE PUMPED (GALLONS)	CUMULATIVE VOL. OF LEACHATE PUMPED (GALLONS)	PUMPING RATE (GPM)	REMARKS
07-Mar-94	6006.04		97000		
08-Mar-94	6006.09		97000		
10-Mar-94	6006.04		97000		
11-Mar-94	6006.14		97000		
14-Mar-94	6006.09		97000		
15-Mar-94	6006.09		97000		
17-Mar-94	6006.09		97000		
21-Mar-94	6006.19		97000		
23-Mar-94	6006.24		97000		
25-Mar-94	6006.24		97000		
28-Mar-94	6006.19		97000		
31-Mar-94	6006.39		97000		
01-Apr-94	6006.39		97000		
04-Apr-94	6006.54		97000		
06-Apr-94	6006.54		97000		
08-Apr-94	6006.54		97000		
11-Apr-94	6006.40		97000		
14-Apr-94	6006.60		97000		
15-Apr-94	6006.60		97000		
18-Apr-94	6006.60		97000		
19-Apr-94	6006.60		97000		
21-Apr-94	6006.60		97000		
22-Apr-94	6006.60		97000		
25-Apr-94	6006.90		97000		
27-Apr-94	6006.80		97000		
29-Apr-94	6006.70		97000		
02-May-94	6006.90		97000		
04-May-94	6006.85		97000		
06-May-94	6007.00		97000		
09-May-94	6007.00		97000		
11-May-94	6007.05		97000		
13-May-94	6007.00		97000		
16-May-94	6007.15		97000		
18-May-94	6007.17		97000		
23-May-94	6007.07	3000	100000		
26-May-94	6007.32		100000		
01-Jun-94	6007.37		100000		
07-Jun-94	6007.67		100000		
10-Jun-94	6007.67		100000		
13-Jun-94	6007.67		100000		
16-Jun-94	6007.67	30376	130376		
17-Jun-94	6000.10	30376	160752		
20-Jun-94	5995.70	15600	176352		
22-Jun-94	5994.20	36320	212672		
23-Jun-94	5994.00	14800	227472		
25-Jun-94	6002.40		227472		
26-Jun-94	5995.50	15000	242472		
28-Jun-94	6005.00	22000	264472		
29-Jun-94	5993.00	37800	302272		
01-Jul-94	6001.70	16320	318592		
02-Jul-94	5995.70		318592		
05-Jul-94	6005.10	16600	335192		

TABLE A-1.
UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
LEACHATE SURFACE ELEVATION AND VOLUME OF LEACHATE PUMPED IN MONITOR WELL NO. MW-2

DATE	LEACHATE SURFACE ELEV. IN MW-2 (FT)	VOL. OF LEACHATE PUMPED (GALLONS)	CUMULATIVE VOL. OF LEACHATE PUMPED (GALLONS)	PUMPING RATE (GPM)	REMARKS
06-Jul-94	5996.00	20800	355992		
07-Jul-94	6001.90	22000	377992		
08-Jul-94	5992.50	23280	401272		
09-Jul-94	5998.50	14400	415672		
10-Jul-94	5994.20		415672		
11-Jul-94	5997.60	11000	426672		
12-Jul-94	5992.40	17080	443752		
13-Jul-94	5994.80	24760	468512		
14-Jul-94	5993.00		468512		
15-Jul-94	6000.10		468512		
20-Jul-94	6004.50	12200	480712		
21-Jul-94	5998.20	16600	497312		
22-Jul-94	6003.00		497312		
25-Jul-94	6004.40		497312		
26-Jul-94	5995.50	29592	526904		
27-Jul-94	6002.40	35400	562304		
28-Jul-94	5992.40	20400	582704		
29-Jul-94	5996.70		582704		
30-Jul-94	5993.60	11200	593904		
02-Aug-94	6003.10		593904		
03-Aug-94	5999.00	4080	597984		
05-Aug-94	6001.50		597984		
06-Aug-94	5998.50	4000	601984		
08-Aug-94	6004.00		601984		
09-Aug-94	6004.00		601984		
10-Aug-94	6004.00	24250	626234		
11-Aug-94	5995.10	48500	674734		
12-Aug-94	5995.10	24250	698984		
13-Aug-94	5995.50		698984		
14-Aug-94	5995.10	19760	718744		
16-Aug-94	6001.30		718744		
17-Aug-94	5995.60	14400	733144		
18-Aug-94	6001.20	36000	769144	50	ESTIMATED GPM
19-Aug-94	5995.00		769144		
22-Aug-94	6002.00		769144		
23-Aug-94	5999.50	5040	774184	28	
26-Aug-94	5995.10		774184		
29-Aug-94	6002.10	30750	804934	50	
30-Aug-94	5995.10	30750	835684	50	
07-Sep-94	6003.90		835684		
08-Sep-94	6004.20		835684		
09-Sep-94	6004.00	24000	859684	50	ESTIMATED GPM
10-Sep-94	5996.90	33500	893184	50	ESTIMATED GPM
11-Sep-94	6002.00	18250	911434	50	ESTIMATED GPM
12-Sep-94	5998.20		911434		
13-Sep-94	6002.90	33540	944974	26	AVERAGE GPM
14-Sep-94	5995.20	21780	966754	26	
20-Sep-94	6003.70		966754		
21-Sep-94	5995.10	24840	991594	18	ESTIMATED GPM
22-Sep-94	5995.10	34938	1026532		
23-Sep-94	5997.80	37950	1064482	30	
24-Sep-94	5995.10		1064482		

TABLE A-1.
UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
LEACHATE SURFACE ELEVATION AND VOLUME OF LEACHATE PUMPED IN MONITOR WELL NO. MW-2

DATE	LEACHATE SURFACE ELEV. IN MW-2 (FT)	VOL. OF LEACHATE PUMPED (GALLONS)	CUMULATIVE VOL. OF LEACHATE PUMPED (GALLONS)	PUMPING RATE (GPM)	REMARKS
25-Sep-94	5998.40		1064482		
26-Sep-94	5995.20	14880	1079362	12	
27-Sep-94	5997.20		1079362		
29-Sep-94	6001.00		1079362		
30-Sep-94	5995.10	20520	1099882	12	ESTIMATED GPM
03-Oct-94	6000.30		1099882		
04-Oct-94	5995.10	12960	1112842	12	ESTIMATED GPM
19-Oct-94	6004.50		1112842		
24-Oct-94	6005.00		1112842		
11-Nov-94	6004.90	17900	1130742		
12-Nov-94	5996.10	10000	1140742		
13-Nov-94	6003.70	29400	1170142		
14-Nov-94	5991.60		1170142		
15-Nov-94	5993.30	24000	1194142		
16-Nov-94	5991.60		1194142		
22-Nov-94	6003.80		1194142		
21-Dec-94	6005.40	30000	1224142		
04-Jan-95	6006.30	27400	1251542		
05-Jan-95	5996.50	27400	1278942		
09-Jan-95	6004.60	24050	1302992		
10-Jan-95	5995.70	24050	1327042		
12-Jan-95	6002.70		1327042		
13-Jan-95	5995.70	13700	1340742		
16-Jan-95	6004.90		1340742		
17-Jan-95	5995.80	45450	1386192		
19-Jan-95	6002.40		1386192		
20-Jan-95	5995.00	35650	1421842		
24-Jan-95	6003.30		1421842		
25-Jan-95	5991.60	43200	1465042		
27-Jan-95	6001.70		1465042		
28-Jan-95	5997.30	11400	1476442		
30-Jan-95	6002.90	18000	1494442		
31-Jan-95	5991.70	36000	1530442		
02-Feb-95	5998.60		1530442		
03-Feb-95	5996.80	11400	1541842		
06-Feb-95	6002.90		1541842		
07-Feb-95	5995.30	42300	1584142		
08-Feb-95	5998.10		1584142		
09-Feb-95	5995.70	11300	1595442		
28-Mar-95	6004.90		1595442		
04-Apr-95	6005.50		1595442		
07-Apr-95	6006.70		1595442		
11-Apr-95	5997.80	49950	1645392		
12-Apr-95	5997.40	49950	1695342		
13-Apr-95	6001.80		1695342		
24-Apr-95	6006.30		1695342		
25-Apr-95	6006.60		1695342		
22-May-95	6007.00		1695342		
23-May-95	5992.00	43560	1738902		
24-May-95	5992.00	43560	1782462		
25-May-95	5992.00	43560	1826022		
01-Jun-95	6005.10		1826022		

TABLE A-1.
UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
LEACHATE SURFACE ELEVATION AND VOLUME OF LEACHATE PUMPED IN MONITOR
WELL NO. MW-2

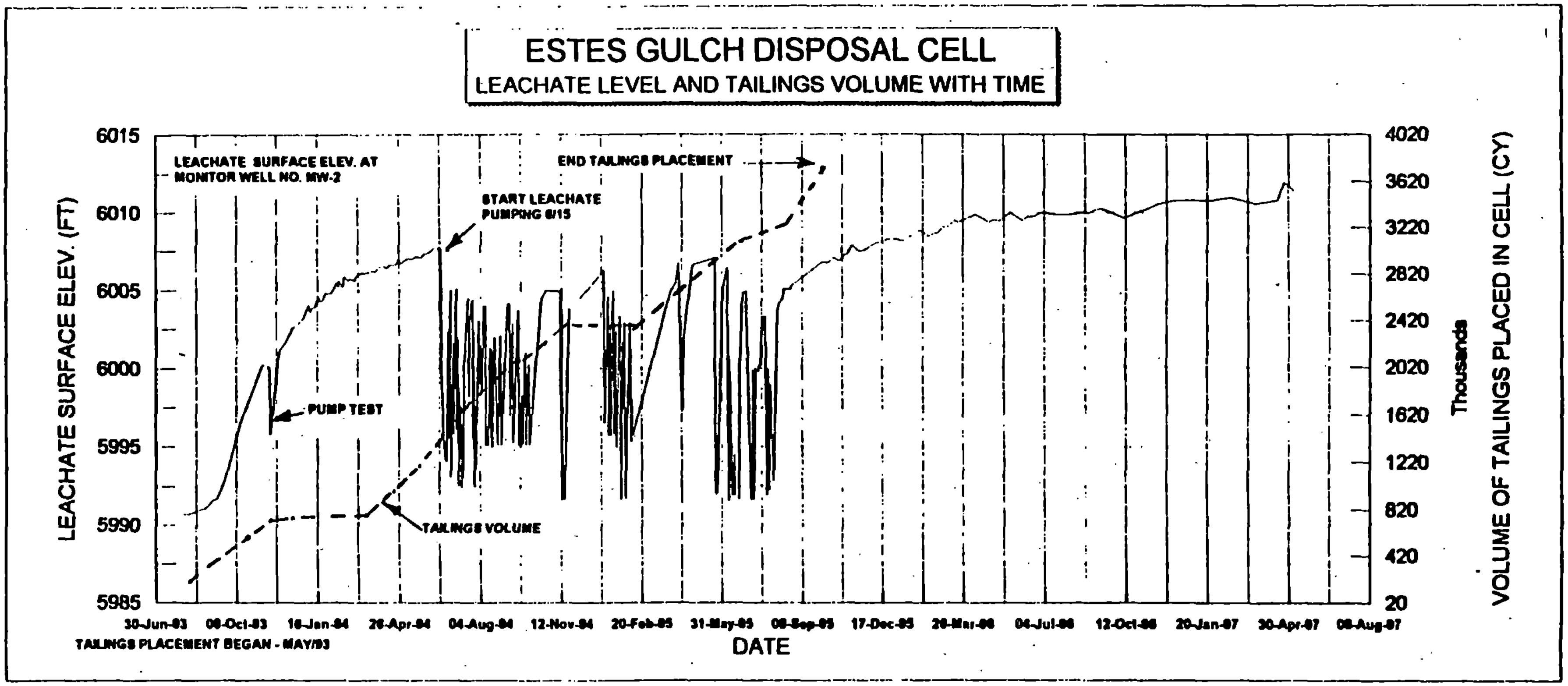
DATE	LEACHATE SURFACE ELEV. IN MW-2 (FT)	VOL. OF LEACHATE PUMPED (GALLONS)	CUMULATIVE VOL. OF LEACHATE PUMPED (GALLONS)	PUMPING RATE (GPM)	REMARKS
06-Jun-95	6006.30		1826022		
07-Jun-95	6006.40		1826022		
08-Jun-95	5991.50	29720	1855742		
09-Jun-95	5991.70	29720	1885462		
10-Jun-95	6000.60		1885462		
12-Jun-95	5991.90	29720	1915182		
14-Jun-95	5991.90	29720	1944902		
15-Jun-95	5994.50		1944902		
16-Jun-95	5991.90	29720	1974622		
20-Jun-95	5991.80	29720	2004342		
21-Jun-95	5991.60	29720	2034062		
22-Jun-95	5999.80		2034062		
26-Jun-95	6004.80		2034062		
28-Jun-95	6004.80		2034062		
29-Jun-95	6004.70		2034062		
30-Jun-95	6004.90		2034062		
06-Jul-95	5991.60	47197	2081259		
07-Jul-95	5991.60	47197	2128456		
08-Jul-95	5991.80	47197	2175653		
09-Jul-95	5999.90		2175653		
10-Jul-95	5991.60	47197	2222850		
11-Jul-95	5996.10		2222850		
12-Jul-95	6000.00		2222850		
13-Jul-95	5999.80		2222850		
14-Jul-95	5999.80		2222850		
15-Jul-95	5999.80		2222850		
17-Jul-95	6000.20		2222850		
18-Jul-95	6000.20		2222850		
19-Jul-95	6001.50		2222850		
21-Jul-95	6003.20		2222850		
24-Jul-95	6003.30		2222850		
26-Jul-95	5991.90	28520	2251370		
27-Jul-95	6000.00		2251370		
28-Jul-95	5992.20	28520	2279890		
30-Jul-95	5999.00		2279890		
03-Aug-95	5992.80	28520	2308410		
08-Aug-95	6003.60	28520	2336930		
10-Aug-95	6004.10	28520	2365450		
14-Aug-95	6004.50		2365450		
15-Aug-95	6004.70		2365450		
16-Aug-95	6005.00		2365450		
17-Aug-95	6005.00		2365450		
18-Aug-95	6005.00		2365450		
21-Aug-95	6005.00		2365450		
22-Aug-95	6005.00		2365450		
23-Aug-95	6005.00		2365450		
24-Aug-95	6005.00		2365450		
25-Aug-95	6005.20		2365450		
02-Oct-95	6006.70		2365450		
11-Oct-95	6006.74		2365450		
17-Oct-95	6007.00		2365450		
24-Oct-95	6006.80		2365450		

A-6

TABLE A-1.
UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
LEACHATE SURFACE ELEVATION AND VOLUME OF LEACHATE PUMPED IN MONITOR WELL NO. MW-2

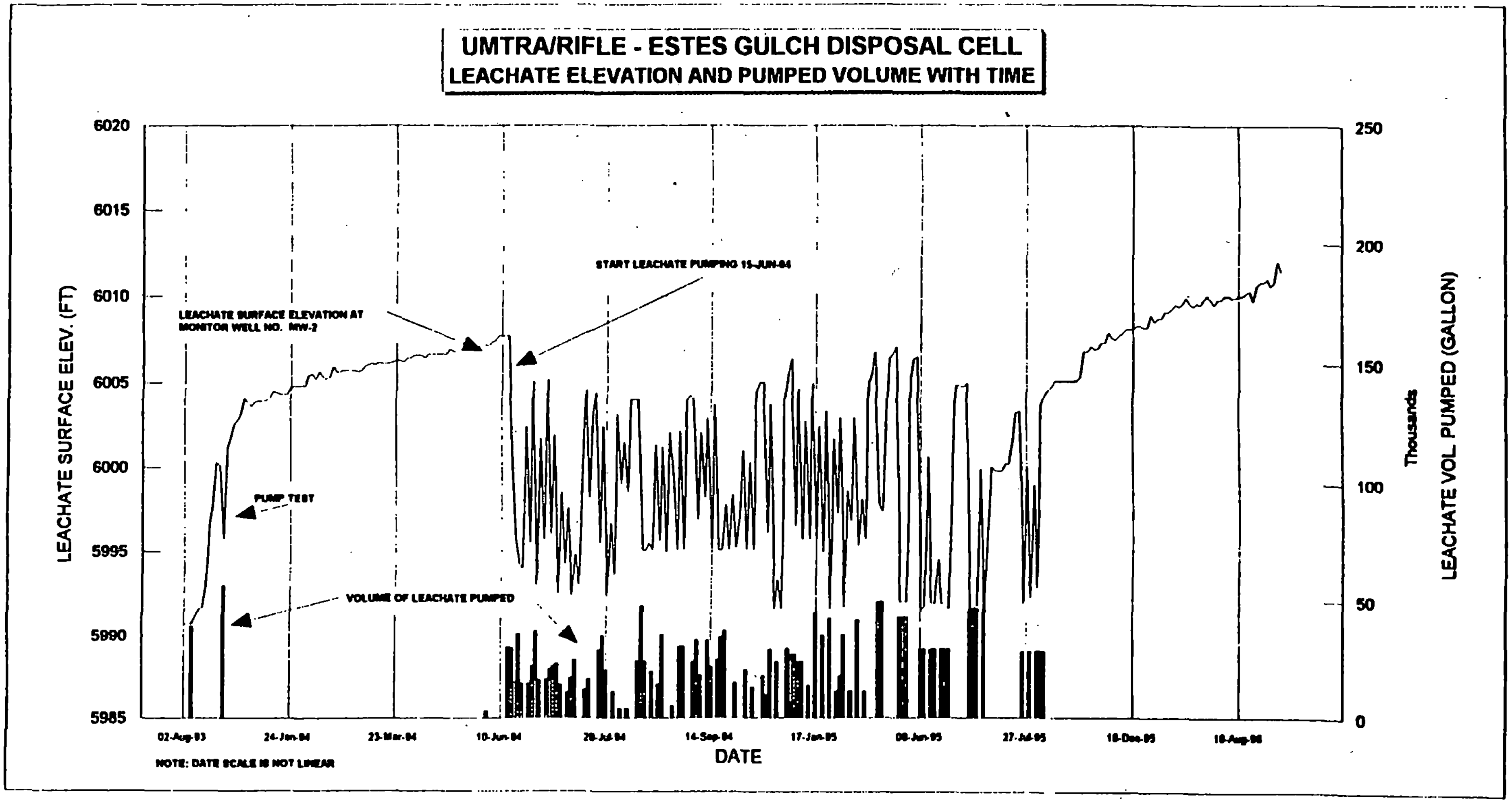
DATE	LEACHATE SURFACE ELEV. IN MW-2 (FT)	VOL. OF LEACHATE PUMPED (GALLONS)	CUMULATIVE VOL. OF LEACHATE PUMPED (GALLONS)	PUMPING RATE (GPM)	REMARKS
27-Oct-95	6006.90		2365450		
30-Oct-95	6007.20		2365450		
03-Nov-95	6007.20		2365450		
09-Nov-95	6007.80		2365450		
16-Nov-95	6007.50		2365450		
21-Nov-95	6007.40		2365450		
28-Nov-95	6007.60		2365450		
04-Dec-95	6007.80		2365450		
11-Dec-95	6008.00		2365450		
15-Dec-95	6008.00		2365450		
18-Dec-95	6008.00		2365450		
21-Dec-95	6008.20		2365450		
03-Jan-96	6008.20		2365450		
09-Jan-96	6008.10		2365450		
12-Jan-96	6008.10		2365450		
01-Feb-96	6008.80		2365450		
12-Feb-96	6008.40		2365450		
20-Feb-96	6008.60		2365450		
23-Feb-96	6008.60		2365450		
01-Mar-96	6009.00		2365450		
06-Mar-96	6009.00		2365450		
11-Mar-96	6009.20		2365450		
15-Mar-96	6009.40		2365450		
19-Mar-96	6009.30		2365450		
28-Mar-96	6009.50		2365450		
09-Apr-96	6009.80		2365450		
22-Apr-96	6009.50		2365450		
26-Apr-96	6009.30		2365450		
02-May-96	6009.50		2365450		
10-May-96	6009.40		2365450		
16-May-96	6009.70		2365450		
23-May-96	6009.90		2365450		
30-May-96	6009.70		2365450		
07-Jun-96	6009.40		2365450		
14-Jun-96	6009.70		2365450		
22-Jun-96	6009.70		2365450		
27-Jun-96	6009.90		2365450		
06-Jul-96	6009.90		2365450		
19-Jul-96	6009.80		2365450		
02-Aug-96	6009.80		2365450		
19-Aug-96	6009.90		2365450		
28-Aug-96	6009.90		2365450		
04-Sep-96	6010.10		2365450		
11-Sep-96	6010.20		2365450		
10-Oct-96	6009.60		2365450		
21-Nov-96	6010.50		2365450		
10-Dec-96	6010.74		2365450		
24-Jan-97	6010.74		2365450		
18-Feb-97	6010.94		2365450		
19-Mar-97	6010.54		2365450		
17-Apr-97	6010.74		2365450		
24-Apr-97	6011.93		2365450		
08-May-97	6011.32		2365450		

FIGURE A-1



[redacted]

FIGURE A-2



w-46w mw2_levl.wk4 05/20/97 04:32 PM

APPENDIX B

DESIGN DATA FOR RETENTION BASIN AND SPRAY EVAPORATION SYSTEM

TABLES

FIGURES

TABLE B-1. LEACHATE STORAGE VS. ELEVATION CURVE - UMTRA/RIFLE - IN SATURATED AREAS OF THE DISPOSAL CELL (see Note A)

SATURATED ZONE

ELEVATION	LENGTH (NOTE B)	WIDTH	AREA	AVERAGE AREA	TAILINGS VOL. (INCREMENTAL)	TAILINGS VOL. (CUMULATIVE)	POROSITY (MKES, May 1995)	TOTAL PORE VOLUME (CUMULATIVE)	TOTAL PORE VOLUME (CUMULATIVE)	POTENTIAL LEACHATE DRAINAGE (CUMULATIVE)
(FT)	(FT)	(FT)	(SQ.FT)	(SQ.FT)	(CU.FT)	(CU.FT)		(CU.FT)	(GALLONS)	(GALLONS)
5992			2,428						0	(NOTE C)
5994			29,708	16,068	32,136	32,136	0.441	14,172	106,006	65,383
5996			72,600	51,154	102,308	134,444	0.441	59,290	443,488	273,534
5998	540	270	145,800	109,200	218,400	352,844	0.441	155,604	1,163,919	717,882
6000	570	270	153,900	149,850	299,700	652,544	0.441	287,772	2,152,534	1,327,640
6002	595	270	160,650	157,275	314,550	967,094	0.441	426,488	3,190,134	1,967,611
6004	630	270	170,100	165,375	330,750	1,297,844	0.441	572,349	4,281,172	2,640,541
6006	650	270	175,500	172,800	345,600	1,643,444	0.441	724,759	5,421,196	3,343,685
6008	665	270	179,550	177,525	355,050	1,998,494	0.441	881,336	6,592,392	4,066,056
6010	675	270	182,250	180,900	361,800	2,360,294	0.441	1,040,890	7,785,855	4,802,160
6012	695	270	187,650	184,950	369,900	2,730,194	0.441	1,204,016	9,006,036	5,554,744
6014	715	270	193,050	190,350	380,700	3,110,894	0.441	1,371,904	10,261,844	6,329,300
6016	735	270	198,450	195,750	391,500	3,502,394	0.441	1,544,556	11,553,277	7,125,831
6018	760	270	205,200	201,825	403,650	3,906,044	0.441	1,722,565	12,884,789	7,947,081

NOTES:

A. UNSAT2 RUN 21EE shows that only a limited area is saturated during T=1.1 and 5.6 years

B. Lengths are measured from the sandstone zone plotted on a 1"=100' bedrock foundation map

W-29W LEACHATE.WB1:Sheet F

UMTRA/RIFLE
TABLE B-2. MEASURED SPRAY EVAPORATION RATE

SITE	SPRAY EVAPORATOR PUMP CAPACITY (GPM)	RANGE OF EVAPORATION RATE (GPM)	AVERAGE EVAPORATION RATE (See Note 1) (GPM)	DATA SOURCE
ESTES GULCH SITE, RIFLE COLORADO	250 to 475 (Variable Speed Pump)	114 to 395	215	MK-F, Recorded data at Estes Gulch site June, July 1995 (See Note 2)
FALLS CITY TEXAS	950	140 to 240	200	MK-F, Recorded data at Falls City site 1993

NOTE:

1. Average evaporation rate is based on the total volume of spray evaporation divided by the total period during which the spray evaporation occurred.

2. For design of the retention basin, the spray evaporation rates are modified as follows:
   (I) During the winter months of Nov, Dec, Jan and Feb, the 215 GPM rate is halved = 215/2 = 108 GPM
   (II) During the freezing days of winter spray evaporation rate = 0, assumed to occur for an estimated 15 consecutive days.

UMTRA/RIFLE - ESTES GULCH DISPOSAL CELL
TABLE B-3. LEACHATE BALANCE IN PROPOSED NEW RETENTION BASIN

SPRAY EVAPORATION RATE=
215 GPM for 24 hours (in all months except Nov,Dec. Jan,Feb)
215 GPM for 12 hours(during Nov, Dec, Jan, Feb)
0 GPM - during freezing days of (Nov,Dec,Jan,Feb for a maximum total of 15 days consecutively)

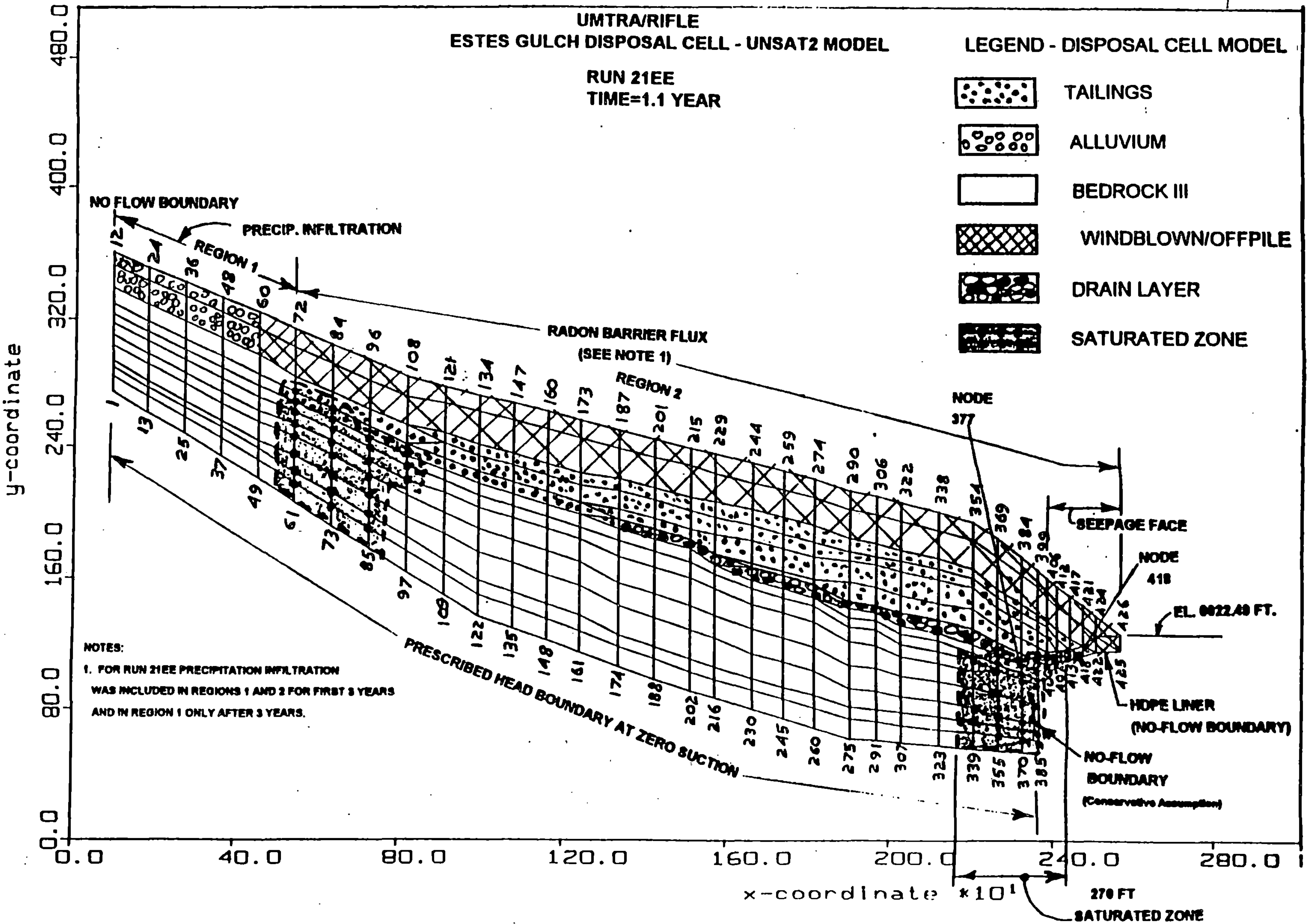
RETENTION BASIN SURFACE AREA= 50FT x 100FT= 5000 SF

(Input) COL. A DAY (See Note 1)	(Input) COL. B TOTAL VOLUME OF LEACHATE PUMPED (GALLON)	(Input) COL. C (From Ref. 4) DIRECT PRECIP. INFLOW INTO RETENTION BASIN (GALLON)	(Calculated) COL. D LEACHATE PLUS DIRECT PRECIPITATION (COLS. B+C) (GALLONS)	(Calculated) COL. E ACCUMULATED VOLUME IN RETENTION BASIN PRIOR TO ANY EVAP. OR TREATMENT (GALLONS)	(Calculated) COL. F SPRAY EVAPORATION VOLUME (GALLON)	(Calculated) COL. G NATURAL EVAPORATION FROM RETENTION BASIN (GALLON)	(Calculated) COL. H CUMULATIVE LEACHATE VOLUME IN RETENTION BASIN (=COL. E - F - G) (GALLON)
1		0	0	0	0	0	0
2		0	0	0	0	0	0
3		1091	1091	1091	1091	0	0
4		0	0	0	0	0	0
5		0	0	0	0	0	0
6		0	0	0	0	0	0
7		0	0	0	0	0	0
8		249	249	249	249	0	0
9		779	779	779	779	0	0
10		0	0	0	0	0	0
11	14400	0	14400	14400	0	140	14260
12	14400	0	14400	28660	0	140	28521
13	14400	0	14400	42921	0	140	42781
14	14400	94	14494	57275	0	140	57135
15	14400	0	14400	71535	0	140	71395
16	14400	0	14400	85795	0	140	85655
17	14400	343	14743	100399	0	140	100259
18	14400	0	14400	114659	0	140	114519
19	14400	0	14400	128919	0	140	128780
20	14400	0	14400	143180	0	140	143040
21	14400	374	14774	157814	0	140	157674
22	14400	0	14400	172074	0	140	171935
23	14400	0	14400	186335	0	140	186195
24	14400	0	14400	200595	0	140	200456
25	14400	0	14400	214856	0	140	214716
26	14400	0	14400	229116	154800	140	74176
27	14400	0	14400	88576	88576	0	0
28	14400	530	14930	14930	14930	0	0
29	14400	94	14494	14494	14494	0	0
30	14400	0	14400	14400	14400	0	0
31	14400	0	14400	14400	14400	0	0
32	14400	0	14400	14400	14400	0	0
33	14400	0	14400	14400	14400	0	0
34	14400	0	14400	14400	14400	0	0
35	14400	0	14400	14400	14400	0	0
36	14400	2119	16519	16519	16519	0	0
37	14400	0	14400	14400	14400	0	0
38	14400	623	15023	15023	15023	0	0
39	14400	0	14400	14400	14400	0	0
40	14400	0	14400	14400	14400	0	0
41	14400	0	14400	14400	14400	0	0
42	14400	0	14400	14400	14400	0	0
43	14400	0	14400	14400	14400	0	0
44	14400	935	15335	15335	15335	0	0
45	14400	0	14400	14400	14400	0	0
46	14400	0	14400	14400	14400	0	0
47	14400	0	14400	14400	14400	0	0
48	14400	0	14400	14400	14400	0	0
49	14400	0	14400	14400	14400	0	0
50	14400	0	14400	14400	14400	0	0
51	14400	0	14400	14400	14400	0	0
52	14400	0	14400	14400	14400	0	0
53	14400	0	14400	14400	14400	0	0
54	14400	0	14400	14400	14400	0	0
55	14400	0	14400	14400	14400	0	0
56	14400	0	14400	14400	14400	0	0
57	14400	0	14400	14400	14400	0	0
58	14400	0	14400	14400	14400	0	0
59	14400	0	14400	14400	14400	0	0
60	14400	0	14400	14400	14400	0	0
61	14400	0	14400	14400	14400	0	0
62	14400	0	14400	14400	14400	0	0
63	14400	0	14400	14400	14400	0	0
64	14400	405	14805	14805	14805	0	0
65	14400	0	14400	14400	14400	0	0
66	14400	0	14400	14400	14400	0	0
67	14400	0	14400	14400	14400	0	0
68		0	0	0	0	0	0
69		0	0	0	0	0	0
70		779	779	779	779	0	0
							0
TOTALS =	820800	8415	829215		826981	2234	

Note:

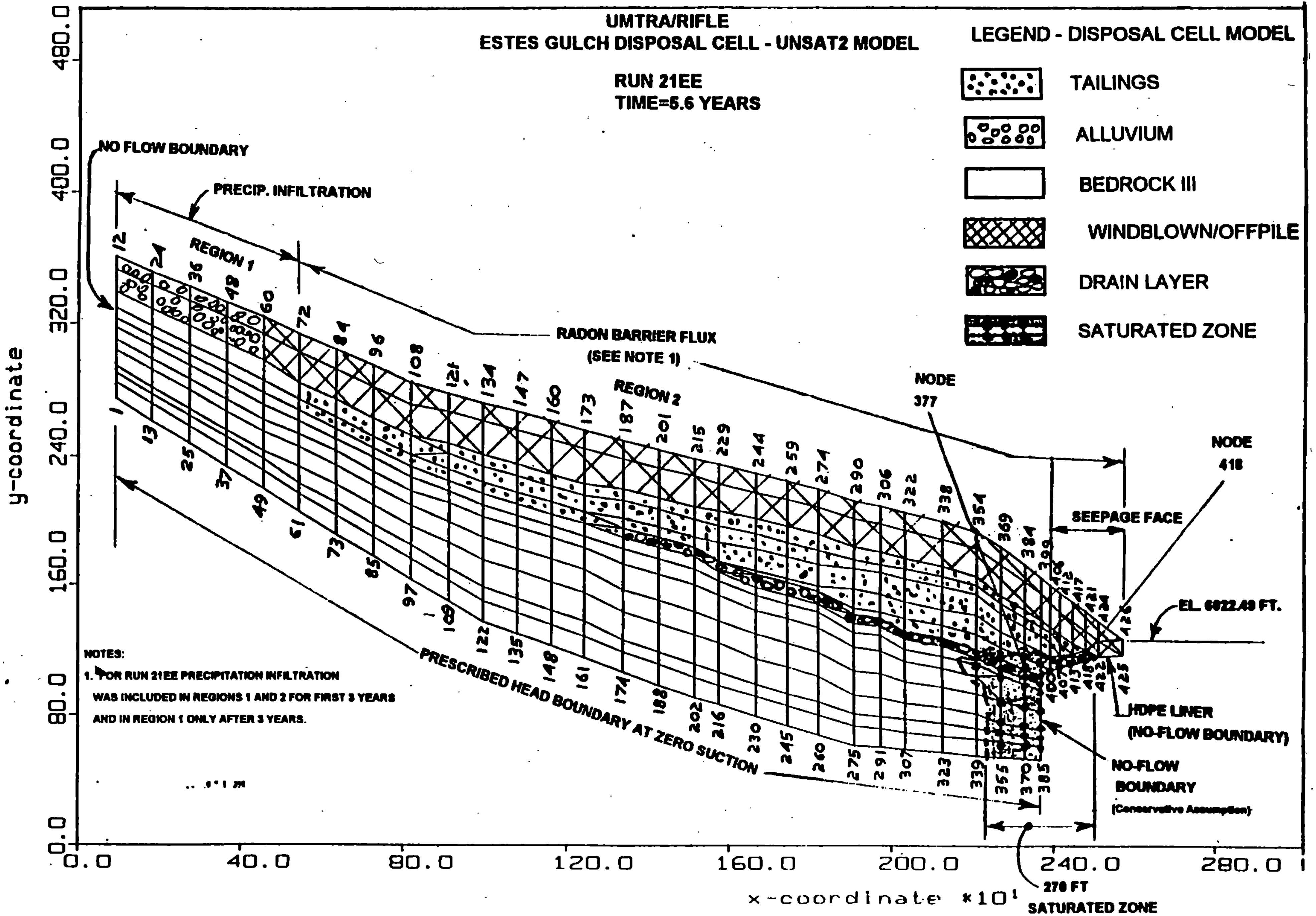
1. The days are assumed to be during the winter months of either Nov, Dec, Jan or Feb, when the freezing days would limit spray evaporation. This is to be conservative for designing the retention basin size. Direct and natural (solar) evaporation at the retention basin correspond to averages for November. This is not likely to introduce significant errors since the quantities of direct precipitation and natural (solar) evaporation are relatively small.

FIGURE B-1



UMTRA/RIFLE
ESTES GULCH DISPOSAL CELL - UNSAT2 MODEL
RUN 21EE
TIME=1.1 YEAR
LEGEND - DISPOSAL CELL MODEL
TAILINGS
ALLUVIUM
BEDROCK III
WINDBLOWN/OFFPILE
DRAIN LAYER
SATURATED ZONE
NO FLOW BOUNDARY
PRECIP. INFILTRATION
REGION 1
REGION 2
RADON BARRIER FLUX
(SEE NOTE 1)
NODE 377
SEEPAGE FACE
NODE 418
EL. 6022.40 FT.
HDPE LINER
(NO-FLOW BOUNDARY)
NO-FLOW
BOUNDARY
(Conservative Assumption)
PRESCRIBED HEAD BOUNDARY AT ZERO SUCTION
270 FT
SATURATED ZONE
NOTES:
1. FOR RUN 21EE PRECIPITATION INFILTRATION
WAS INCLUDED IN REGIONS 1 AND 2 FOR FIRST 3 YEARS
AND IN REGION 1 ONLY AFTER 3 YEARS.
y-coordinate
x-coordinate *10¹
0.0
40.0
80.0
120.0
160.0
200.0
240.0
280.0
80.0
160.0
240.0
320.0
400.0
480.0

FIGURE B-2


UMTRA/RIFLE
ESTES GULCH DISPOSAL CELL - UNSAT2 MODEL
RUN 21EE
TIME=5.6 YEARS
LEGEND - DISPOSAL CELL MODEL
TAILINGS
ALLUVIUM
BEDROCK III
WINDBLOWN/OFFPILE
DRAIN LAYER
SATURATED ZONE
NO FLOW BOUNDARY
PRECIP. INFILTRATION
REGION 1
REGION 2
RADON BARRIER FLUX
(SEE NOTE 1)
NODE
377
NODE
418
SEEPAGE FACE
EL. 6022.49 FT.
HDPE LINER
(NO-FLOW BOUNDARY)
NO-FLOW
BOUNDARY
(Conservative Assumption)
PRESCRIBED HEAD BOUNDARY AT ZERO SUCTION
NOTES:
1. FOR RUN 21EE PRECIPITATION INFILTRATION
WAS INCLUDED IN REGIONS 1 AND 2 FOR FIRST 3 YEARS
AND IN REGION 1 ONLY AFTER 3 YEARS.
270 FT
SATURATED ZONE
y-coordinate
x-coordinate *10¹
0.0
80.0
160.0
240.0
320.0
400.0
480.0
40.0
120.0
200.0
280.0

The following 2 Drawings specifically

reference

<u>Table of Contents</u>

<u>List of Plates</u>

D01 to D02X